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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VOL. XIII.—SEVENTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY SIMPKIN, MARSHALL, HAMILTON, KENT, AND CO., LD.;
BAILLIÈRE, PARIS: HODGES, FIGGIS, AND CO., DUBLIN:
AND ASHER, BERLIN.

1904.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

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

No. 73. JANUARY 1904.

I.—*The Prototheca of the Madreporaria, with Special Reference to the Genera* Calostylis, *Linds., and* Moseleya, *Quelch.* By Henry M. Bernard, M.A. Cantab., F.L.S.

[Plate I.]

The task I have set myself is to sketch what appears to have been the leading features in the evolution of the Madreporarian skeleton. The researches on which the arguments are based have been almost entirely limited to the skeleton, not because the importance of a close study of the soft parts is not recognized, but because, for the attainment of accurate results, the widest possible survey of homologous structures is indispensable. This condition can never be supplied by the soft parts. They can at the most be studied in a few recent specimens, whereas the vast majority of the forms presented by the Madreporarian system are fossil. Further, let me add in passing that I do not believe that the study of the individual development of a few living forms can by itself establish anything certain about the past history of the group, for the simple reason that we cannot tell whether any special developmental feature is a repetition of some ancient condition or a recent adaptation *. As I have already often maintained, lines of phylogenetic growth can only be satisfactorily established by the discovery of connected series of variations, morphologically and chronologically arranged. The skeleton alone can supply us with such series, and that of the corals probably with a more complete series of forms, extending *from the Palæozoic era to the present day, than will ever be obtained of any other animal group*. Whether, therefore, the skeleton be of great or of little importance in itself in the morphology of the corals, it alone supplies us with what we want—a continuous series of homologous structures. On this account alone, then, when our aim is taken into account, we are obliged to confine our attention to the skeleton.

As a matter of fact, the skeleton is of paramount importance in the coral organism. There is a sameness in all the soft parts which limits their morphological importance in any comparative study. Their chief variations may, for practical purposes, be said to be repetitions of the variations of the skeleton which they secrete. The skeleton is, *par excellence*, the chief structural feature of the coral, its relation to the soft parts being extremely simple. It is, as we now know, thanks to the researches of von Koch, Heider, Fowler, Bourne, Ortmann, and Miss Ogilvie, an excretion of the basal parts of the outer wall of the body, and hence morphologically it is external to the organism. At times very complicated, it is an organ of protection and support for the body of the polyp, or, in colony formation, for the colonies of polyps, the polyps themselves, thus protected, having, as a rule, remained simple and primitive. The corals, indeed, present us with a group of organisms still primitive enough to illustrate the fact that, of the earliest morphological modifications of the living matter, skeletal formations were the most pronounced. This is strikingly exemplified by the Foraminifera and Radiolaria, in which there is a wealth of skeletal formations with little or no visible variation of the soft matter. Again, in the sponges the skeletal variations far outrun those of the soft parts. The same is true of the stony corals.

In what follows, therefore, I shall make no detailed reference to the soft parts or to the excellent work which is being done with their help by Dr. Duerden towards the elucidation

* N. Guldberg and Nansen, "On the Development and Structure of the Whale," Bergens Museum, 1894, p. 39; also Sedgwick, Proc. Fourth International Congress of Zoology, 1898, p. 74.

of the same problem as that which here interests us. I shall confine myself solely to showing how some of the chief transformations of the skeleton can be linked into series and how, in a few cases, the causes which led to those transformations are apparent. We are justified in hoping that the conclusions obtained from the continued studies of the soft parts on the one hand and of the skeleton on the other will ultimately coincide.

I wish to make it specially clear that only a few of the lines of modification can be dealt with, but those few, being some of the earliest, are, I believe, the most fundamental and important for the elucidation of all the later transformations of the coral skeleton. To deal with the whole of these latter would be to write a complete systematic account of the stony corals. This is the aim of the great catalogue now being prepared and published by order of the Trustees of the British Museum, and must be a work of years *.

The researches of the writer in reference to this work so far hardly entitle him to speak with confidence on any other of the larger divisions than the Perforata; no other has as yet been systematically dealt with by him, at least in the thorough manner required for a British Museum Catalogue. It would not, however, have been possible to discover the morphology of these highly specialized Perforate forms without a study of and constant reference backwards to earlier and simpler types. In this way certain lines along which the stony corals have travelled, viz., those leading from the most primitive to the most specialized, have been growing clearer.

* The last attempt to deal with the whole of the coral system in the 'Hist. Nat. des Coralliaires' of Milne-Edwards and Haime, completed in 1860 by Milne-Edwards alone, was founded on comparatively small collections and written at a time when the relations between the skeleton and the polyps were not understood. The excellence of the results which were nevertheless obtained is, on the one hand, a tribute to the genius of the great French naturalists, and, on the other, a witness to the comparative unimportance of the polyp, morphologically, as compared with the skeleton.

The new catalogue projected by the authorities of the British Museum, and rendered necessary by the immense increase in the collections due especially to the sending out of scientific expeditions, was started in 1876, but was interrupted by the death of Dr. Brüggemann, who was engaged for the purpose. After fourteen years Mr. George Brook undertook the work, but again death intervened soon after the first volume was published in 1893. Two years were again lost, when the present writer was appointed to continue the work. There are now four volumes published, and the fifth is rapidly approaching completion. Each volume is practically a monograph of one, or at the most two, genera, and, like the earlier attempt of Milne-Edwards and Haime, it now describes the fossil as well as the recent forms.

The following pages sum up the principal conclusions he has arrived at.

The most important stage to establish in an evolutionary history is the first, or that which we may consider as the first, inasmuch as from it all the modifications we wish to compare can be deduced. The first stage in the evolution of the coral skeleton was first dimly recognized by me in the minute *saucer*-shaped cups of young Madreporidan colonies—so young as to consist only of a parent calicle and one or two daughters. In none of the Madreporids have I yet found the earliest stage in which the cup containing the parent alone was *cup*-shaped. Such a stage, however, may be legitimately assumed.

The discovery of such colonies made three points clear to me:—

1. The parent calicle of a colony rises out of a basal cup—the PROTOTHECA *.

2. This prototheca is not a composite structure, but a morphological unit, the rim of which can be bent up, flattened completely down, and indefinitely expanded in any direction as a film, from the upper surface of which, as originally from within the cup, the coral skeleton arises.

3. This film is the EPITHECA †.

These conclusions received complete confirmation from a study of the Palæozoic form *Favosites* and of its modern descendant *Alveopora*. I have already described and figured the prototheca of the latter genus ‡. Its rim, as shown in the figures referred to, does not usually flatten down, but grows upwards and outwards to form the irregular film-like investments characteristic of the colonies of this genus.

In both cases—that is, in Madreporidæ and Favositidæ alike—it was easy to see the bars of the intracalicular skeleton rising directly out of the wall of the cup as internal projections from its surface; this point is of importance, because von Koch, whose developmental researches also revealed to him the prototheca, was led by what he saw to regard it as a composite structure consisting of a *basal portion* ("Basal-

* Lindström suggested the word "initium" for the earliest cup-like skeleton; the term "prototheca" was suggested to me in conversation by my friend Prof. Jeffrey Bell.

† The fact that the skeletal elements rise from the surface of the epitheca was pointed out by Martin Duncan in 1884 (Journ. Linn. Soc., Zool. xvii. p. 361) as indicating the importance of that element of the coral skeleton.

‡ Journ. Linn. Soc., Zool. xxvi. 1898, p. 495, pl. xxxiii.

platte," sole) and of a peripheral portion (*epitheca*). This appears, however, now to have been a too literal rendering of the facts of his observations, for no one who had seen several of these epithecal saucers of different sizes and with edges turned up to different heights at different curves, and the skeletal bars springing indifferently from the sides and the base, could possibly divide it into a basal and a peripheral portion.

Besides, in a young saucer-shaped colony it is obvious that the turned-down side (the "epitheca") of the parent becomes the "basal plate" of the daughter, and in this successive flattening down of the rim we can see the explanation of the characteristic wrinkled appearance of the supporting epitheca of so many horizontally expanding corals, whether single or compound. Each furrow represents a pause in the outward growth long enough to allow the rim of the widening saucer-shaped epitheca to grow upwards a short distance. The next period of growth carries it downwards and outwards again. This process has been actually seen by Lacaze-Duthiers * in the development of *Balanophyllia regia*. This writer observed three attempts of the basal secretion of the larva to turn up to form a cup or "envelope calicinale," but they were always futile; the septa overran them and the edge was flattened down again and continued as a basal secretion (*cf.* Pl. I. fig. 10).

Before continuing with the history of this prototheca—that is, with our account of some of its earliest modifications—it will strengthen our argument to mention a few instances in which earlier writers have come near to recognizing this identity of the prototheca with the epitheca. As we might expect, such an identification would be more probable in relation to Palæozoic forms, in which the primitive cup remained longest in evidence and had not become so distorted and masked as it is in the majority of the modern forms. Milne-Edwards †, in describing the Palæozoic genus *Zaphrentis*, which, from its appearance in time, might have been expected to have retained the prototheca, says that it is completely surrounded by an epitheca. Nicholson could not distinguish the epitheca of these same corals from the wall. Miss Ogilvie ‡ declared that in *Zaphrentis* the epitheca "supplied the primitive base and periphery in one," and again that the primitive wall of corals was epithecate; and

* Arch. Zool. expérimentale, (3) vol. v. 1897, pp. 179–183 & 230, pl. x. figs. 19–24.

† 'Les Coralliaires,' iii. p. 335 (1860).

‡ Phil. Trans. 1896, p. 320 &c.

again the same writer recognized the wall of *Zaphrentis* as "euthecate," which means that the persistent prototheca in these early corals is the eutheca or true primitive wall of Heider and Ortmann, as compared with which all other thecæ are secondary. To this last opinion we shall return.

Mention should also surely be made of Ludwig *, who, so long ago as 1866, attempted to found a classification upon his recognition of the prototheca as the primitive shell ("Gehäuse") of the coral polyp. But beyond the interest attaching to the fact that he thus emphasized the importance of the prototheca in Madreporarian morphology his work has no value, for he was led astray in his further analysis by a fancied analogy with the shell of the mollusk.

In the present paper, then, we start again from the recognition of the prototheca, but this time, avoiding Ludwig's mistake, we shall try to analyze some of the actual modifications which this primitive coral skeleton has undergone in the progress of its evolution. So far from being as simple as Ludwig appears to have assumed it to be, it is a task of considerable complexity to follow and of no small difficulty to describe. This paper, indeed, was begun five years ago, and has been frequently rewritten.

As I have shown, those parts of the coral skeleton called epitheca must for the future be referred to the rim of the prototheca. This seems simple and clear now, but in the past the epitheca has been *the* stumbling-block of coral morphology. It has been this for the very reason that it waited for the discovery of the prototheca before there was any possibility of its elucidation. The fact of the confusion in the prevailing views as to what the epitheca is is familiar to every coral student. For instance, Prof. Gregory, of Melbourne, after all his years of work at corals, characteristically summed up his despair of ever making anything out of it by declaring that "there was no part of the coral skeleton over which more time had been wasted" †. This attitude and that which is taken in this paper are poles asunder. Between these two, authors and text-books hover. None are so bold as Prof. Gregory, yet none have succeeded in formulating an intelligible doctrine.

We may here state that there is ample excuse for this confusion, for even now that we know that the epitheca, as it occurs in the majority of specimens, is only an extension of the rim of the original cup, still in each case the problem as

* 'Palæontographica,' vol. xiv.

† Palæontol. Indica, ser. IX. vol. ii. p. 11 (1900).

to how this can be requires unravelling. It may, for instance, be the rim extended indefinitely and continuously as a chalky film round a colony (e. g. *Alveopora*), or, again, it may be discontinuous and represent the separate rims of an aggregation of corals, each with its own cup, as in so many Palæozoic forms. In this case it depends upon the way in which the corals are aggregated whether the rims are easy or difficult to recognize. Add to these difficulties the fact that apparently any part of the surface of a polyp may die down and secrete a calcareous film * which is purely adventitious and has no morphological significance, and it is obvious that until we had a key to its elucidation the epitheca could not fail to be a source of bewilderment.

Diagram 1 (Pl. I.) shows the three earliest growth periods of a primitive Madreporarian skeleton. All that we see is a deep cup with three tabular floors. The process is explained in diagram 2, in which we see three cups progressively modifying their shapes. The lowest of these is the prototheca in the strict sense of the word †, but it is advisable to apply the term to all simple repetitions with free edges. Fig. 2 is so far diagrammatic, inasmuch as with cups of this shape it is impossible to say how far the rim of each cup extended before the soft parts of the base of the polyp became detached from the base of its prototheca. Cases, however, do occur in which the change in the shape of the new thecæ was rapid, and for this and also for other reasons the rims of the separate

* The formation of calcareous films somewhat irregularly over the skin of corals is hardly to be wondered at. The prototheca was but the primitive secretion of the basal portion of the polyp, forming a protective cup into which the animal could retract the oral and exposed end of its body. Above the rim of this cup calcareous secretions were not usual, otherwise they would have interfered with the process of retraction, but the power of secreting them was not lost. Indeed, some forms actually secreted lids, which, when the polyps retracted, closed down over the prototheca (*Calceola*, *Goniophyllum*). A histological difference between these secondary films and true epitheca may sometimes be noticed. The former may be built up of separate plates, each of which starts round some point of the skeleton and grows by concentric increments.

† The prototheca is here drawn quite diagrammatically. Figure 8, after Lacaze-Duthiers, is one of the best figures from life. My own figures, already referred to, of a young *Alveopora* are of a prototheca somewhat distorted. Theoretically we might expect a slight constriction above the flattened sac, for as the soft larva settled down we might expect its aboral end to flatten out somewhat wider than the neck carrying the oral disk and tentacles. The base of the second prototheca might easily be rounded or pointed, for it would hang down in the hollow of the prototheca proper. The later development of *convex* tabulæ and vesicular dissepiments may have been due to the pulls of mesenterial muscles.

cups may be distinguishable. For instance, the development of exsert laminate septa may lift the cups above one another (see Pl. I. figs. 3, 11, 12).

Fig. 3 refers to *Montlivaltia*, of especial interest because it was the irregular bands of epitheca round specimens of this genus which induced Dr. Gregory to give up this element of the coral skeleton in despair. We shall now show that an understanding of these bands is essential to a true insight into the morphology of the skeleton.

It is frequently stated * that in *Montlivaltia* there is epitheca, but no theca. There was, however, certainly a prototheca, and examination of the coral shows that the successive protothecæ gradually flattened out until, after reaching a certain size, they formed a series of flat saucers (fig. 3, *e*, *e*, *e* . . .) of nearly uniform size, and piled up one above the other as tabulæ with edges which may either only just reach the surface or be bent sharply upwards to varying heights according to the accidents of secretion. On the left of the figure a few of the septa are shown supporting and raising the successive saucers above one another. The septa of each polyp continue those of that which went before it, so that these radial structures naturally run up continuously through the whole skeleton. On the left of the diagram the saucers alone are shown in optical section as a series of flat or wavy floors with turned-up rims.

Here, then, we have the three facts necessary for the understanding of the case in hand:—

1. A series of shallow thecæ or protothecal saucers ending abruptly at the surface or with edges bent up externally.

2. The septa which, being exsert, support and lift these saucers above one another, so that, while the septa are continuous, the rims of the cups may be free and separate, or, when bent up, may run together as irregular epithecal bands.

3. The extreme irregularity of the bands is due to the want of uniformity in the height to which the secretion of the rims of the saucers, if bent up, extends.

These three factors fully explain the puzzle presented by the epitheca of *Montlivaltia*.

It is obvious that in diagram fig. 3 the saucers might contain not single polyps, but gradually expanding colonies

* *E. g.*, by Miss Ogilvie (*l. c.* p. 158), who, however, followed Milne-Edwards and Haime, who wrote with reference to *Amplexus*, in which the succession of saucer-shaped protothecæ is very pronounced:—"Quelquefois même la muraille paraît manquer et le polypier n'est constitué que par une série de cornets très évasés et naissant les uns au-dessus des autres" (Ann. Sci. nat. (3ᵉ) ix. p. 84, 1848).

(*cf.* the minute colonies of Madreporids already mentioned). Such series of gradually expanding colonies might grow into columnar or massive stocks widening at the top. In all such stocks the tabulæ which run through them must be regarded as the floors of successive saucers. This is well exemplified in the genus *Goniopora,* as I have already explained *. In this genus too we have, as we have in *Montlivaltia,* irregular bands of epitheca running round the stocks. These are the rims of the protothecal saucers showing irregularly at the surface. In *Alveopora* the rims all run together to form continuous epithecal investments, except, perhaps, in their branching forms, in which the protothecæ may be lifted up above one another by the growth of the spiny septal skeleton.

For an understanding of the morphology of the coral skeleton we must bear in mind that essentially the same process, viz. *a succession of epithecal cups or saucers, occurs throughout the whole of the Madreporaria.* They may be simple conical cups fitted one into the other (*Zaphrentis*) or flat plates piled up (*Montlivaltia, Goniopora*), or their epithecal floors may be thrown into complicated folds and both the cup and its repetitions may be difficult to unravel, but the fundamental principle is the same throughout. There is only one group I can think of in which the epitheca is not normally repeated, namely in the highest Madreporids—*Madrepora, Turbinaria, Montipora, Astræopora,* and their simpler ancestors the Eupsammiids. In these the purely septal skeleton rises rapidly above the original flattened prototheca which is then left behind. This is the reason of that well-known characteristic of these forms that the calicle cavities run continuously for long distances through the skeleton.

We repeat, then, for the sake of emphasis that wherever the epitheca occurs it represents the rim or the coalesced rims of one or more protothecal cups or saucers, the floors of which are represented by the tabulæ. In any individual case the tabula below the living layer is the *n*th repetition of the original prototheca of the parent polyp.

The main problem, then, of the student of coral morphology, that is, taking the skeleton alone into account, is to trace the various modifications of the prototheca from its earliest simple cup stage to the many different shapes and positions it now assumes and occupies as part of the coral skeleton.

Roughly speaking, we may say that there are two periods in the evolution of the Madreporaria—that in which the prototheca, though modified, remains in evidence, and that in

* *Cf.* vol. iv. Brit. Mus. Madreporaria, p. 24, diagram A.

which it has disappeared from view or is difficult to unravel. Only in the few Madreporids (the chief families of the Perforata) above mentioned can it be said to have been aborted, and then only in a limited sense, for the whole coral skeleton is its product. If the original rim of the cup is replaced as the edge of the theca by new thecæ formed either by the rising up of concentric folds from its floor or of radial plates from its sides, or by complicated combinations of these two, these new thecæ are strictly infoldings of the prototheca. The prototheca, then, however obscured its early cup shape, being replaced by secondary cups produced by its own infoldings, remains throughout *the fundamental element in the Madreporarian skeleton.*

I propose here to trace some of the more obvious transformations of the prototheca, treating them entirely morphologically—that is, simply as forms which admit of explanation and deduction from simpler forms, and without regard to their real phylogenetic sequences.

The working out of these latter—that is, the attempt to discover the real places of these transformatory processes in the genealogy of the Madreporaria—must be a work of time. I am convinced, however, that it will at once give a new and much needed interest to the student of the stony corals.

We return, then, to our simplest form (diagram fig. 1). It shows us a conical cup standing on a flattened slightly expanded base and gradually thickening upwards. *The problem of increasing instability must obviously have been one of the first which the polyp inhabiting such a skeleton had to solve.* I shall endeavour to show that the earliest divisions of the Madreporaria were due to the different ways in which this problem was solved.

I. *Falling over and recovery of the upright position.*—The simplest of all methods was to fall over so that the flesh of the polyp could come once more into contact with the substratum and secrete a new cementing layer where it touched. From this new base the polyp could bend upwards once more securely attached. The following is some of the evidence which shows that this actually took place:—

(*a*) The earliest period is specially characterized by the great number of single corals which are conical but curved. The curve is exactly what is required; that is, it is most pronounced at the tip, e. g. *Zaphrentis, Menophyllum,* &c.

(*b*) All these curved corals have what is known as a fossula, that is a deep depression within the calicle and most frequently on the convex or what is called the "dorsal" side. The fossula has a very simple explanation, if the assumption of the falling over is correct (see diagram fig. 4). As the soft parts detach themselves from the base of the prototheca they might be expected to bag down, and they will continue to be acted upon by gravitation and drawn over towards the convex side of the coral until the vertical position has been regained. It is possible that this bearing over to the side may be due to the efforts of the polyp itself to bend up, but gravitation is a *causa efficiens*.

In some forms, however, the fossula is not on the dorsal, but on the ventral side. There is abundance of scope for variations of all kinds: a deep cup (that is, the cup of a polyp which grew very slowly in width, for instance) would lie very prone and its fossula would fall over to the dorsal side (diagram fig. 4); but a shallower more open prototheca (that is, one in which the polyp grew very rapidly in width) would, in the prone position, have one (the "ventral") wall nearer the vertical, and this would keep the skin of the point while it hung loose for the while near the ventral side, and the fossula would consequently also appear on this side (diagram fig. 5) *.

(*c*) The falling over of the prototheca will explain the departure from a strictly radial symmetry of the septa seen in these curved Palæozoic corals. It is obvious that, as the coral is bending to the vertical, seen from above, the septa would have the arrangement shown in diagram fig. 6, which is after the classical figure of Kunth showing the septal formula typical of the group called Rugosa. The position of the fossula with relation to this modification of the septal arrangement shows that this is the true explanation. Further, it has long been known that, as such corals gradually reacquire a vertical position, the septal arrangement slowly gives up the bilateral and returns to the radial symmetry. Thus the character on which it was proposed to found a great division of the stony corals was nothing but a slight mechanical

* This is not the first time that this origin of the fossula as a repetition of the tip of the prototheca has been recognized. Ludwig's figures made it quite clear in 1866 ("Corallen aus paläolithischen Formationen," Palæontographica, xiv. 1866). But, regarding the skeletons as analogous to the shells of mollusks, to whose shapes he thought they were adapted, he failed entirely to understand the true character of the coral skeleton or of the causes of its changes.

The use assigned in text-books to the fossula, viz. as a sort of crypt for the sexual products, is probable enough, but need not have been the cause of its origin. I fail to see the evidences for the existence of more than one true fossula in any coral I have examined. Superficial irregularities in the septa, due perhaps to the presence of sexual products, may be quite distinct from the true fossula. A longitudinal section or a fracture showing a complete tabula is the only evidence which can be relied on.

adaptation to a passing phase in the life of each individual coral. But it is only fair to say that the whole tendency of recent works on corals has been to discover the invalidity of the supposed division Tetracorallia.

Into the interesting questions which this suggests as to the value of the existing divisions of the corals, we cannot here enter, but content ourselves with merely pointing out that while probably all the *very earliest* corals fell over and, if they bent up again, became Tetracorallia during the process, it is possible that many, which later had learnt a different method of acquiring stability, might easily be knocked over and in their efforts to become vertical again might become Tetracorallia by accident.

(*d*) The falling over of the prototheca enables us to find an origin for several groups which are usually regarded as corals, but whose position is still a matter of uncertainty. It is quite within the limits of probability that a certain number of these overturned polyps in their small protothecæ should remain prone and bud in this position. One such case we know of for certain (see p. 28, on *Heliolites*). We ask whether the creeping branching stocks of *Aulopora* might not also have been formed by the early budding of a parent whose prototheca had fallen over.

From *Aulopora* the genus *Syringopora* might be deduced. *Syringopora* is said to begin with the same horizontal creeping stock as *Aulopora*, and then to bend up and form its tufts of wavy tubes freely communicating with and supporting one another. In these erect tubes very irregular tabulæ are formed by the constant rising of the polyp in the tube as the latter lengthens. The very presence of tabulæ and of the rudimentary septa, consisting of rows of points, clearly indicates an affinity with early Madreporaria. Add to these the protothecal outer covering, and we have the same three structures which make up an *Alveopora* or a *Favosites*. It is only their dispositions and the relative developments of the parts which differ *.

Halysites could also be deduced from such a prone theca by rapid continuous budding, in such a way that the parent and its buds bent up in rapid succession into the vertical, as shown in the diagram fig. 7, each then continuing to grow as a thin flattened tube. These in contact and mutually supporting one another would supply the typical skeleton of this

* The apparent affinity between *Syringopora* and *Favosites* has been pointed out by Mr. Bourne (Phil. Trans. vol. 186 B, p. 474). But *Favosites* is structurally indistinguishable from *Alveopora*, and was not therefore an Alcyonarian (Proc. Linn. Soc., Zool. vol. xxvi. (1898) p. 495.

remarkable genus. We have the same three elements, protothecal tubes, tabulæ, and spiny septa *.

(*e*) The habit of falling over is known still to occur in the genus *Flabellum*.

(*f*) Lastly, I appeal to the modifications of the prototheca which will be described in the following pages, every one of which may be regarded as an adaptation for the purpose of solving the problem of vertical stability, that is, how to avoid the natural consequence of having to stand on a point while continuing to grow in height and bulk. For we are surely justified in assuming that the falling over at the very outset of life of an organism intended, if we may say so, to stand upright, would mean considerable loss of time and energy during the reattainment of the upright position. Such a loss might be expected to delay budding, and it is probable that we may have to take this into account in our ultimate classification. We may have to form a group which arose from the early budding of parents still in their protothecæ (*sens. str.*), and this would include such forms as *Aulopora, Syringopora*, and *Halysites*, in all of which the protothecæ fell over, and to these we might add *Chætetes* arising probably by fission. Whether the prototheca also fell over in this last case I have not ascertained. Such a group arising from parents still in their protothecæ proper, would stand in contrast to another group in which the budding was delayed until the polyp had grown considerably larger and had again assumed the upright position, and our divisions of these latter would have, in the first instance, to be based upon the methods adopted to attain this end.

II. *Radicle-formation.*—This process has been carefully studied and described in *Flabellum* by Lacaze-Duthiers †. A small portion of the lip of a prototheca bends over until it adheres to the ground (see diagram fig. 8 *a*, *b*). I have myself seen a similar process as an occasional thing in young colonies of *Alveopora*. It is difficult to see how the great pear-shaped colonies in this latter genus could possibly stand upon the tip of the original prototheca without gaining support on this principle. Extensive droopings of the rim till it touched the ground with subsequent bends up again are probably more common in this genus than the formation of thin radicles.

Root-processes may come from the rims of different protothecæ in those cases in which the corallum is built up of a

* *Cf.* Fischer-Benzon, Abhandl. wissench. Ver. Hamburg, Bd. v. 2 (1871), pp. 1–23.

† Arch. Zool. expér. (3) ii. 1894, p. 445, pl. xviii.

series, like those shown, for instance, in fig. 3. *Omphyma* is a typical case.

But this whole process need not detain us; it has no serious morphological value, being obviously a device for a certain end. When that is attained, it has no further influence on the shape of the skeleton *.

III. *Early flattening out of the Prototheca.*—It is obvious that if, by any means, the early prototheca could be transformed rapidly into a disk, a broad base could be acquired by the skeleton which would keep it upright. It seems to me clear that the morphology of many of the Palæozoic corals can be explained on this hypothesis. But the different ways adopted of so changing the primitive conical prototheca seem to have been very numerous, and a review of the forms from this point of view is a desideratum. It is, I believe, along this line that we shall find a more natural set of characters for the revision of such groups as those now included, *e. g.*, in the Cyathophyllidæ, than any now adopted.

In the present place I can only give a few samples, and, to avoid doubt as to the forms meant, I propose to take as examples certain well-known figures accessible to every student.

"*Zaphrentis gigantea*," pl. iv. of Milne-Edwards and Haimes's Pol. foss. d. Terr. paléozoïques. I give this in passing because it is interesting as a very irregular method of acquiring a broad flat base. Diagram fig. 9 (Pl. I.) shows my interpretation of the process. It may be that the coral did not actually become detached and fall over, but that the method may be compared with radicle-formation, only, instead of a narrow lip, the whole side of the prototheca bent outwards and apparently became cemented to the substratum.

It will be seen from a comparison with Milne-Edwards and Haimes's figures that in this diagram I am assuming what the early transformation of the prototheca was from the shape of the tabulæ in the adult stages; and this is, I believe, perfectly justifiable. Unfortunately not sufficient attention has yet been paid to the variations of the prototheca, which are still to be discovered. In certain types of modifications, *e. g.* those shown in diagrams figs. 11 and 12, the very earliest

* Miss Ogilvie's suggested origin of the Perforata from a great elaboration of root-processes so as to form the reticular cœnenchyma is very ingenious. But it is hardly borne out by the development of young Madreporidan corals in which the cup- or saucer-shaped prototheca persists as a basal epitheca (see p. 4), and being flattened out from the first has no opportunity to form radicles.

modifications can still be easily seen ; but in others they are at once obscured, incorporated perhaps in the subsequent stock, or, again, in others worn or dissolved off.

The tendency has been to regard the variations at the extreme bases of these Palæozoic corals as accidental, and hence of no real value in classification. This view will, I hope, for the future be abandoned and special attention be paid to any traces which can be seen of the different ways in which the early prototheca was modified. It is quite possible, indeed, that many will be found to have been largely accidental. For instance, such a bend over as that shown in diagram fig. 9 may have been pure accident. The same may be said of radicle-formation. More extensive comparisons, especially from this point of view, are necessary before we can say whether such a method of forming a broad base as that shown in fig. 9 became habitual in any group of early corals or not. It is worth noting that other corals are known which adopted it, as, for instance, the *Dipterophyllum glans* of Roemer (' Lethæa Geognostica,' i. p. 371).

More interesting, however, than these irregular, one-sided bendings over are those which took place more or less symmetrically all round. The most perfect of these methods, and, I believe, one of the most recent, is certainly that in which the edge of the prototheca is very early bent down, that is before the cup has any real depth, as already described above (see p. 5) as being the case in the Perforata. The successive bendings down and attempts to bend up again of the edge of this prototheca will, as we have seen, account for the successive wrinkling of the flattened epitheca (see diagram fig. 10). The Perforata owe their leading characteristics to this fact, that upon their flattened prototheca or epitheca a purely septal theca arises, and as the polyps bud the new thecæ are also septal and may mount upwards to form enormous stocks built entirely out of radial septa mutually supported by concentric synaptaculæ, leaving the epitheca, as in *Turbinaria*, as a film beneath the base of the stalk.

On the solution of the question as to when this very early flattening out of the prototheca arose depends that of the first appearance of the Perforata in the coral system. We get what appears to be a flat, very wrinkled epitheca in *Cyclolites* of the Secondary epoch, and again still earlier in the Palæozoic *Palæocyclus*. But an examination of specimens of these at once shows that their flattened epithecæ were not continuous as in fig. 10. In *Palæocyclus* the conditions may be represented by the diagram fig. 11, and for *Cyclolites* by diagram fig. 12, the tabulæ in this latter case being represented internally by vesicular dissepiments *. In these cases, then, instead of there being one continuously expanding prototheca, there was the usual repetition of protothecæ which is so patent in the Palæozoic forms and still persisting, though disguised, in all corals. Even in the Perforata with tall conical septal calicles it must occasionally reappear, while in forms like *Porites* and *Goniopora* it is very marked (see above, p. 9).

These diagrams (11 & 12) are instructive because we see in the Silurian *Palæocyclus* that the original conical shape of the prototheca was not yet quite got rid of but persisted as a kind of stalk, whereas in *Cyclolites* it was quite flattened out. The process of flattening was apparently a slow one, and we may assume that the earlier forms always started from a deep prototheca, however rapidly (as in the case of *Palæocyclus*, for instance) the following protothecæ may have flattened out. Only in time was the flattening-out process so antedated that the very first larval prototheca appeared as a flattened saucer. And then, again, it was necessary to wait for the development of a septal theca to take the place of the flattened prototheca, before the latter could be left to grow outwards continuously as a mere basal support. One factor in bringing about this gradual flattening of the prototheca, as seen, for instance, in *Cyclolites*, might perhaps be seen in the delaying of the secretion of the rigid walls of the cup, which was probably rendered possible in the case of those forms which produced well-developed radial or septal thecæ, the formation of which might, in the early stages, use up the available material †.

There was, therefore, apparently a long period during which the rim of the prototheca was undergoing modification in the direction of bending outwards and, if one may so describe it, a period of uncertainty and hesitation. I am convinced that the gradual steps by which the various flattened

* Tabulæ are secreted when the whole basal skin becomes detached at once and secretes a new continuous floor. Dissepiments are the secretions of portions of the skin coming loose at different times. We may see two reasons for this partial detachment, and, these if correct, would throw some light on the distribution of vesicular dissepiments :—(1) the muscular attachments of the mesenteries buried in the skeleton may hold the skin down at definite spots ; (2) the original floor becomes divided up by radial septa, and thus the skin could not come off in one continuous sheet.

In *Cyclolites* the rims of the tabulæ, the internal parts of which are broken up into vesicular dissepiments, can be traced round the corallum as sharp lines (see fig. 12).

† Lacaze-Duthiers, *l. c.*, found that the septa could be the first skeletal elements produced in developing Perforates, whereas phylogenetically the prototheca came first.

protothecæ were brought about deserve much more attention than has ever yet been bestowed upon them. While I would not deny that the rise of the radial ingrowths from the inner (or upper) face of the prototheca, that is the septa, on which Milne Edwards's classification is mainly based, may not supply during this period the best taxonomic characters, I still do not think that the variations in the curve of the protothecal rims, or, in other words, the shapes and dispositions of the tabulæ, can be so completely ignored as has hitherto been done. A few examples will show what I mean.

Diagrams figs. 13 *a–f* show some of the forms assumed by the prototheca of adult single Palæozoic corals. They were built up of series of such protothecæ fitting into one another and usually raised above one another, sometimes by septal folds or ridges, sometimes by vesicular arrangements of the tabulæ of which only the edges showed clear and sharp, or sometimes the sloping sides being vesicular, while the more or less flattened bases are smooth.

It is impossible now to say how far these foldings outwards and downwards of the rims are of the nature of accidental variations. But until we know I can hardly think it right to ignore them so completely as has been done, say, in the genus *Cyathophyllum* as given by Milne-Edwards and Haime. For instance, we find specimens called *Cyathophyllum* which show the prototheca of the shape given in fig. 13 *a* (e. g. *C. turbinatum*, Goldfuss*, said by Milne-Edwards and Haime† to be *C. ceratites,* although they themselves give a figure of it which appears to have the prototheca of the form 13 *h*). Again, Goldfuss (*l. c.* fig. 8 *d*) gives other figures of his *C. turbinatum* with prototheca 13 *c,* while his *C. ceratites* (pl. xvii. fig. 2 *h*) is shown with prototheca 13 *d*, with tabulate floor and vesicular sides. This latter M.-Edwards and Haime called *C. Decheni* with the same form of prototheca as their *C. Bouchardi* ‡. *C. heterophyllum* § appears to have a prototheca of the form, 13 *g*. Goldfuss again gives a *Cyathophyllum helianthoides* (in his pl. xx. fig. 2 *e*) with the same prototheca, 13 *e,* as that given for the genus *Ptychophyllum.*

It is quite true that considerable variation in the slopes of these flattening rims may be expected. For instance, in Goldfuss's figures of *C. helianthoides,* just referred to, some have the prototheca 13 *c,* others wih rims even more convex

* Petref. Germ. pl. xvi. fig. 8 *a*.
† Brit. Foss. Corals, pl. 50. fig. 2.
‡ Pol. foss. Terr. paléozoïques, pl. x. fig. 2.
§ Ibid. pl. x. fig. 1.

than 13 *f*. And again variations of curve are seen in the figured section of *Chonophyllum perfoliatum* * with prototheca 13 *b*.

Thus at the very outset we find ourselves face to face with the crux of all systematic work: What is the taxonomic value of these slopes and curves of the rim in any individual case? We know from Mr. Pace's observations † that great variability in the openness and flatness of the calicle can be correlated with the degree of muddiness of the water. The sediment runs more easily off a coral with a flattened open theca than from one with a cup-shaped theca. Then, again, we are justified in assuming that these forms were developed in each case by slow modifications of an originally deep prototheca (age, therefore, may have something to do with the form); and, lastly, we can imagine many different accidents which would tilt or depress such rims.

Nevertheless we have a structure of fundamental importance in the coral skeleton, and the form-variations of this structure may justly claim to take the first taxonomic rank. But how are we to distinguish those of importance from those which are accidental in individual cases? The matter is further complicated in the case of these ancient fossils, because the transition-forms are preserved equally with those which have passed over finally to some well-defined type. It seems fairly clear that classification of such forms must be attempted on wholly different lines from that still in vogue. Before any form receives a name we should satisfy ourselves by a close study of series that it embodies some new principle of structure. Three or four such distinct principles can be gathered from the forms of the prototheca given in Pl. I. diagram 13 *a*–*g*. In *a* the rim continues to show no sharp bend downwards, and is distinct from that in which the rim tends to bend out so as to form an open dish either as 13 *c* or 13 *f*; and both these differ from the sharper curve of the edge all round (13 *g*). Fig. 13 *h*, in which the edge bends rapidly over and then either hangs straight down or shows a tendency to curve up again, seems to me to be very easily distinguishable from 13 *f*, for, even though the two might possibly pass into one another, a smooth curve and a sharp bend are very distinct.

I propose now to leave all but one of these early variations of the prototheca, hoping that I have said enough to claim greater consideration for them in all future work on Palæozoic

* Brit. Foss. Corals, pl. 50. fig. 5. The section perhaps does not run true.

† Ann. & Mag. Nat. Hist. ser. 7, vol. vii. (1901) p. 385.

forms. Fig. 13 *h*, however, is of very great morphological interest and demands some further attention.

In the first place, it shows a simple and very efficient method of enabling the skeleton to stand upright. It differs from the radicle-formation in that the lip bends over all round. The septa which come over the lip run down on the outside just as we know that they run down inside the radicle (see fig. 8 *b*). It is also obvious that the flesh of the polyp must have clothed the outer surface of such a theca, which is no longer the outer surface of the prototheca. To the flesh thus hanging over Bourne's term "perisarc" may be applied, and lower down we will compare it with, and distinguish it from, another principle of structure which also involves the formation of a perisarc. A calicle built up of a succession of such protothecæ as those now under discussion, one fitted inside the other, as in diagram fig. 1, would have a rib-like arrangement of septa running down on the outside; but in this case one would expect to find traces of the hanging rims appearing irregularly one above another as whole or portions of rings round the corallum. They would appear to be drooping or perhaps even show a tendency to curl up again.

It is because no such epithecal rims show in the fig. 2, pl. 50, 'British Fossil Corals,' that I doubt whether its prototheca has this form (13 *h*) or belongs to the type I shall presently describe as also depending upon the formation of a perisarc. This point, then, may be left for the present. It is clear at any rate that its true place is nowhere among the Cyathophyllidæ.

This form 13 *h* is of special importance, however, for the understanding it gives of the morphology of the Silurian *Calostylis* as developed by Lindström.

This coral has been announced as a Palæozoic Perforate, and this claim has had to be dealt with for the British Museum Catalogue, the first section of which, it is proposed, shall deal with the Perforata. As I have shown above, the true Perforates were only possible when the prototheca was flattened out as shown in diagram fig. 10. When thus flattened the septal ridges towered up above it and free of its rim, carrying on the skeleton by themselves alone. The thecæ being constructed solely of radial plates and their synapticulæ were necessarily porous. In *Calostylis* the prototheca was not flattened out at all, but folded as shown in 13 *h*, and the septa were not laminate, but appear to have been represented by a compact mass of large, irregular, rounded or subangular nodules, arranged roughly in radial rows. These come over the edge of the thecal fold and extend down to the rim of the prototheca. The compact layer of septal nodules on both the inner and outer surfaces of the calicles cause the walls to look as if they might be perforated—as if the deep depressions between adjacent nodules might run right through. But this they do not do. One of the chief puzzles of *Calostylis* has been how to explain the pendent tongues of epitheca which hang down irregularly and at intervals round the corallum and sometimes bend even slightly outwards. There can be only one explanation of them, and that is supplied us as soon as we have unravelled the modifications of the prototheca and recognized that its rim was bent in the way shown in this diagram. I repeat it was of importance to have this point settled, for a Silurian Perforate was a difficulty which the British Museum Catalogue had now to dispose of one way or the other.

Turning from this to a somewhat kindred point which has too long been waiting for solution, and which may be partly dealt with in this connexion: Mr. Quelch * has raised the question as to whether the Palæozoic Cyathophyllidæ are not still surviving in the form which he has called *Moseleya.* It is quite true that we have in both cases skeletons built up of the same elements, and at first sight similarly disposed. It has already been pointed out by Mr. Pace that some of the suggested resemblances of *Moseleya* to a *Cyathophyllum* have no value, such as, for instance, the supposed tetrameral symmetry of *Moseleya.* But arguments based upon more or less similarity will not carry us far. The relationship can only be proved or disproved by an analysis of the principles on which the two corals are built. It is not merely the fact that both have similar elements somewhat similarly arranged, which is of importance, but the principles of their respective arrangements. Now whichever of the curves or series of curves of the rim of the prototheca shall afterwards be decided upon as that which shall characterize the genus *Cyathophyllum*, there is no question at all that the special forms which Mr. Quelch relied upon (e.g. *C. Stutchburyi* and *C. regium*, at least as figured by Milne-Edwards and Haime in the 'British Fossil Corals') are of the pattern 13 *d* with the floors tabulate and the sloping sides vesicular. Hence unless *Moseleya* can show a somewhat similar arrangement of tabulæ or vesicles, the relationship between the two cannot be maintained. Now an examination of the available specimens of *Moseleya* shows a principle of protothecal modification which, in some respects, resembles diagram 13 *h* ; but on closer analysis it appears to be nearer that other method

* Chall. Report, xvi. 1886, p. 110.

of perisarcal formation referred to above, which will be described in detail in the next section. We shall have therefore to postpone the further discussion of this point for a few pages, contenting ourselves with stating that a comparison of the protothecal specialization of *Cyathophyllum* with that of *Moseleya* shows them to have been well nigh as wide apart as they could possibly be.

One word before leaving these early flattenings of the prototheca as methods adopted by the early Madreporaria for the purpose of retaining the upright position. It is difficult to see how, as single corals, they would be efficient for the purpose unless the rims managed to touch the ground and re-cement a part of the animal to the solid substratum, and this, judging from some of the shapes assumed, does not appear to have taken place. But what is wanted is a closer study of the protothecæ and their earliest modifications. One advantage of early flattening out they would obtain, however; they would grow more slowly in height, and the leverage would not be so great. Further, if this flattening out meant ever so small an increase in the size of the base of the prototheca, we can see that it might be of some value to the coral, even though the rims did not again touch the ground.

The moment these flat-calicled forms begin to bud and form colonies the advantages of the flattening become obvious, as will be seen in another section.

IV. *The Perisarc.*—One of the simplest of the really important methods of keeping the prototheca upright was for the soft parts to bag over all round the cup until they touched the ground, so as to form a secondary fleshy foot. This process differs from that shown in diagram fig. 13 *h*, for it involves no *gradual* bending over of the rim of the prototheca. I assume that the polyp simply overflowed the edge of the cup, that it reached the ground, and even expanded somewhat over the substratum all round the point of attachment of the skeleton. Since the under surface of this overhanging flesh is a continuation of that which secreted the prototheca, it might be expected not only to secrete a layer over the outer face of the cup, but also to deposit a continuation of that layer where it touches the ground. This latter might be thickened to form a solid pedestal, in which the tip of the prototheca would be firmly fixed. The fleshy foot secondarily formed in the way described may have taken almost any shape, even sending out radial prolongations or embracing the round stems of weeds, in which cases the solid pedestals which it secretes would encircle such stems, fixing the corals firmly.

When once fixed the coral may continue to grow in height and size without fear of falling over. If the rise in height is slow the soft parts hanging all round down to the ground may go on thickening the wall, and especially the base, almost indefinitely, so as to keep the corallite nearly cylindrical. In such cases the septal ridges on the inner face of the cup may be continued over the edge as ridges (costæ) or as rows of (costal) spines down the outside. On the other hand, as soon as the base of the prototheca is sufficiently firmly fixed the corallite may grow rapidly in height as well as in width, and in so doing may drag the soft parts away from contact with the ground. The latter will then persist as the typical "*edge-zone*" or "*Randplatte*" round the mouth of the corallite. The withdrawal of the parts that thickened the base while the coral grows in size leads to the latter being turbinate.

From this point of view the typical "*edge-zone*" is in reality a vestigial structure; it is the remains of the perisarc * which in the young stage formed the secondary fleshy foot. But even as such it may continue to fulfil some useful function. It will always continue to leave a layer of skeletal matter on the outer face of the prototheca, thus increasing the thickness and strength of the latter, and it will continue to form costal (=septal) ridges or spines. In *Galaxea* advantage is taken of its gradual withdrawal from contact with the ground to secrete horizontal or arched films round the base of each calicle. In this way the corallites of a *Galaxea* colony are embedded in and supported by an increasingly thick layer of irregular filmy vesicular tissue †.

We are now in a position to reconcile our statement that the epitheca, as usually seen in adult corals, is the rim of the protothecal cup perhaps indefinitely expanded, with the appearances which have led to the text-book statement

* I suggest this distinction between Bourne's "perisarc" and the "edge-zone" of Miss Ogilvie; the edge-zone is the vestigial perisarc. It is important not to confuse the perisarc which hangs over the solid edge of the prototheca with the sides of the polyp of a perforate coral in which the prototheca has been flattened down and the septa alone form a secondary internal theca, and no bagging over of soft parts ever took place.

† There is in the Natural History Museum a specimen showing a group of "*Caryophyllia clavus*" growing on a piece of a telegraph-cable from the Caribbean Sea (700 fath.). The individuals are near together and their perisarcs have covered the intervening spaces with a chalky film. Here and there in the angles made by the corallites with the substratum the film is raised and slopes outward and downward from the sides of the coral. It is this kind of free film formation which has been specialized in *Galaxea*.

that the epitheca is that part of the skeleton secreted by the edge-zone and left on the sides of the coral as it (the edge-zone) is drawn up with the growth of the coral. This secretion may show periodical wrinkles or thickenings if the withdrawal is intermittent; and it is also clearly epithecal, inasmuch as, morphologically, it must be regarded as a doubling over of the rim of the prototheca, as can be gathered from the diagram (fig. 14). But this secretion is only one of many, and, moreover, one of the most highly specialized, modifications of the rim of the epithecal cup. Hence while it is quite correct to call it epitheca, it is quite incorrect to define epitheca in terms of this single specialization of it.

It is also clear that if the term "eutheca" is applied to such cups as those shown in diagrams figs. 1, 2, 4, and 5, in which the lip of the prototheca grows straight on, we want some other term to designate a cup in which the bagging over of the soft parts has practically doubled back the edge of the cup, so that the fold adheres to its sides (see fig. 14). But I would suggest that the simple unmodified theca should be called prototheca, while the term eutheca would be more aptly applied to the theca which has been secondarily attached by a solid pedestal, thickened by the extra matter secreted on its outside, and strengthened and armed by ribs and spines. We might call the wall of *Zaphrentis*, *Streptelasma*, &c. (diagrams figs. 1–4) "continuously protothecate" and that of *Montlivaltia* (diagram fig. 3), or at least of those specimens in which the septa can be seen between the edges of successive saucers, *discontinuously protothecate*.

But although this eutheca, with the meaning just suggested, is due morphologically to a doubling of the wall of the prototheca by the secretion of a layer on the outside of the cup, it can hardly be described as due to a *bending over* of its rim. I conceive of it rather as due to the rapid bagging over of the soft parts, without at the moment any actual continuous growth of the rim. A true bending over would have been a growth process of the rim itself (see fig. 13 *g*). I imagine that only when the soft parts had acquired their new position on the outside of the cup that they commenced secreting the external layer, which is nevertheless strictly a continuance of the rim down the outside and into the basal pedestal.

This explanation of the morphology and origin of the edge-zone throws an interesting light upon a very specialized and morphologically puzzling group, viz. the small highly sculptured free Turbinolidæ. Their origin can now be understood from diagram fig. 14, if we suppose that the powers of secreting carbonate of lime were for some reason restricted, perhaps locally *. In that case the outside fleshy foot might fail to secrete a solid pedestal, and then if, perhaps owing to the movements of the animal itself, the prototheca became detached from the substratum, it would be completely enveloped by the polyp and become a small internal cup-shaped skeleton. The ribs or spines coming over the edge of the cup could then run right down to the extreme tip of the original prototheca, as they do in typical members of the genus. If this origin is correct, the genus *Turbinolia* will have to be regarded as an extreme specialization of the "Euthecate corals," and can hardly, as it now does, give its name to a family.

It is evident then that a considerable reshuffling of the Milne-Edwards classification is required. For instance, as has already been pointed out by Bourne, the "Turbinolidæ" can no longer contain such purely protothecate forms as *Flabellum* and *Rhizotrochus*, while the Euthecate corals will have to include such forms as *Galaxea*, *Euphyllia*, and *Mussa*, which were placed among the Astræidæ by Milne-Edwards and Haime. *Turbinolia* itself will be a specialized offshoot of the Euthecate corals. It would, however, be premature to found such morphological divisions as Protothecata, Euthecata, for it might be discovered, for instance, that the method of forming a perisarcal foot round the larval prototheca has been adopted more than once by different types of coral. Indeed, we seem already to have discovered two ways, viz. that shown in fig. 14 and that found in the Palæozoic *Calostylis* (fig. 13 *h*).

And this brings me back again to the much discussed genus *Moseleya*, already referred to as that which Mr. Quelch, working on a single specimen, took to be a Cyathophyllid. Fortunately Mr. Pace was able to bring more specimens of *Moseleya*, and I have found two others in the great collection made by Mr. W. Saville-Kent on the Great Barrier Reef. All these specimens are *Lithophylliæ*. The only difference that I can detect between them and the 'Challenger' specimen lies in the fact that the latter has flatter and more open calicles. This, as Mr. Pace suggests †, may be merely an adaptation to the mud which we gather is present in the parts where the 'Challenger' specimen was obtained. Examination of the specimens with a view to discover what was the principle of protothecal modification overlying them reveals the type of structure shown in the diagram fig. 15. It is

* They are plentiful in the Barton Clays.

† Ann. & Mag. Nat. Hist. ser. 7, vol. vii. (1901) p. 385.

essentially the same as that shown in fig. 14, but the prototheca was shallow and open and the soft parts had bagged over the low walls on to the ground, doubling them as shown in the figure. Large wing-like septa come over the wall and also reach to the ground or to the rim of the epitheca all round outside. Between these flange-like septa, as they grow upward and outward, the polyps leave one basal secretion after another, so that both inside the cup and outside it there is an increasing thickness of vesicular tissue. In the diagram (fig. 15) the lines are drawn as so many distinct tabulæ. But it would hardly be expected that the successive detachments of the polyp would take place simultaneously within each interseptal loculus, right from the centre of the calicle over the edge of the theca down to the ground. But as dissepiments are only portions of tabulæ, the diagram is the best way of illustrating the facts. This type of structure, in which the vesicular tissue not only rises between the septa within the calicle, but also thickens the column between the costæ outside it, is that which lies at the base of *Lithophyllia*. It is true that emphasis has not hitherto been laid upon this point, for the simple reason that the prototheca had first to be discovered. Milne-Edwards and Haime merely remark that dissepimental tissue is very abundant, while their classing *Mussa* with *Lithophyllia* shows clearly indeed that the arrangement of the dissepimental tissue had not been analyzed. On the other hand Knorr, to whose figure among others Milne-Edwards and Haime refer as a type of *L. lacera*, mentioned the "stony films round the foot" and described the impression made upon him by the words "*new crowns continually covered up the old ones.*" The meaning of this otherwise enigmatical saying is quite clear when we glance at the diagram (fig. 15) here given. We conclude, then, that there is no generic difference between *Moseleya* and *Lithophyllia* and that the genus *Moseleya* is superfluous. At the same time it is due to Mr. Quelch to point out, (1) that the analysis of the essential structure of *Moseleya* was hardly to be discovered from the single specimen at his disposal at the time, and (2) if it had been, there was no existing description of *Lithophyllia* which would greatly have helped him. The calicle of which he made a section was old, very much flattened, and somewhat distorted, and with the tissue on its exposed side largely killed down. This latter point is of great importance, for it is the structure of the sides of the column which is essential to a correct diagnosis. Once, however, the clue is given, which is supplied in abundance by the new specimens, the structure is easy to comprehend.

With the striking superficial resemblance to Cyathophyllidæ to mislead him, it is no wonder that Mr. Quelch was misled. Nor do I see how his claim could have been disproved without a clear understanding of the position of the prototheca in coral morphology.

While on this subject I may point out that Mr. Quelch's figure (*l. c.* pl. xii. no. 5) of a small calicle of *Moseleya* showing marked tetrameral symmetry is seen on the actual specimen to have been distorted by too close contact with the shell of a mollusk much larger than itself. Its internal arrangement is not quite normal. Mr. Pace has presented the Museum with over a dozen specimens, most of them single forms in all stages of growth, and not one shows any such striking tetrameral arrangement. On this subject of tetrameral symmetry in the so-called "Rugose" division of the Madreporaria I would refer the reader to what is said above (p. 11).

Whether, after all, the subsequent classification of the Lithophyllidæ will ultimately admit of the existence of a genus *Moseleya* among them I cannot say. In this paper I am only concerned in showing that it has no place among the Cyathophyllidæ. The latter are characterized by extreme simplicity of protothecal modification, the Lithophyllidæ by great complexity; they are at opposite ends of the evolution of the coral skeleton.

Before closing this section I should like to refer once more to the difference between the principles of modifying the prototheca shown in diagram fig. 13 *h* and diagram fig. 15. In both the soft parts bag over and reach the ground, but in the former the lip grows with the growing of the soft parts and its bend is a true bend. In fig. 15 the soft parts seem to overflow the edge of the cup too rapidly actually to bend the edge. Only after they have taken up their new position do they secrete a layer on the outer side of the cup, and this layer is practically the homologue of the bent-down edge shown in fig. 13 *h*. The two methods are thus clearly distinct, but it is not always easy to say whether a particular case belongs to the one or to the other. For instance, in those specimens of *Lithophylliæ* in the Museum which have the corallites crowded together and forming pseudo-colonies, it is frequently noted that where the interseptal loculi of adjacent corals run into one another the dissepiments are everywhere arched, suggesting an open bend of the thecal lip, such as is shown in the diagram fig. 13 *h*, or even more resembling the bend of fig. 13 *g*, or even of 13 *f*. But in the specimens with single corallites the actual lip of the theca is mostly a solid plate like those shown in diagrams figs. 14 or 15, and from it the dissepiments slope away on the one side into and across the calicle, and on the other down to the substratum. But it is doubtful whether an actual section of the wall would show that structure so straight and continuous as it is shown diagrammatically in the figure (15), and it is quite certain that the tabulæ would not be so regular and complete.

It was some such case as that just referred to (? a specimen of *Acanthastræa*), in which vesicular arched walls separated calicle from calicle, that inspired the diagram given by me on pl. xxxiii. fig. 10 in vol. xxvi. of the 'Journal of the Linnean Society of London.' I am not yet, however, prepared to answer the question as to which of the two methods of edge-zone formation we have just been comparing—that of fig. 13 *h* or of fig. 15—the actual case was due. For, as we have just seen, the *Lithophylliæ* show that the smooth, arched, vesicular dissepimental wall might be a secondary modification, and due to colony formation, of the true edge-zone formation of fig. 14, which is the subject of this section.

V. *Early Budding and Colony Formation.*—In vol. iv. of the 'British Museum Madreporaria,' Introduction, p. 23, I suggested a restricted use of the word "astræiform," viz. to colonies of calicles all reaching to the same height and without any apparent tendency to grow and bud independently. The true astræiform colony is therefore that built up by a calicle which is by habit low and whose buds spread laterally over the substratum all round the parent. The group Astraidæ as now understood consequently cannot be a natural one. It appears to me that we may have astræiform colonies of corals whose protothecæ are modified upon very different plans. And it is on these modifications of this fundamental element that the ultimate classification will have to be based.

We might expect, then, a great development of astræiform colonies among the Palæozoic corals from the forms in which the prototheca was early flattened out in the ways described. We might also expect that it would be those methods of flattening out which were from the first symmetrical, because if the parent had acquired its flattening as a secondary matter, after having perhaps at one time fallen over, it could hardly be expected that the buds would appear with the necessary flattened symmetry straight away, although in some of the Astræid forms with very large calicles this must apparently have taken place.

While I think these conclusions are perfectly justifiable, we learn from the researches of Lindström that one great group of Palæozoic astræiform corals with very small calicles, *e. g.* the genus *Heliolites*, developed from a prototheca which had fallen over. From Lindström's figures * we gather that the lip which touched the ground expanded as a flattened epitheca over the substratum, and buds appeared at intervals upon it. Especially characteristic are the various wrinklings and ridges which appear on the upper face of the epitheca between the buds. As the living layers were periodically detached from and rose above this epitheca they secreted tabulate floors, which repeated its wrinkles and foldings. In this way the structure seen in the section typical of the Heliolitidæ was produced. Through the tabulate laminæ which form the bulk of the coral the calicles run as tubes, while smaller tubes also appear in many cases in the intervening tabulate tissue. These smaller tubes receive their explanation as the continuation of the folds or wrinkles already mentioned through the whole series of tabulæ. Such folds or wrinkles would run as naturally through a series of tabulæ as the septa run apparently continuously through the tabulæ of *Montlivaltia*, as already explained in fig. 3 and p. 8.

If, however, we had had no knowledge of the origin of *Heliolites*, we should have assumed that it had been built up of calicles with the form shown in fig. 13 *j*. And, indeed, this is the form which the calicles of the adult colony assume, but it is not arrived at by a symmetrical outward folding of the rim of the prototheca, but indirectly from a parent the unmodified prototheca of which fell over in the way already described. We owe the small size of the calicle of *Heliolites* to this fact.

The chief difference between the Palæozoic and Recent astræiform corals is due entirely to the more recent development of the radial or septal, as compared with the concentric, protothecal foldings. In Palæozoic times the former were not very pronounced, so that the flattened or curved sides of the protothecal cups with their tabulate floors formed the most characteristic portion of the skeleton. The cup was, however, never quite flattened out, there is always the remains of the bend where the lip first turned over. These bends frequently form ring-folds (see fig. 13 *j*), which become the walls of the fossæ, while tabulæ form not only the floors of these fossæ, but also the areas which intervene between the fossæ. These areas are variously sculptured with radial septa, and when the respective areas of the individual calicles are not marked off from one another, the septa of one may run into the septa

* See K. Sv. Vet.-Akad. Handl. xxxii. (1899), pl. i. figs. 25–28. Compare the case of *Palæocyclus* referred to above.

of those around it, as, for instance, in *Darwinia* and *Phillipsastræa.*

On turning to modern Astræidæ, we find that the tabulate character of the Palæozoic corals has become obscured, on the other hand the septa have become prominent. These conspicuous radial folds of the prototheca make it difficult to discern the exact character of the concentric foldings of the protothecal wall.

I would suggest that, as a rule, the rising of the radial septal folds has also raised the concentric rim-folds. We might diagrammatically express it by imagining a calicle like that in figure 13 *j* becoming changed into the form shown in fig. 16, which represents a calicle with high double walls, and on each side of it a smaller bud. We may assume that the tall ring-fold has been formed at the expense of the earlier horizontal tabulate area round the fossa. It is impossible here to attempt any review of the many Astræid forms, but, speaking roughly, they are built of groups of low calicles with the protothecæ modified in this way. The difference between this and that shown in diagram fig. 14 is that the calicle is shallower and more open.

Without professing any intimate knowledge, I am inclined to believe that most of the different forms now included among the modern Astræidæ may be referred to variations:—

(1) In the distances of the corallites from one another: (*a*) they may be wide apart, as in *Orbicella*, *Solenastræa*, *Echinopora*, &c.; (*b*) they may be close together, *Favia*, *Diploria*, &c.; (*c*) they may be so close that the outer wall of the parent supplies the inner wall of the bud, *Prionastræa*, *Goniastræa*, *Leptastræa**, &c.; (*d*) even these single division-walls may be incomplete, *Hydnophora*.

(2) In the ways the intercalicinal valleys are filled up.

(3) In the characters of the septa and in the way in which they come over the edges of the fossæ and are distributed on the surface of the intervening tissue.

Concluding Notes on the Terminology of the Walls.

A wall built by a direct continuation of the edge of the prototheca should, I think, be called prototheca†. These

* The Palæozoic *Michelinia* might be regarded as the morphological equivalent of these forms before the development of septa disguised the protothecal cups.

† The term epitheca may be retained in its usual sense, and be understood to refer to all traces of the primitive undifferentiated protothecal wall and rim, even though they have lost all signs of having been once parts or expansions of a cup.

primitive protothecal walls, recognized by Miss Ogilvie as equivalent to epitheca, have been hitherto called eutheca. But *proto-* is a more appropriate affix to express primitive simplicity than *eu-*, which better denotes some special excellence. Hence I propose, once more, that eutheca be applied to those walls which have been thickened, ornamented outside, and cemented firmly to the substratum in the way described above (p. 22) and illustrated in diagrams figs. 13 *h*, 14, and 15.

We now come to the term "pseudotheca" of Heider. This is applied to cases in which the septa are so crowded together that they fuse along lines which together constitute a fairly symmetrical solid thecal ring. The parts of the septa within this ring are septa proper and the parts without are costæ. Now I cannot help doubting whether this differs in any respect from the eutheca, for it is obvious that a eutheca, as here understood, over which the septa ran close together, would give exactly the same result.

The suggestion that this wall is built wholly of fused septa does not take the possibility of a ring-fold into account. But from the review of coral morphology here set out it would appear that the ring-fold was a more primitive structure than the radial septa. Further, it is really impossible in a matter of such complicated folds to say how much at their points of crossing belongs to the radial and how much to the concentric elements.

That the concentric element plays a part we gather from the fact that dissepiments frequently slope up the interseptal loculi just as if, had there been space enough, they would mount over the walls. This giving off of dissepiments means that the basal floor shares in the formation of the wall. What is usually called pseudotheca, then, is to my mind simply a modification of the eutheca as here understood, and the word, if retained at all, should have a new significance. My own proposal is to apply it in the sense of Ortmann's "athecalia" *. This term was suggested by that author for the Perforata in which the protothecal cup, being entirely flattened out, a new secondary theca rises up formed entirely out of septa with their synapticular junctions. Now it is obvious that no part of the old protothecal rim is found in this new septate thecal wall, and to mark the total distinction between this and all the wall-formations made by folds of the true lip of the prototheca, it might well be called pseudotheca.

* Zool. Jahrb. (Syst. Abth.) iv. 1889, p. 493.

The term "athecalia" of Ortmann, it may be remarked, has not been very well received, for it is certainly not true that the corallites, say, of *Madrepora* have no thecæ. The very opposite is the case; the thecæ are most pronounced. What we want to express is that these thecæ are morphologically distinct from the original thecæ of the Madreporaria, and no better term could be employed than that here suggested—pseudotheca.

I am aware that a long critique of the views and suggestions of other workers on the subject of the wall should be offered before proposing a revision. But I have the excuse that the revision of the terminology here suggested rests upon a somewhat far-reaching revision of the skeleton. A closer comparison of the terminologies would involve a closer comparison and criticism of the views on the wall-structure of each different author, some of which are, I confess, not always clear to me. Indeed, we seem to have had enough of detailed and complicated discussion. The great want is some simple working hypothesis which will enable us to coordinate the facts.

My own work has convinced me that some order appears out of the chaos if we recognize the prototheca and give it the important place in the morphology of the coral skeleton here all too briefly sketched.

In conclusion, I should like to emphasize the fact that this paper is intentionally devoted to the prototheca and its concentric modifications—that is, to those modifications which alter its cup-shape concentrically. Only occasionally and where necessary reference has been made to the great and complicated system of radial wall-folds which are the most characteristic structures of the stony corals. These have, however, claimed the attention of workers too exclusively in the past. We shall only be able to obtain a true insight into the evolution of the coral skeleton when we understand both systems of modification—the more primitive concentric and the later radial—and can trace out their influences on one another. It is to me a matter of sincere regret that this paper was not published prior to Miss Ogilvie's comprehensive and patient treatise on the septa, for her valuable observations would then, I am convinced, have admitted of more precise and coherent treatment.

EXPLANATION OF PLATE I.

Fig. 1. The three earliest growth-periods of a primitive Madreporarian. The thick basal part is the prototheca (*sens. strict.*), see fig. 2.

The curved line *a* represents the secretion of the basal skin after it has been *dragged* (?) out of the prototheca by the growth of the walls in height; *b* represents the secretion formed by the skin after it has become detached from *a*.

Fig. 2. The same regarded hypothetically as three separate cups, the lowest thick-walled cup being the prototheca (*sens. strict.*); in it cup *a a a* is inserted, and cup *b b b* in *a a a*.

Fig. 3. A diagram to explain the morphology of *Montlivaltia.* The early cups rapidly expand and eventually become a series of saucers, *e e* . ., supported above one another by the septal folds which run continuously upwards. On the right half of the figure the upper part is in section, showing the tabulate floor and the irregularly bent-up rim. On the left half these rims are shown from the outside as irregular bands of epitheca running round the coral.

Fig. 4. An early stage like that of fig. 1, but, having fallen over and resecreted itself at *a*, it bends upwards again. The bagging of the detached basal skins will take the shapes shown, and the fossula in the bases of the cups will be on the convex or dorsal side of the curved skeleton.

Fig. 5. A diagram to show how, if the prototheca proper was wide-mouthed when it fell over, the fossula will come over to the ventral or concave side. *a* is again the spot where the coral secretes a new attachment.

Fig. 6. The diagrammatic representation of the arrangement of the septa in the so-called *Tetracorallia.* It receives a simple explanation as due to the necessary rearrangement of the septa in a coral which fell over and was bending up again. See text, p. 11.

Fig. 7. Diagram to illustrate the method of budding of a prone prototheca and the subsequent bending upwards of parent and buds which might give rise to such a form as *Halysites.*

Fig. 8. Two figures of radicle-formation, after Lacaze-Duthiers.

Fig. 9. Diagram to illustrate the one-sided bend-over of the prototheca such as it is suggested would give rise to the *Zaphrentis gigantea* of Milne-Edwards and Haime. See text, p. 14.

Fig. 10. Diagram to explain the early flattening out of the prototheca in the Perforata. The rim of the cup creeps outwards all round, generally with successive slight bendings up and then down again.

Fig. 11. Diagram of the early stages in *Palæocyclus.* The prototheca proper seems to have fallen over and then suddenly to have widened out, the repetition of this is still more widened out, and so on. What appears to have been a wrinkled basal epitheca is not a continuous growth like that in fig. 10, but a repetition of so many separate protothecal rims.

Fig. 12. Diagram of the early stage of *Cyclolites.* The prototheca is nearly flattened out, but it is still repeated continually, only instead of the secretions of the successively detached skins forming continuous tabulæ, they are broken up into vesicular dissepiments. Here also what appears to be the wrinkled epithecal floor is in reality a concentric series of separate rims.

Figs. 13 *a–g.* Various forms assumed by the protothecæ in Palæozoic corals, all in the direction of becoming flattened out. The developmental transitional stages between the deep prototheca and these adult forms have still in many cases to be worked out.

Figs. 13 *h* and *j*. Two types of foldings of the wall of the prototheca—*h*, seen in *Calostylis*; *j*, common in early astræiform colonies, e. g. *Heliolites*.

Fig. 14. Diagram to show the overflow of the prototheca by soft parts which bag all round down to the ground and form a new fleshy foot. This secretes a pedestal which can fix the prototheca firmly to the substratum and doubles the thickness of the protothecal wall. This, it is suggested, should be called the *eutheca*.

Fig. 15. Diagrammatic section of a *Lithophyllia*. Large wing-like septa radiate out over the wall, and dissepiments are formed on both sides of it; within the calicle they slope inwards, on its outer side they bend down and thicken the column with vesicular tissue between the costæ. Mr. Quelch's genus *Moseleya* is built on this plan, and cannot therefore be a Cyathophyllid with prototheca modified on one of the simpler plans shown in figs. 13 *a*–*f*.

Fig. 16. A diagram to illustrate the principle of structure characterizing the modern Astræidæ: 1 is the central parent calicle with the prototheca modified somewhat as in fig. 14; 2, 2 represent buds from the lateral edges, the budding thus resulting in the production of an astræiform colony.

II.—*Some Parasitic Bees.* By T. D. A. Cockerell.

Cœlioxys ribis, var. *Kincaidi*, n. var.

♀.—Length 11–13 millim., the difference in size partly dependent on the extension or retraction of the apical part of the abdomen.

Similar in all structural characters to *C. ribis*, but the pubescence of the head and thorax is ochreous, the basal part of the third abdominal segment is more sparsely punctured, and the apical dorsal plate has the apex beyond the slight lateral constriction a little more produced. There are distinct and conspicuous transverse grooves across the middle of the second and third abdominal segments, but not on the fourth or fifth. Tibial spurs black.

Hab. Olympia, Washington State, June 9 to 24, 1895, June 26, 1896, five females (*T. Kincaid*).

This is the first *Cœlioxys* recorded from the north-west. It is quite different from *ribis* in appearance, but structurally it is almost the same, having the same sculpture on the penultimate ventral segment, &c. A male collected by Mr. Kincaid at Olympia, June 18, 1895, is presumed to belong to *C. ribis Kincaidi*, though the pubescence (especially on the face) is white. This male almost exactly agrees with

C. sodalis, Cresson, though the lateral teeth of the scutellum, while obtuse, are not short; the apical margins of the wings are only slightly dusky. The tibial spurs are black, and the fifth abdominal segment has no lateral teeth, though there are minute nodules. The lateral teeth of the sixth segment are long. The upper apical teeth are flattened and rounded. The spines on the anterior coxæ are large and blunt. It is to be remarked that while *C. ribis* was described from a locality in the upper austral zone, it is also an inhabitant of the boreal, and probably goes far north of New Mexico. On June 29, 1902, my wife took females of *C. ribis* and *C. Porteræ* at flowers of *Frasera* at Beulah, New Mexico, in the Canadian zone.

The exact relationship of *C. sodalis* to *ribis* and *Kincaidi* will not be determined until the male of the first-mentioned is discovered. The localities given for *sodalis* are New York and Colorado; New York, being first mentioned, may be considered the type locality. I rather expect that *ribis* and *sodalis* will prove to be one species.

Epeolus, Latr. (sens. lat.).

Females.

	Fifth ventral segment of abdomen strongly concave in lateral view; fifth dorsal segment truncate; size large..	1.
	Fifth ventral segment not so	2.
1.	Legs black........................	*Triepeolus concavus* (Cress.).
	Legs ferruginous	*Triepeolus penicilliferus* (Brues).
2.	Fifth dorsal segment with only a differentiated apical lunule; small species. (*Epeolus.*)	3.
	Fifth dorsal segment with a large differentiated area; large species. (*Triepeolus.*)	6.
3.	Front with a tubercle on each side; scutellum red	*bifasciatus*, Cress.
	Front simple; scutellum black or faintly reddish	4.
4.	First abdominal segment hairy all over; antennæ red, suffused with blackish; tibial spurs clear red.............	*crucis*, Ckll.
	First abdominal segment with a black hairless area; antennæ black, with little, if any, red	5.
5.	Hind tibial spurs black; two submarginal cells; antennæ entirely black; lower half of pleura hairless	*Phileremus americanus*, Cresson.
	Hind tibial spurs clear red; three submarginal cells; second and third	

antennal joints largely red; lower half of pleura covered with hair	*beulahensis*, Ckll.
6. Legs black	7.
Legs red	8.
7. Larger; black area on first segment narrow, *i. e.* not much produced laterally	*nevadensis*, Cress.
Smaller; black area on first segment very broad	*donatus*, Smith.
8. Scutellar teeth long and sharply pointed, at least partly red; dark area on disk of first segment very small..	9.
Scutellar teeth shorter, entirely black .	10.
9. Larger; mesothorax mainly red	*pimarum*, Ckll.
Smaller; mesothorax black	*mesillæ*, Ckll.
10. Area on first segment a broad transverse band	11.
Area on first segment small, not produced laterally; size large	*texanus*, Cress.
11. Tegulæ clear light red; mesothorax with an anterior patch, not two distinct stripes	*occidentalis*, Cress.
Tegulæ dark reddish to dark fuscous; mesothorax with two distinct stripes.	12.
12. Larger; labrum entirely black	*helianthi*, Rob., var.
Smaller; labrum with two red spots..	*helianthi*, Rob.

Males.

Abdomen with eight club-shaped light marks	*verbesinæ*, Ckll.
Abdomen not so marked	1.
1. Markings of abdomen orange, white on sixth segment....................	*nautlanus*, Ckll.
Markings of abdomen white or pale cream-colour	2.
2. Mark on first abdominal segment semilunar	3.
Mark on first abdominal segment a transverse band	4.
3. Legs black	*concolor*, Rob.
Legs red	*lunatus*, Say.
4. Bands on second to fourth segments interrupted in middle line; size small; femora black	*olympiellus*, Ckll.
Bands on third and fourth segments, at least, entire; hind femora, at least, red	5.
5. Lower part of pleura bare	6.
Lower part of pleura covered with hair.	7.
6. Larger; tegulæ clear red	*occidentalis*, Cress.
Smaller; tegulæ darkened	*helianthi*, var. *arizonensis*, [Ckll.
7. Anterior femora red; abdominal markings white	*isocomæ*, Ckll.
Anterior femora black; abdominal markings cream-colour; antennæ black	*Cressoni*, var. *fraseræ*, Ckll.

Triepeolus nautlanus, sp. n.

♂.—Length $9\frac{3}{4}$–11 millim.

Agreeing with *T. lunatus* and *T. concolor* except as follows:—Light markings of thoracic dorsum, and particularly of dorsal segments of abdomen, light orange; sixth dorsal segment with the pubescence entirely silvery white, in strong contrast with the orange of the other segments; the extreme sides of the second to fifth segments are touched with silvery white, which is most conspicuous on the fifth; the bands on the second and third ventral segments are silvery white, the erect curved hairs on the fourth and fifth being fuscous; the pubescence of the face is entirely silvery (not golden at the sides as in *T. flavofasciatus*); the lower part of the pleura is hairy, with an ill-defined bare central area; mandibles with a dull red spot in middle of outer side; antennæ black, first joint of flagellum red beneath; tibiæ and tarsi red, spurs on middle and hind tibiæ black; femora black, reddened at apex, and the middle femora sometimes red beneath; the tibiæ vary to black, but the tarsi in such specimens remain red.

Hab. Vicinity of San Rafael, Rio Nautla, State of Vera Cruz, Mexico (*C. H. T. Townsend*). The dates are March 13 and April 7; it occurs at flowers of plant no. 1 of Townsend's collection, which is a species of Compositæ.

The insect is a tropical representative of *T. lunatus*, apparently constant in its bright colours. It is possible that *T. nautlanus* may prove to be the male of the species described by Cresson from the female as *Epeolus totonacus*.

Triepeolus nevadensis (Cresson).

Albuquerque, New Mexico, Sept. 15.

Recorded erroneously in Bull. Denison Lab. as *Epeolus remigatus* (p. 73) and *E. robustus* (p. 61). It is easily known from *robustus* by the prominence between the antennæ. *E. robustus* was described from New Mexico, but I have not met with it.

Triepeolus pimarum and *T. mesillæ*, spp. nn.

The females of these two species agree in the following characters:—Light markings of thorax and abdomen cream-colour; first abdominal segment with only a very small median black mark; second to fourth segments with broad even bands, that on second with no anterior lateral processes; labrum, greater part of mandibles (at least), and first three joints of antennæ and base of fourth red; considerable white hair about base of antennæ (not so in *T. bardus*), but clypeus and adjacent sides of face hairless; clypeus and face extremely closely but very distinctly punctured; pleura very strongly punctured; tubercles red; hind border of prothorax densely pubescent; mesothorax extremely densely punctured, not hairy, but having a sort of mealy appearance; two short anterior stripes of pubescence (slender and very weak in *mesillæ*); scutellum not or hardly at all bilobed, its lateral teeth very long and pointed; only the margins of pleura hairy; tegulæ apricot-colour; legs red, some blackish suffused markings on middle and hind femora; hind tibial spurs dark; hair on inner side of basal joint of hind tarsi orange; abdomen extremely closely punctured; fifth segment without a band, convex, with fine silvery pubescence, and with a quadrate minutely roughened red area; apical plate red, punctured, sharply truncate; ventral surface of abdomen not banded, but pruinose, with minute white pubescence. They differ as follows:—

T. pimarum.	*T. mesillæ.*
Larger, length about $12\frac{1}{2}$ millim.	Smaller, length 11 millim.
Clypeus red.	Clypeus black, with anterior margin red.
Mesothorax red, with a broad median black band.	Mesothorax entirely black.
Scutellum and pleura (except an oblique black band) red.	Scutellum black, the ends of the teeth red; pleura black, with a faint reddish spot.
Teeth of scutellum curved at ends.	Teeth of scutellum straight.
Apical plate of abdomen not or hardly keeled.	Apical plate of abdomen keeled.
Punctures at sides of second and third ventral segments of abdomen not conspicuously different.	Punctures at sides of second and third ventral segments very different, those of second being much larger and less dense.
Wings quite dark, nervures piceous.	Wings not so dark, nervures fuscous.
Three submarginal cells.	Nervure between second and third submarginal cells usually incomplete.

T. pimarum was found by myself at Alhambra, Salt River Valley, Arizona, in the autumn of 1899, at flowers of *Verbesina encelioides*. Of *T. mesillæ* I collected a number of specimens at Mesilla, New Mexico, Sept. 24. For a long time I have had the latter species labelled with doubt *T. bardus*, Cresson, but I believe it to be distinct, though closely allied. According to Mr. Brues the scutellar teeth of *bardus* are incurved.

Triepeolus donatus (Smith).

A female in the National Museum, from San Bernardino County, California, October (*Coquillett*), is referred here, as it agrees in every particular with the descriptions of *donatus* by Smith and Cresson, except that the pubescence of the abdomen is identical in colour with that of *T. concolor*. It is to be remarked that *T. superbus* (Provancher) has nearly the same characters; but its pubescence is pale yellow and the markings of the abdomen appear to be different.

Triepeolus isocomæ, sp. n.

The male was taken at Albuquerque, New Mexico, Sept. 16, at flowers of *Isocoma Wrightii*, and was recorded in Bull. Denison Lab. xi. p. 73, as *Epeolus occidentalis*. It is certainly a distinct species, differing from *occidentalis* as follows:—

T. isocomæ ♂.	*T. occidentalis* ♂ (from Colorado).
Smaller, about 9 millim. long; abdomen less tapering.	Larger, about 11 millim. long; abdomen more tapering.
Markings pale cinereous.	Markings cream-colour.
Labrum with a little apical pit full of white pubescence, its sides projecting and subdentiform.	Labrum with two minute apical projections, but no pit.
Labrum all black.	Labrum with a red spot on each side.
Stripes on mesothorax hardly separated, *i. e.* the area between them pubescent.	Stripes on mesothorax well separated.
Scutellum strongly bilobed.	Scutellum feebly bilobed.
Lower part of pleura covered with hair.	Lower part of pleura nude, except on anterior margin.
Wings shorter, hyaline; venation more ferruginous, marginal cell more obtuse.	Wings longer, brownish; venation more fuscous, marginal cell more acute.
Hair on inner side of basal joint of hind tarsi black.	Hair on inner side of basal joint of hind tarsi orange-ferruginous.
Second abdominal segment with large pyriform lateral hair-patches, pointed antero-mesad.	Second abdominal segment with rather small lateral patches anterior to the band.

The mandibles of *T. isocomæ* are perfectly simple, red in the middle; the antennæ are black, the flagellar joints with obscure reddish spots; the hind coxæ are mainly red; all the trochanters, femora, tibiæ, and tarsi are red; the scutellar teeth are short and black; the hind tibial spurs are black. Eyes (at least when dry) light green.

T. segregatus (*Epeolus occidentalis*, var. *segregatus*) appears to be also a distinct species, allied by the punctuation of the pleura to *T. pectoralis* (Rob.).

Triepeolus helianthi (Rob.).

I have confused this with *T. Cressoni*, which it very closely resembles. I have a female from Illinois, sent by Robertson years ago as *Epeolus mercatus*. Another female was collected by Mr. C. E. Mead, Sept. 19, 1898, at the Experiment Station near Aztec, New Mexico, at flowers of *Verbesina encelioides*. A specimen from near San Ignacio, N. M., formerly recorded as *Cressoni*, is nearly 13 millim. long, but appears to be the same species.

Triepeolus helianthi, var. *arizonensis*, var. nov.

♂.—Small, length about 8 millim.

Wings clearer, marginal cell considerably shorter and more rounded at end; labrum red; pubescent margin of first abdominal segment not broken anteriorly or posteriorly; fringe on fourth and fifth ventral segments fuscous.

Hab. Phœnix, Arizona, at flowers of *Helianthus annuus*, October 9 (*Cockerell*).

Perhaps a distinct species. The legs are coloured as in *helianthi*, the anterior legs being very dark.

Triepeolus Cressoni (Rob.), var. *fraseræ*, var. nov.

♂.—Variable in size, from about 8 to nearly 11 millim.

Antennæ and labrum entirely black; mandibles black with a red spot; hind femora red, middle femora with a black mark above; tegulæ reddish to piceous; nervures black except towards base of wing, where they become reddish; hair-stripes on mesothorax broad, flame-like, connected with a broad hairy anterior border.

Known from *helianthi* by the entirely hairy pleura, and from *occidentalis* by the black anterior femora &c.

Hab. Beulah, New Mexico, about 8000 ft., June 29, at flowers of *Frasera* (*W. P. Cockerell*), July 12 (*W. P. Ckll.*), July 12 (*T. D. A. Ckll.*); Las Vegas, N. M., at flowers of *Sphæralcea Fendleri lobata*, July 24 (*W. Porter*). I think the insect recorded from Beulah by Mr. Viereck as *E. occidentalis* must have belonged to the present form.

Epeolus crucis, sp. n.

♀.—Length about 7½ millim.

This is the species, found at Las Cruces by Professor C. H. T.

Townsend, which has passed as *E. compactus*, Cresson, in New Mexico, having been so identified by Mr. Fox. It may have been included by Cresson among his specimens of *compactus*; but it surely is not the species described under that name. From the description (Tr. Am. Ent. Soc. vii. p. 89) it differs thus:—Not especially compact, the abdomen at least twice as long as broad; pleura with the upper part densely white-hairy, the lower densely and coarsely rugoso-punctate, nearly free from pubescence; pale (hair) markings white, not buff; abdomen strongly pruinose all over with fine pubescence, so that the usual black markings, while indicated, are more or less obscured, the black surface being nowhere exposed; the apical white bands on the first four segments are broad and entire, and are somewhat emphasized by the fact that the apical margins of the segments, beneath the pubescence, are white; the transverse dark band (grey because pubescent) on the first segment is much produced and quite attenuated laterally. Labrum, mandibles, and first three joints of antennæ ferruginous, the flagellum brownish grey with a sort of silvery sheen above, ferruginous beneath; anterior middle of mesothorax with a white hair-patch, no separate stripes; scutellum faintly bilobed, black with two reddish spots, lateral teeth red, quite sharply pointed, not extending so far as scutellum; tegulæ bright orange-ferruginous. Wings rather short, faintly dusky, with an apical cloud; stigma and nervures of basal half of wing ferruginous, nervures of apical half dark fuscous; marginal cell rounded at end, appendiculate. Legs ferruginous, the femora strongly infuscated, spurs light ferruginous; silvery area on last dorsal segment of abdomen inconspicuous.

Epeolus beulahensis, sp. n.

♀.—Length 7 millim.

Black with yellowish-white markings due to pubescence; face, including clypeus, covered with silvery-white appressed hair; mandibles and labrum dark ferruginous; eyes strongly converging below; eyes (dry) grey; antennæ long, brown-black; end of scape and the two following joints ferruginous beneath; tubercles and tegulæ ferruginous; scutellum entirely black, faintly bilobed, the lateral teeth very short; thorax, including pleura, covered with pubescence, except disk and anterior margin (except two broad short stripes) of mesothorax, anterior half of scutellum, metathoracic enclosure, and a spot on each side of metathorax, which are bare and consequently black; legs clear red, including the spurs; anterior femora except knees, and anterior tibiæ except ends, black; middle femora with a black stripe above. Wings quite clear, except the broad apical margin, which is faintly dusky; nervures and stigma piceous; marginal cell obliquely subtruncate, minutely appendiculate; second submarginal cell nearly as broad above as third. Abdomen thick-fusiform, the black areas very distinct, that on first segment a broad transverse band, obliquely truncate laterally; hair-bands on first and second segments narrowly interrupted medially; second with large lateral oval spots touching the band; light areas on fifth segment just meeting on disk; pygidial plate ferruginous, broadly triangular, but subtruncate at tip; second ventral segment white with a large black (nude) patch on each side; third and fourth with white hair-bands.

Hab. Beulah, New Mexico, prox. 8000 ft., July 11 (*Cockerell*).

Allied to *E. autumnalis*, Rob., but differs by the clear wings, small spines of scutellum, &c.

Epeolus olympiellus, sp. n.

♂.—Length about $7\frac{1}{2}$ millim.

Stout, with an oval abdomen, black with the usual yellowish-white markings; labrum entirely black, with two prominent apical projections; middle part of mandibles bright ferruginous; lower part of face, down to middle of clypeus, covered with silvery hair; clypeus densely rugoso-punctate; scape black; tubercles ferruginous; tegulæ dark ferruginous, minutely and densely punctulate. Wings nearly clear, apical margin broadly dusky, nervures and stigma piceous; marginal cell obliquely subtruncate, minutely appendiculate; second transverso-cubital nervure with its upper half wanting; if it were complete, the second submarginal cell would be fully twice as broad above as the third. Femora black, the knees red; tibiæ with the greater part black; tarsi ferruginous; spurs light ferruginous; lower part of pleura thinly pubescent, densely rugoso-punctate; mesothorax with the usual two stripes widely separated, and without erect pubescence; scutellum subbilobate, wholly black, the lateral teeth short, but very distinct. Abdomen with the black areas well-defined; apical bands on segments 1 to 4 interrupted in the middle, the approximating portions of the bands on 2 to 4 club-shaped; black area on first segment a very broad band, obliquely truncate laterally, and not produced much more than halfway to the lateral margins; band on second segment broadened at the sides, but no oval patch; apical plate broadly rounded, black; ventral surface with two broad white hair-bands.

Hab. Olympia, Washington State, July 2, 1896 (*Trevor Kincaid*).

Allied to *E. interruptus*, Rob., but basal joints of antennæ not red, legs with much more black, postscutellum without a tooth, &c.

Phileremus americanus, Cresson.

Hab. Beulah, N. M., at flowers of *Apocynum androsæmifolium*, July 8 (*W. P. Cockerell*).

New to New Mexico. Cresson's description is not sufficiently detailed, but I think my identification is certainly correct. This species and *P. mesillæ*, Ckll., are to all intents and purposes *Epeolus* with two submarginal cells. I am convinced that these insects stand nearer to *Epeolus* as restricted by Robertson than that genus does to *Triepeolus*.

The black band on the first abdominal segment is much less produced laterally in *P. americanus* than in *P. mesillæ*. The fringes of erect hairs on the fourth and fifth ventral segments of *P. mesillæ* are white. While *P. americanus* flies in summer in the Canadian zone, *P. mesillæ* is a spring insect of the Middle Sonoran; a male before me was collected at Mesilla Park, N. M., May 7, at flowers of *Dithyrea Wislizenii*. It has the face densely covered with white hair.

The female of *P. mesillæ* has not been described; but I have a specimen (Ckll. 2810) collected at flowers of *Sophia* at Mesilla Park. The abdomen is longer than in the male, and the hind margins of the first four segments are broadly orange, with a coppery lustre, and practically hairless, though perhaps denuded. More than the apical half of the fifth segment is orange, and the very distinct white lunule is bordered behind by brown. The pygidial plate is truncate. The knees, tibiæ, and tarsi are all ferruginous. The flagellum is ferruginous, darker above. The disk of the mesothorax is dark brown, and the two light stripes are very distinct; in the male there are two very large light patches on the anterior part of the mesothorax.

III.—*Description of a new Genus of Frogs of the Family* Dyscophidæ, *and List of the Genera and Species of that Family*. By G. A. Boulenger, F.R.S.

[Plate II.]

Colpoglossus.

Pupil vertically elliptic. Tongue large, oval, entire and free behind, forming a plicate pouch at the point of its posterior attachment. Palatine teeth forming a long transverse series narrowly interrupted in the middle. Two denticulate transverse dermal folds in front of the pharynx. Tympanum hidden. Fingers free, toes webbed at the base, the tips not dilated; outer metatarsal bound together. Coracoids strong; præcoracoids very weak, ligamentous; no omosternum; sternum a large cartilaginous plate. Diapophyses of sacral vertebra moderately dilated.

Colpoglossus Brooksii. (Pl. II.)

Habit very stout; head strongly depressed, once and two thirds as broad as long; eye small, interorbital width three times the width of the upper eyelid. Fingers short, obtusely pointed, first shorter than second; subarticular tubercles indistinct; a large, oval, inner metacarpal tubercle. Toes short, blunt, with a very short basal web; subarticular tubercles feebly prominent; a rather large and very prominent inner metatarsal tubercle. The tarso-metatarsal articulation reaches the eye. Skin of head and body granulate, of belly and limbs smooth. Yellowish above, elegantly marked with dark brown lines, which form a network on the sides and limbs; a)-(shaped dark brown, light-edged marking on the head and nape, each of the longitudinal branches bifurcating in front and behind; two chains of small black spots, some with light centre, along the middle of the back; lower parts white, throat with wrinkle-like transverse brown lines.

From snout to vent 50 mm.

A single specimen from Bidi, Sarawak, discovered by Mr. Cecil J. Brooks in a hole whilst prospecting, and presented by him to the British Museum.

The discovery of a member of the family Dyscophidæ in Borneo is a very important addition to our knowledge, all the members of this natural group being inhabitants of Madagascar, with the exception of the Burmese *Calluella guttulata*. So many genera and species have been added to this family since the publication of the British Museum Catalogue (1882) that a complete list, such as is here appended, will be welcome to herpetologists and to students of geographical distribution.

I. Pupil vertical; palatine teeth in long transverse series.

A. Præcoracoids ossified; tips of fingers and toes not dilated.

a. Sternum large.

1. *Dyscophus*, Grand. 1872.—Madagascar.
    1. *insularis*, Grand. 1872.
    2. *Guineti*, Grand. 1875.
    3. *Antongilii*, Grand. 1877.

4. *Grandidieri*, Blgr. 1896.
5. *Alluaudi*, Mocq. 1901.

b. Sternum small.

2. *Calluella*, Stol. 1872.—Burma.
   1. *guttulata*, Blyth, 1855.

B. Præcoracoids not ossified.

a. Sternum large; tongue forming a pocket behind; tips of fingers and toes not dilated.

3. *Colpoglossus*, Blgr. 1904.—Borneo.
   1. *Brooksii*, Blgr. 1904.

b. Sternum small; tips of fingers and toes dilated.

4. *Plethodontohyla*, Blgr. 1882.—Madagascar.
   1. *notosticta*, Gthr. 1877.
   2. *inguinalis*, Blgr. 1882.
   3. *brevipes*, Blgr. 1882.

II. Pupil horizontal.

A. Palatine teeth in long transverse series.

a. Præcoracoids ossified; tips of fingers and toes dilated.

α. Fingers and toes free.

5. *Mantipus*, Peters, 1883.—Madagascar.
   1. *Hildebrandti*, Peters, 1883.

β. Fingers and toes webbed at the base.

6. *Platyhyla*, Blgr. 1889.—Madagascar.
   1. *grandis*, Blgr. 1889.
   2. *verrucosa*, Mocq. 1901.

b. Præcoracoids not ossified; tips of fingers and toes not dilated.

7. *Phrynocara*, Peters, 1883.—Madagascar.
   1. *tuberatum*, Peters, 1883.

B. Palatine teeth in one or two small groups or absent; præcoracoids ossified; tips of fingers and toes dilated.

a. Two small groups of palatine teeth.

8. *Platypelis*, Blgr. 1882.—Madagascar.
   1. *Cowanii*, Blgr. 1882.
   2. *pollicaris*, Blgr. 1888.

b. A single small group of teeth in the middle of the palate.

9. *Cophyla*, Bttgr. 1880.—Madagascar.
   1. *phyllodactyla*, Bttgr. 1880.

c. No teeth on the palate.

10. *Anodontohyla*, F. Müll. 1892.—Madagascar.
    1. *Boulengeri*, F. Müll. 1892.

EXPLANATION OF PLATE II.

Colpoglossus Brooksii, upper view, natural size. *a*, open mouth (× 2); *b*, lower view of hand (× 2); *c*, sternal apparatus (× $1\frac{1}{2}$).

IV.—*The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.*

I. *Introduction.* By Edward B. Poulton, D.Sc., M.A., Hon. LL.D. (Princeton), F.R.S., F.L.S., F.Z.S., F.G.S., President of the Entomological Society of London, Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

[Plate III.]

When, in June 1893, I was first placed in charge of the Hope Collections of the University of Oxford my attention was at once arrested by specimens of insects and other arthropods collected in South Africa about ninety years ago, and much larger numbers from Brazil with dates going back about three-quarters of a century. I was struck by the precision and detail of the data and by the existence of numbers which evidently referred to a diary. Three manuscript note-books were eventually found in the Hope Library, and these showed that the material had been collected by the great naturalist William John Burchell, truly described by Swainson as "one of the most learned and accomplished travellers of any age or country—whether we regard the extent of his acquirements in every branch of physical science or the range of the countries he has explored" ('Cabinet Cyclopædia' of Dionysius Lardner, vol. Taxidermy &c., Appendix, p. 383 : London, 1840).

The first necessity was to ascertain if the data were as accurate as they were full and elaborate. A single quotation from the Brazilian note-book throws much light upon this important question. From Oct. 6th to Nov. 16th, 1825, Burchell was upon an expedition into Minas Geraes from Rio de Janeiro. The following note refers to the beetles collected on four days towards the end of this journey :—

"All the Coleoptera of 3rd, 4th, 5th, and 6th have since been marked 4. 11. 25, as the different day's collections being mixed in one paper could not be distinguished. They were, however, all caught in forests or on the edge of forests. Some other Coleoptera caught on these same days, but which were put up in separate papers and marked, are properly distinguished by their labels, but those *certainly* of the 4th are marked 4. 11. 25, with the 4 underlined, and consist of only a few minute insects caught at night by the candle."

It is obvious that the man who wrote that note was a man to be trusted, and the immense numbers of his unpublished observations on natural history at once acquire the value of records by a trained naturalist with a fanatical love of truth for its own sake. Here, then, was the means of carrying back the detailed record of the occurrence of many thousands of species in two most interesting parts of the world, and to construct a trustworthy standard by which to measure the rate of future change; for one great justification of the immense funds which are expended on museums is that they will serve this very purpose for generations yet to come. The critical examination of the Burchell specimens proves that with ordinary care and the exclusion of light insects' pigments will endure for probably an indefinite period. Many of these specimens have not had ordinary care during a part of their history, the African collection being especially attacked by *Anthreni*, probably between 1825 and 1830, when Burchell was travelling in Brazil. But even upon the most fragmentary of these the patterns are still quite distinct and have undergone hardly any change.

The collection, combined with the manuscript notes on labels and in the note-books, furthermore supplies a great body of observations on habits, instincts, &c. which are still imperfectly known, and often altogether unknown. In many cases I find the records of interesting observations since made and published by others, such as the sound produced by the South-American butterfly, *Ageronia feronia*, described by Darwin in the "Voyage of the 'Beagle'" (London, 1876, pp. 33, 34), or the habits of the driver-ant (*Eciton*) and leaf-cutting ant (*Œcodoma*), described by Darwin, Belt, Bates, &c.

When I first began to arrange for the publication of an account of the Burchell Collections at Oxford it was intended to prepare an introductory memoir upon the life of the great naturalist himself; but this proved to be too extensive an undertaking for these pages, and it is hoped that the "Life" will appear as a separate work at no distant date. In the meantime a brief abstract of the chief facts which I have been able to bring together is set forth below as an introduction to the papers which will follow.

William John Burchell, the eldest son of a nurseryman at Fulham, was born about the year 1782. He received an excellent education, as is proved by the admirable style of his published works, the facility with which he wrote Latin, and the number of sciences with which he was intimately acquainted. His manuscript notes on South-African insects in the Hope Department are written on the blank sides of the pages of his French exercise-book—a history of Greece translated into French in 1794, when he was about twelve years old. Burchell was also an accomplished artist and musician. He must have had a remarkable constitution, for he enjoyed uninterrupted good health and vigour throughout his long and, with the exception of native attendants, solitary journeys. He laboured throughout the whole of the time with astonishing energy—collecting, observing, recording, sketching, and writing detailed journals. The details of his tragic end in his eightieth year also show that he possessed extraordinary resolution at that advanced age.

Burchell's features at about thirty-four years of age are preserved in a drawing made by J. S. Cotman in 1816, the year after the South-African travels had come to an end. The drawing was etched by Mrs. Dawson Turner, the grandmother of Sir Joseph Hooker. The portrait, of which there is a copy at Oxford, brings back to us Burchell in the full vigour of manhood. The face is highly intellectual and indicative of strong purpose and resolution, yet singularly attractive, even winning. The appreciation and description in his South-African travels of many a quaint incongruity shows that he possessed an ample fund of humour. His invariable breadth of view and justice are well seen in the calm discussion of the methods and results of missionary labours and his accounts of the shabby treatment he received from some of the Boers, in which he always warns the reader against coming to a too hasty conclusion as to the character of a whole people.

In 1805, when he was about twenty-three, Burchell was appointed "Schoolmaster and acting Botanist" at St. Helena by the East India Company, and he remained in the island for five years, until his departure for Cape Town in order to begin his South-African travels. He was elected a Fellow of the Linnean Society, Feb. 15, 1808. The romance of his life happened in St. Helena, and probably exerted a profound influence upon his character, explaining much that is difficult to understand, and especially the secretive barren period which followed his return from Brazil in 1830. His father had disapproved of Burchell's engagement to a lady in Fulham, and had, perhaps, obtained the appointment in St. Helena, hoping that everything might be forgotten. But the two still corresponded, and Burchell persuaded the lady to come out and join him in the island. During the voyage someone on the ship—it is said, the captain—fell in love with her and married her. Burchell had always been a naturalist and collector, but it is probable that the terrible shock drove him into these pursuits and away from companionship with his fellow-men, for consolation or, at any rate, oblivion. Natural history pursued in this spirit, especially when habits become fixed and deepened with advancing age, is only too likely to lead to the non-productive life of the recluse, poring for long years over his collections, jealously guarding them from the sight of others, and yet giving no account of them to the world.

We now enter on the next great period of his life, the five years (1810–1815) of splendid work in South Africa. The first part of his travels, discoveries, and observations are described in the classical 'Southern Africa' (vol. i. London, 1822, vol. ii. 1824), covering the period between his landing at Cape Town on Nov. 26, 1810, and his departure from Litakun on Aug. 3, 1812. The work contains a large and excellent map, showing the whole of his route. He had intended to follow up these volumes by a complete account of the whole journey, but this was never accomplished, and the manuscript of his journal and other materials from which it might be written have not yet been found. The fine collection of insects which he made in St. Helena and South Africa was almost destroyed by neglect, probably during his absence in Brazil (1825–30), but hundreds of species can be named from the fragments preserved in the Oxford Museum. The botanical collections, now at Kew, did not suffer in the same way, and are in excellent condition.

Burchell remained in England during the ten years which intervened between his South-African and Brazilian journeys. He sowed in his garden at Fulham hundreds of South-African seeds and some from St. Helena, keeping a careful record, now preserved at Kew, of the dates at which they came up. On Sept. 30th, 1817, he presented forty-three skins of South-African quadrupeds to the British Museum, and the neglect of these specimens, many of them unique, was the cause of his quarrel with that Institution ('Southern Africa,' vol. i. p. 383 &c., vol. ii. p. 336 &c.).

A letter to Sir William Hooker, dated March 31, 1819, shows the care he took to suggest appropriate names for the new species which he had discovered:—"I should mention that it was my practice when on my travels to give such specific names to my plants as the view of them in their native place of growth naturally suggested, without attending to their being new or not, which I had not always on the spot time to ascertain; but my object in thus naming them was that on my return to England I should find all the new species with more appropriate names than an inspection of the dried specimens in the herbarium might probably suggest to me." An examination of his Brazilian note-book proves that he adopted the same excellent method in his later travels.

In 1819 Burchell was called to give evidence before a Committee of the House of Commons on the question of emigration as a relief from pauperism. In his evidence, which occupied nearly three hours, he advocated the suitability of the Albany district in the easternmost part of Cape Colony. In a few days the Committee reported, and a grant of £50,000 was voted for this purpose. Burchell then amplified and published his evidence in a pamphlet, 'Hints on Emigration to the Cape of Good Hope' (London, Aug. 1819). This was savagely attacked in the 'Quarterly Review' for the following November, and Burchell replied in a sheet of four pages bound into the first volume of his 'Southern Africa.' Looking at the controversy from the standpoint of the present day, there can be no doubt that Burchell was entirely right and that the loyalty of the Grahamstown district, which has shone so conspicuously during recent years, is in large part the outcome of his wise advice.

More than all the work described above, the arrangement of his South-African collections and the preparation of the two volumes on South Africa occupied Burchell's time until he began to get ready for his next great journey.

Of the five years in Brazil very little is known, mainly because Burchell published nothing after his return. Hooker's 'Botanical Miscellany' (vol. ii. 1831, pp. 128–133) contains some very interesting extracts from his letters to Sir William Hooker, and the life of Burchell in the 'Dictionary of National Biography' (vol. vii. London, 1886, p. 290) also has an excellent short account of these travels.

Inasmuch as the Brazilian collections of insects &c. are far more extensive than the African, and are, considering their age and the vicissitudes through which they have passed, in excellent condition, the following papers will be chiefly concerned with them, and it becomes of the utmost importance to show the exact route traversed by Burchell. This is clearly shown by the map on the accompanying Plate III., prepared from the data obtained by Miss Cora B. Sanders, of Lady Margaret Hall, Oxford. The data were gained by a careful study of Burchell's manuscript note-books at Oxford, and especially the Index to the Localities of the Plants and Insects. Miss Sanders was able to find many of the names which have disappeared from modern atlases by an examination of the older maps of Brazil in the possession of the Royal Geographical Society. The numerous smaller villages, halting-places, streams, &c. mentioned in the manuscript note-books or upon the specimens themselves will always be described as between or near places which have been thus identified and are indicated upon the map. As regards Burchell's two expeditions from Rio de Janeiro into Minas Geraës and the Organ Mountains, hardly any of the places mentioned could be found; but it is clear from the time occupied and the account of the work done that he did not travel far.

Following the exact data which Burchell always records, we find that he left Fulham at 9.30 A.M. on March 10, 1825, and sailed from Portsmouth at 9 A.M. on March 15th. The main outlines of the journey are set forth below in a tabular form copied from a paper gummed into one of his manuscript note-books in the Hope Department, viz. "Index to the Localities of the Plants in the Brazilian Herbarium &c., serving also for the Localities for the Collection of Insects &c." The only modification of Burchell's original table is the insertion of the two expeditions from Rio in their proper positions in time, instead of placing them at the end, and thus putting the three separated periods in Rio itself in juxtaposition.

Place.	Dates.	Time.	
		Months.	Days.
Voyage	......	....	11
In Portugal	25. 3. 25 25. 5. 25	2	0
Voyage	......	....	5
Madeira..............	29. 5. 25	....	1
Voyage	......	....	2
Teneriffe	1. 6. 25	....	2
Voyage	......	1	16
Rio de Janeiro........	18. 7. 25 6. 10. 25		
Minas Geraës	6. 10. 25 16. 11. 25	1	4*
Rio de Janeiro........	16. 11. 25 5. 2. 26		
Organ Mountains......	6. 2. 26 2. 3. 26	....	27
Rio de Janeiro........	2. 3. 26 10. 9. 26	[total time spent in Rio] 11	16

* This number is given by Burchell. He probably deducted the days spent in travelling from and to Rio.

Place.	Dates.	Time.	
		Months.	Days.
Voyage from Rio	......	....	3
Santos	12. 9. 26 2. 12. 26	2	21
Cubatão..............	3. 12. 26 17. 1. 27	1	14
Travelling............	......	....	3
S. Paulo	20. 1. 27 24. 7. 27	6	4
Travelling............	25. 7. 27 2. 11. 27	3	8
Goyaz	3. 11. 27 21. 8. 28	9	18
Travelling............	22. 8. 28 13. 11. 28	2	22
Porto Real	14. 11. 28 27. 4. 29	5	13
Travelling (Tucantins) .	28. 4. 29 10. 6. 29	1	13
Pará	10. 6. 29 10. 2. 30	8	0
Voyage	......	1	15

Burchell landed at Dover on March 24th, 1830, and reached his home in Fulham on the following day.

The journey originally planned by Burchell was far more extensive. Thus he wrote to Sir William Hooker from Rio (July 8th, 1826) :—

". . . It is at least my *wish* to visit the city of S. Paulo, and thence by land through the provinces of Goyaz, Cuyaba, and Matto Grosso into Peru, having the city of Luzco as my principal object; and after doing in Peru as much as my time (for my family prefer my being in England) and slender means will allow me to do, I should wish to proceed by land to Arequipa, Potosí, Salta, &c., &c., to Buenos Ayres, and thence to my home at Fulham. . ."

A letter nearly two years later to the same friend explains the change. It is dated from Goyaz, April 25, 1828 :—

". . . I have kept my original plan always in view, and had advanced thus far on my way to Peru &c. when letters from Fulham overtook me, stating that my dear father's health, from the infirmities natural to his age, was gradually declining, and that it was his wish and that of the rest of the family that I should return directly to England. Whatever regret I may feel at thus relinquishing my American travels, and whatever disappointment I may experience from a premature return, I have no hesitation whatever in preferring filial duty to science and the gratification of my own inclinations. I have therefore greatly altered my plans, and instead of ending this journey at Beunos Ayres, shall, *Deo volente*, end it at Pará, where I shall embark for England."

Burchell was not destined to see his father again, for Matthew Burchell died soon after this letter was written, on July 12, 1828.

An excellent brief account of the Brazilian journey is given in a letter to Sir William Hooker, written from Burchell's home at Churchfield House, Fulham. Much of it is printed in 'Hooker's Botanical Miscellany' (vol. ii. 1831, pp. 128–133). The original letter, together with the others which have been made use of on the present occasion, are preserved in the Herbarium of the Royal Gardens at Kew. The letter is dated Nov. 1, 1830 :—

"I left England in March 1825, passed two months at Lisbon and in the vicinity : landed at Rio de Janeiro in July, where I continued making collections in botany, entomology, and geology, &c., till Sept. 1826, during which period I visited a part of Minas Geraës. While at Rio I made some drawings of landscape, among which was a panorama taken from a hill in the middle of the city ; many astronomical, philosophical, and geodetical observations. I finally quitted Rio in Sept. 1826, and proceeded by sea to Santos, where I remained three months, and then proceeded and took up my station in a solitary hut in the midst of forests at the foot of the great range of mountains, for the purpose of exploring them at leisure. My next station or headquarters was at the city of S. Paulo, nearly under the tropic of Capricorn, where I remained about seven months, extending my excursions in various directions. Having there purchased a troop of mules and engaged the requisite muleteers, I travelled northward, and finally took up my station at the city of Goyaz, being the first and only Englishman who has entered that province. There I passed the rainy season of 1827 and made large collections, being detained there nine months, owing chiefly to the difficulty of finding the means of conveyance for my baggage. At length, resuming the road and still continuing Northward, I reached in November 1828 Porto-Real, on the great river Tucantins. Here I remained till the proper season for embarking, and, descending the stream, at all times rendered dangerous by numerous rocky falls, rapids, and whirlpools, I made considerable collections on ground over which no scientific traveller had ever passed. I completed a survey of the whole length of this voyage, fixed by numerous astronomical observations. Finally, I arrived at the city of Pará in June 1829, and, while waiting till February for a convenient opportunity of embarking for England, added largely to my collections both in zoology and botany. Of this city I made a panorama, which, with that of Rio, I hope perhaps to succeed in getting engraved, together with my landscapes &c. Of insects I found from 16 to 20 thousand specimens (at a guess). Of birds I shot and preserved 362 species. In the other classes a proportionally smaller number. I am not aware of any part of my collections being lost, though I daily lament my inability to unpack them for want of room in the house. The space I require is large, and I have some hesitation in building on bishop's land, unless it were possible to enfranchise it. I fear I shall lose much time before I am comfortably settled: nothing is more distressing to me than thus to be forced to delay my labours in arranging my collections and rendering them useful to science. You, who are so great an example of industry, complain also of overwhelming collections, and feel the necessity of manual help. But I have nowhere beheld an herbarium so large as my own; and, added to this, I cannot bring my mind to abandon any branch of natural history for the sake of giving more time and attention to any one in particular; although I know this is wrong and can never lead to perfection in any. Still the contemplation of the whole system of created objects is so fascinating that it is very diffic[ult to] turn away from all but a few."

These latter sentences, together with the considerations mentioned on pages 47, 48, help us to understand Burchell's unproductive later years. Living secluded in the midst of his vast collections, he wandered from one point to another without the stimulus to work out any one part thoroughly which contact with his brother naturalists would have supplied. Furthermore, he belonged to that class of men, much rarer now than formerly, who value and gloat over collections as collections. His letters, even to his most intimate friends, such as Sir William Hooker, as well as many records preserved in his note-books, show that he jealously watched over the material of his collections, and indicate that he suffered much anxiety on this account. His will, which was proved for probate at under £4000, also shows that he was right in the contention that he could not afford to employ assistance in the skilled mechanical work which was required, while his almost too-scrupulous care and attention to detail must have consumed an immense amount of his time. Sir William Hooker had evidently urged him to employ a curator or librarian, for Burchell's letter of June 25th, 1835, contains the following passage:—"After the consumption of so much of my property by my travels and the disinterested pursuit of science all the rest of my life, the obtaining of assistance by payment is quite out of the question." Similar advice had been given and answered in the same sense five years before.

The degree of D.C.L. *Honoris Causa* was conferred upon Burchell by the University of Oxford on May 8th, 1834. Daubeny, the Professor of Botany, had given his inaugural address on May 1st, and the first lecture of his first course (on Vegetable Physiology) was delivered on May 8th. It seems probable that Burchell came to Oxford in order to be present, and that the occasion was selected for the conferment of the degree.

There is no doubt that Burchell expected a government pension and that he bitterly resented what he regarded as undeserved neglect. Hence, to the other causes which operated to prevent productive work, we must add the brooding melancholy and the bitterness of a disappointed man, the man with a grievance.

It is probable that he freely communicated his ideas on this subject to his friend Swainson, and that the attack on the government for neglect of Burchell was a result of their intimacy. These severe criticisms may be seen in Swainson's article quoted on page 45. The same article is probably responsible for exaggerated statements, which have been constantly repeated, as to the condition of his collections and the assertion that they were never unpacked. It was probably an extreme way of indicating the injury which science was receiving because Burchell remained unassisted. But it was certainly exaggerated. In the note-books at Oxford there is the record of the different dates at which he accomplished the setting of the various groups of Brazilian insects. Moreover, the beautifully written labels which nearly all specimens possess are very different from the hasty but distinctly legible notes made in the field. Many specimens still retain both labels, but generally the older ones have been discarded.

To this grievance was added the further sense of failure in that others were continually gaining credit for work which he had done but had not published. Thus he wrote to Sir William Hooker on Sept. 3, 1832 :—

"I am vexed almost to death at all my fine collections being thus shut up from me while I am daily losing portions of the only reward a traveller has—that of his discoveries. . . . . I trust that [in] future my work will make more show, at least to the world."

A few years later the same kind friend seems to have made a great and probably a final effort to induce Burchell to publish his results. Burchell's reply is dated June 25th, 1835 :—

"From the manner in which you express yourself with regard to my botanical collections you appear to be under very erroneous impressions, for to say that I '*will* not publish' is quite the opposite to what has ever been my intention, and the almost only pleasure I had in my travels to alleviate the excessive toil of forming them was the anticipating of the gratification of publishing them at my return to Europe, and of obtaining the satisfaction of being useful to science, and of securing the honor [spelt thus, according to his custom] due to my discoveries; and if I have been, and still am being, robbed of those honors by others, who, having less on their hands than I have, can run the publishing race with more expedition, I feel most sensibly the injury I sustain. Many circumstances have unfortunately concurred hitherto to tie up my hands, but I do and shall ever look to Natural History as a most delightful and congenial employment for my future years."

Probably owing to the combination of causes set forth above and their deepening effect as years went on, Burchell became more and more of a recluse, and kept his collections more and more from the sight of other naturalists. The climax was reached when he refused the request of his old friend to allow his son, Sir Joseph Hooker, to see the collection of St. Helena plants, in order to help in the production of a work upon the flora of that island.

Towards the end of his life Burchell must have come to realize that his methods could lead to nothing. He committed suicide on March 23rd, 1863, in his eightieth year. It is stated by C. J. Fèret, in 'Fulham Old and New' (London, 1900), that he "shot himself under the large cedar tree in front of Churchfield House. The wound not proving fatal, he terminated his existence by hanging himself in a small out-house at the back."

Burchell's collections were not specially mentioned in his will (dated March 2, 1841). Upon his death in 1863 they came into the possession of his sister, Miss Anna Burchell, who offered the whole of them to the University of Oxford in the following year upon the condition "that separate rooms shall be set apart for them, and that the whole be put out, set up, and systematically arranged, and be called 'The Burchell Collection' or presented to the Museum by Wm. J. Burchell, Esq., D.C.L." The Delegates of the Museum were unable to accept these conditions. A few months later Miss Burchell wrote (April 8, 1865) concerning "the collections in Zoology and Entomology," "I am still desirous, in accordance with what I believe to have been his [Dr. Burchell's] wish, of presenting the same to the University of Oxford." The only condition was "that the Collections should be distinguished as those of my late Brother." This offer was gratefully accepted, and in a few weeks the collections arrived. About the same time the immense Herbarium was offered by Miss Burchell to the Linnean Society, which was unable to accept it. A little later it was presented to the National Collection at Kew.

In drawing up this brief account of Burchell, as a preface to the description of his collections, I desire above all to acknowledge the kind help I have received from Miss Cora B. Sanders in the study of Burchell's manuscript at Kew and Oxford, and of his collections in the Hope Department. It has been already mentioned that the map forming Plate III. is entirely due to Miss Sanders's researches. I have also received the kindest assistance and encouragement from Sir Joseph Hooker and also the authorities of the Royal Gardens at Kew. The Delegates of the Oxford University Museum have kindly given me access to their correspondence and minute-books.

II. *On a new Stridulating-organ in Scorpions discovered by W. J. Burchell in Brazil in* 1828. By R. I. Pocock, F.Z.S.

[Plate IV.]

Up to the present time stridulating-organs are known with certainty to exist in three genera of scorpions, namely, the Oriental genus *Palamnæus*, the tropical African and Arabian genus *Pandinus*, and the South-African *Opisthophthalmus*, all belonging to the family Pandinidæ. The certainty in these cases lies in the fact that in both *Palamnæus* and *Opisthophthalmus* the hearing of the sound preceded the anatomical investigation which led to the discovery of the organ, and that in the species of *Pandinus* an organ exists exactly similar in structure to that of *Palamnæus*, although the rasp and the vibratile bristles occur upon different segments of the chelæ and legs of the first pair in the two genera. What is believed to be a stridulating-organ has also been found in certain South-African species of the genus *Parabuthus*, which belongs to a totally different family, namely, the Buthidæ. Unfortunately in this instance there is no proof, based upon human perception of the sound emitted by the living animal, that the function of the organ described has been correctly interpreted. The tenability of the supposition, however, is justified by the structure of the organ and by the distinctly audible stridulation it can be made to yield, when the appropriate movements, all capable of being performed by the animal itself, are induced by artificial means on a freshly killed or alcohol-preserved specimen.

In the Pandinidæ the stridulating-organs have been developed in connexion with the anterior appendages. In *Opisthophthalmus* it consists of large foliaceous bristles on the inner (preaxial) surface of the basal segment of the cheliceræ, and the sound given out by the rubbing of these appendages together is in many cases supplemented by the sound produced by the catching of certain short, erect, stiff bristles on the dorsal side of this segment against the anterior edge of the carapace as the appendages are forcibly withdrawn beneath it.

In *Pandinus* and *Palamnæus* it lies between the basal segments of the appendages of the third and fourth pairs, commonly called the chelæ and first pair of legs, and consists of a finely papillate area and an area beset with short erect bristles exactly like those that are found upon the upperside of the basal segment of the cheliceræ in *Opisthophthalmus* *.

In *Parabuthus* what is supposed to be a stridulating-organ is totally different both in structure and position. It is a finely granular or transversely ridged area upon the dorsal side of the first and second segments of the tail, possibly also upon that of the last tergal plate of the abdomen, and the stridulation above mentioned can be artificially produced by scraping the point of the sting over the roughened field in question †. A fairly similar but less differentiated system of granules, probably subserving the same end, is found upon the first segment of the tail in certain black North-African species of *Buthus*, namely, the Egyptian *B. bicolor* and the Algerian *B. æneas* ‡.

* See Pocock, Nat. Science, ix. pp. 17–25 (1896).

† Pocock, Proc. Zool. Soc., March 1902, pp. 222–224.

‡ Pocock, Ann. & Mag. Nat. Hist. (7) x. p. 374 (1902).

Apart from the legs, which are almost immovably welded by their basal segments to the sternal surface of the body, the chelicerae, chelae, and tail are, with one exception, the only organs in a scorpion susceptible of vigorous and rapid movement. The one exception is the pectines. It is in connexion with these appendages that the stridulating-organ now to be described has been discovered *.

In the course of a recent study of Burchell's manuscript 'Note-book of Brazilian Insects &c.,' Professor Poulton found the following record under the date December 3rd, 1828:—

"1274. *Scorpio* of a light redish [thus] brown. Legs and claws pale. Several of these were caught in my house. I found one feeding on a large blatta which it held close to its mouth with its claws. '*Lacráia*.' Makes a noise between a hiss and a whistle, v. J. 31. 12. 28, with its pectiniform appendages."

The word "*Lacráia*" evidently represents the native name of the species. Burchell always made a point of obtaining such names whenever possible, and took the greatest pains in writing them clearly and inserting accents. The reference "v. J. 31. 12. 28" apparently alludes to a Brazilian journal which has unfortunately not been found. It certainly did not reach either Oxford or Kew.

At once appreciating the interest and importance of the last sentence of the note, Prof. Poulton arranged for the collection to be searched for a scorpion bearing the number 1274. The specimen was soon found by Mr. W. Holland, and Prof. Poulton brought it to the Natural History Museum and asked me to determine it and to examine the pectines, to discover if possible the nature and situation of the stridulating-organ. This I undertook with the greatest pleasure, and with the result that the accuracy of Burchell's observation was substantiated to the full.

The specimen is a male and belongs to the Brazilian species that I described last year as *Rhopalurus Borellii*. Although dried, it is sufficiently well preserved to preclude all likelihood of error on this point; but without the relaxation or removal of the pectines the structure of the stridulating-organ could not be investigated. The examination necessary for this

* Reference may here be made to the suggestion of Landois ('Tierrstimmen,' pp. 22–23, 1874), that the pectines might be capable of emitting sounds by friction. This idea, however, was not supported by facts, and, except that the guess has now been verified, it is on a par with Wood-Mason's view that the prehensile teeth on the digits of the chelæ in Buthidæ might also be used for this purpose (Proc. Ent. Soc. London, 1877, p. xix).

purpose therefore was carried out upon the three spirit-preserved examples the Museum possesses, namely, the type, an adult female, an immature specimen of the same sex, and an adult but badly preserved male.

Although only described seven months ago, this species has been known to me for ten years. Briefly told, its history and that of its allies is as follows:—In 1893 * I pointed out that two American species of Buthidæ identified with the *Scorpio junceus* of Herbst and *Tityus agamemnon* of C. Koch differ from their allies in the structure of the pectines and of the first sternal plate of the abdomen. The pectines are unusually broad in their proximal half, and the overlying area of the sternal plate is depressed, the grooves which ordinarily pass forwards and inwards from the inner extremity of the stigma being exceptionally deep and lying nearer to the middle line, so that they define a narrow, smooth, triangular area, standing at a higher level than the depressed lateral portion already mentioned. On the strength of these structural features the genus *Heteroctenus* was established for these two species. It was also stated that *Heteroctenus junceus* differs from the form then referred to *H. agamemnon* in having the depressed area smooth instead of closely and finely but distinctly granular. Subsequently, as a result of the publication of Dr. Kraepelin's monograph † on the scorpions, it was found that these two species can scarcely be separated generically from the species described as *Rhopalurus laticauda* by Thorell and *R. princeps* by Karsch. Furthermore, the description given by Kraepelin, presumably from an examination of the type of *Tityus agamemnon,* proved my previous determination of *agamemnon* to be erroneous. I therefore redescribed the species so determined under the new name *Borellii* ‡, and at the same time attempted to show that the five species under discussion—namely, *junceus, laticauda, princeps, agamemnon,* and *Borellii*—possess certain characters in common of sufficient systematic value to justify their separation from the series forming the genus *Centruroides,* with which Kraepelin associated them, and to demand their recognition as a distinct genus for which the name *Rhopalurus* is available §.

The significance of the depressed sternal areas and of the expanded pectines in *R. Borellii* and *R. junceus* was always

* Journn. Linn. Soc., Zool. xxiv. p. 393.
† Das Tierr., Scorpiones et Pedipalpi, pp. 94-95 (1899).
‡ Ann. & Mag. Nat. Hist. (7) x. p. 375 (1902).
§ Biol. Centr.-Amer., Arachn. Scorp. p. 37 (1902).

a puzzle, and would probably have remained unsolved, so far at least as I was concerned, had it not been for Burchell's until now unpublished discovery of three-quarters of a century ago. Probably the absence of the granules on the depressed sternal area in *R. junceus*, suggesting as it did the secondary importance of their association with the sternal depressions and with the pectinal expansions in *R. Borellii*, coupled with the flexibility, comparative softness, and known sexual physiological significance of the pectines in these and all other scorpions, combined to conceal the true construction, which, thanks to Burchell's observation, is now known to be assignable to the features in question.

How, then, is the sound described by Burchell as "between a hiss and a whistle" produced? Without doubt by sweeping the pectines across the granular field on the overlying sternal plate (Pl. IV. fig. 2). When one of these organs is turned over it may be noticed that the teeth opposable to the granular area are not parallel-sided, as is normally the case in scorpions; the distal edge is sinuous, presenting towards the apex of the tooth a very decided bulge, which shows up as a slightly thickened area as it catches and reflects the light. When examined under a half-inch objective, or even a lower power, practically the entire face of the tooth, and especially the bulging area, is seen to be covered with a multitude of fine striæ lying parallel to the longitudinal axis of the tooth (Pl. IV. fig. 3). That the structural modifications of the teeth above described are directly connected with the depression and granulation of the sternum is shown by the absence of such modifications in the teeth at the distal end of the series which lie beyond the granular area and sweep clear of it with the movement of the pecten. No doubt the expansion of the shaft of the pecten in its proximal half is correlated with an increase in the size of its muscles and of the surfaces to which they are attached to add force to the sweep of the organ.

Except for the apparent absence of the granules, the sternal depressions in *R. junceus* closely resemble those of *R. Borellii*. I originally described these depressions as smooth; this is only true relatively speaking. No granulation is visible under a lens of low power, and no roughness is perceptible with a pin-point; but when scrutinized with a half-inch objective the entire surface of the depression is seen to be exceedingly minutely shagreened, so minutely as to suggest that the sound emitted must be much finer than that which the organ in *R. Borellii* gives out. Nor is this all the difference between the two species. The pectines in *R. junceus* are expanded exactly as in *R. Borellii*, and the distal edges of the teeth bulge in almost precisely the same way, but the differentiation of the striæ is carried to a greater extreme. Along the edge of each tooth there is a distinct series of small tubercular elevations, which are largest where they cross the thickened bulging area, becoming smaller both above and below it. These elevations are very distinctly striated, and the striæ appear to be practically restricted to them (Pl. IV. fig. 4).

In *R. laticauda*, Thor., the granules on the sternite are relatively as coarse as in *R. Borellii*, but the area is less depressed and less sharply differentiated both in front and towards the middle line than in that species. Also the posterior surfaces of the pectinal teeth are less visibly striated and the distal edges of those opposable to the granular area are straight and without the characteristic bulge so noticeable in *R. Borellii* and *R. junceus*. In all these features the organ in *R. laticauda* is less specialized than in the two species just mentioned.

The remaining species of *Rhopalurus* are unknown to me. Those who have had the opportunity of seeing and describing *R. princeps* have made no mention of any structural peculiarities in the pectines or in the first abdominal sternum. According to Kraepelin, who has seen the typical examples, however, this species is nearly related to *R. laticauda*. Hence it is permissible to suppose that it also possesses a stridulating-organ similar in its general features to the stridulator of that species. In the case of *R. agamemnon* the last-mentioned author states that the pectines are expanded and the sternum grooved and depressed as in *R. junceus*, but that the sternum differs from that of *R. junceus* in being distinctly granular on the *median* triangular area. This peculiarity, in which *R. agamemnon* holds a unique position in the genus, suggests that the median area in question constitutes an integral part of the stridulating-organ. Whether the depressed areas are granular or shagreened, or neither, is at present unknown.

Two other important facts connected with Burchell's observation remain to be mentioned. The first is the discovery of stridulating-scorpions in America: those in which sounding-organs are known or supposed to exist have hitherto been recorded from the Mediterranean, Oriental, and Ethiopian regions. The second is the announcement of the exact locality of *R. Borellii*. *R. princeps* occurs in Hayti, *R. junceus* in Cuba *, *R. laticauda* in Venezuela and Colombia, whereas the only examples of *R. agamemnon* and *R. Borellii* hitherto known are labelled "Brazil," without further particulars. Thanks, however, to Burchell, we are now aware that *R. Borellii* is found in the Province of Goyaz, in the upper valley of the Rio Tocantins or that of at least one of its tributaries. Burchell was at Porto Real (now Porto Nacional) when he made his note on specimen no. 1274. Burchell's collection also contains another specimen of the same species (a female) bearing a label "Body and legs redish. Between the boxes at our station at Sape. 15. 10. 28." Referring to the Index we find that Burchell gives "Sª Brigida" as his locality on Oct. 15, 1828. Sapé is mentioned on Oct. 14. The position is between Cavalcanti, his resting-place on Sept. 30th, and Conceição, which he reached on Oct. 18th, but apparently much nearer to the latter. A glance at Plate III. will show the positions of these two localities of *R. Borellii*.

So far as the function of the organ in these American Buthidæ is concerned, it need only be said that since it is equally well developed in both sexes, and occurs also in immature forms, there is no reason to suppose that it has any sexual significance. Hence, like the stridulating-organs of other scorpions and of the spiders of the family Aviculariidæ, its significance must be regarded as purely aposematic.

EXPLANATION OF PLATE IV.

Fig. 1. *Rhopalurus Borellii*, Poc., ♀, nat. size; drawn from typical example.

Fig. 2. Ditto. Ventral surface of anterior extremity of abdomen and of posterior extremity of cephalothorax, to show the granular areas on the first abdominal sternite, the pecten of the left side being removed.

Fig. 3. Ditto. Piece of the pecten seen from its dorsal side, to show the finely ridged stridulating area.

Fig. 4. *Rhopalurus junceus* (Herbst). Ditto.

V.—*Notes on* Depastrum cyathiforme, *Gosse*. By E. S. Russell.

[Plate V.]

M. Sars, in 1846, was the first to describe and figure this interesting little Lucernarian. He discovered it near Bergen and described it under the name of *Lucernaria cyathiformis*

* There are specimens in the British Museum labelled "Mexico" and "Brazil." These localities, however, require confirmation.

as follows :—" Semipollicaris, stipite disco circulari, repando sese affigente; corpore cyathiformi, margine dilatata, repanda circulari, integra (s. non in radios divisa) tentaculifera, tentaculis sæpissime in fasciculis 8 fere continuis, ad marginem corporis dispositis; organis generationis 8, binis approximatis" (Faun. lit. Norveg. no. 1, p. 26, tab. iii. figs. 8–13).

Shortly afterwards it was found in great abundance by Mr. David Landsborough, Jun., at Southend, Arran, and also by Dr. Landsborough at Corriegils, Arran. The specimens were identified by Mr. Joshua Alder as *Lucernaria cyathiformis*, Sars, and he sent a drawing to Mr. George Johnston, who, on the strength of this drawing, incorporated the species in his 'Hist. of Brit. Zoophytes,' vol. i. p. 475 (London, 1847).

Gosse (Synopsis Brit. Actiniæ, 1858) then founded the genus *Depastrum* for specimens which he found at Weymouth, which he regarded as identical with the *Lucernaria cyathiformis* of Sars. Next year some small specimens were found by Allman (Rep. Brit. Assoc. Aberdeen, 1859) in the Orkney Isles, which seem to have been immature specimens of *Depastrum cyathiforme*, Gosse. It does not appear to have been recorded at any other locality until found by Beaumont at Port Erin, Isle of Man ('Fauna of Liverpool Bay,' iv.: Liverpool, 1895). He mentions also a specimen from Plymouth.

In the month of July 1903 I rediscovered *Depastrum* on the shore at West Bennan, Southend, Arran; and in August, while at the Millport Biological Station, near the Lion Rock, Millport, and also near the old castle on the east side of Little Cumbrae. The animal seems to have a wide distribution, and I have no doubt that a careful search would reveal its presence in many localities from which it is hitherto unrecorded.

I found *Depastrum* in large numbers under stones at about half-tide, and also farther out. It adheres very firmly to the underside or occasionally round the edges of fairly large stones, so firmly that it has to be scraped off with a knife. It is very local in its distribution, but generally abundant where it does occur, though at one locality in Little Cumbrae I found only a few scattered individuals. It is difficult to account for its local distribution, but in my experience it is never found in muddy localities nor in spots where there is much decaying seaweed. It occurs well up the beach, and appears to be quite a hardy form. In Arran my largest specimens were got near low-water mark, but at Cumbrae large specimens occurred more plentifully halfway up the beach. In its natural conditions it is almost always pendent, being incapable of supporting itself with stalk extended and erect, on the upperside of a stone. When watched carefully in confinement it is seen to turn the widely expanded bell-like umbrella in different directions, as if searching for food. It appears to be quite incapable of refixing itself after having been dislodged from its resting-place.

The stalk is very contractile, as is also the rim of the umbrella. Four muscles, which extend up the tænioles (Pl. V., *tm.*), are the agents for contracting the stalk, while the margin is contracted by a circular muscle (*cm.*) which passes round outside the insertion of the tentacles, and in contracting pulls the margin well over the tentacles, leaving only a hole in the centre, through which the tips of some of the tentacles appear. I may here remark that it is only in partly contracted individuals that several rows of tentacles are seen; in fully expanded adult individuals there do not appear to be more than two rows. Haeckel, in his diagnosis of this species ('System der Medusen'), describes it as having the tentacles in several rows. Furthermore, none of my specimens reach the dimensions noted by Haeckel (8–10 mm. for length of stalk, length of umbrella, and breadth of umbrella), the largest I have seen having a stalk only 7 mm. long, while the usual size of good-sized specimens is 4 mm. for length of stalk, 6 mm. for height of bell, and 5–6 mm. for breadth of same. These specimens seemed mature, having well-developed gonads.

There appear to be two forms of the species among my specimens—one as figured, the other with a much sharper distinction between stalk and umbrella, and with the breadth of the umbrella as great as, or even greater than, the height of the umbrella. This latter seems to be the typical form, for Haeckel describes the umbrella as being almost as high as broad. The measurements of a medium-sized individual of this latter form are:—Length of stalk 3 mm.; height of umbrella 4 mm; breadth of umbrella 4·8 mm. The smallest specimen I possess measures respectively 1 mm., 1·1 mm., and 1·4 mm.

The sexes are distinct, but, so far as I can make out, indistinguishable in external appearance. The gonads are typically in four double rows, but I have a specimen with only three gonads and three lobes to the manubrium. Indeed, the animal is very variable, especially as regards the number of fascicles of secondary tentacles. The ova and spermatozoa are very minute and very numerous. I attempted five times in August to fertilize artificially, but failed each time, chiefly, I believe, on account of the immaturity of the spermatozoa.

In the stomach of *Depastrum* I have noted the remains of a small crustacean (probably a Copepod). When kept in confinement unattached to a stone they sometimes void a floccular mass, along with one or two phacellæ, which looks like a portion of the stomach epithelium. The tentacles also are apt to slough off. It is very difficult to kill them well expanded, but I have obtained good results by carefully narcotizing with 30 % alcohol.

VI.—*On a new Genus of Spiders from Bounty Island, with Remarks on a Species from New Zealand.* By H. R. Hogg, M.A., F.Z.S.

Professor Charles Chilton, of Canterbury College, Christchurch, New Zealand, kindly sent me recently some spiders obtained by Mr. L. Cockayne from the islands lying to the east and south-east of the New Zealand coast. Among these were some specimens found on the guano deposits of Bounty Island, situated about 9 degrees east of Dunedin (170° 30′ East longitude), between the better-known Antipodes and Chatham Islands.

The spiders belong to the family Agalenidæ, and the well-developed colulus, front spinnerets close together, inner margin of the falx-sheath toothed and sloping, with fringe of incurved bristles on the outer, the upright maxillæ, and square lip show them to belong to M. Simon's group Cybæeæ. Allied to the genus *Emmenomma*, Sim.*, this species differs too materially to be included therein, so that I have formed a new genus to receive it.

Pacificana, gen. nov.

Differs from *Emmenomma* in having the cephalic part of the cephalothorax convex and wide in front instead of not convex and slightly attenuate. The thoracic fovea quite short and shallow instead of long and deep. Rear row of eyes so recurved as to form an area as long as broad instead of about one half as long as broad. Two teeth on inferior

* The single species for which M. Simon formed his genus *Emmenomma* was found on the islands adjacent to Cape Horn (about 67° W. long.). The two localities are therefore separated by over 120 degrees of longitude.

margin of falx-sheath instead of three; three on superior margin. About five pectinations on superior tarsal claws instead of about nine.

The trochanters of all four pairs of legs are slightly but clearly hollowed on the underside. This, with the mandibular fringe and shape of lip and maxillæ, breaks down the last quotable distinction between the Agalenidæ, Pisauridæ, and Lycosidæ.

Pacificana Cockayni, sp. n.

The *colour* of the cephalothorax is dark brown, the cephalic part being bounded by a pale yellow marginal stripe. A similar pale yellow area extends round the thoracic part almost to the margin, where there is again a narrow streak of brown. The mandibles are dark brown. Lip and maxillæ paler brown, yellow on the outer edges of the latter. Sternum pale brown on each side, with a longitudinal central yellow streak. The legs and palpi are yellow, with brown rings, one near the anterior end of the femur, one on the patella, two on the tibia, two on the metatarsus, one at the anterior end of the tarsus. In the front pair the whole of the tarsus and metatarsus is brown. The abdomen on the upperside has a series of transverse scolloped stripes yellow and black alternately. The underside is greyish yellow.

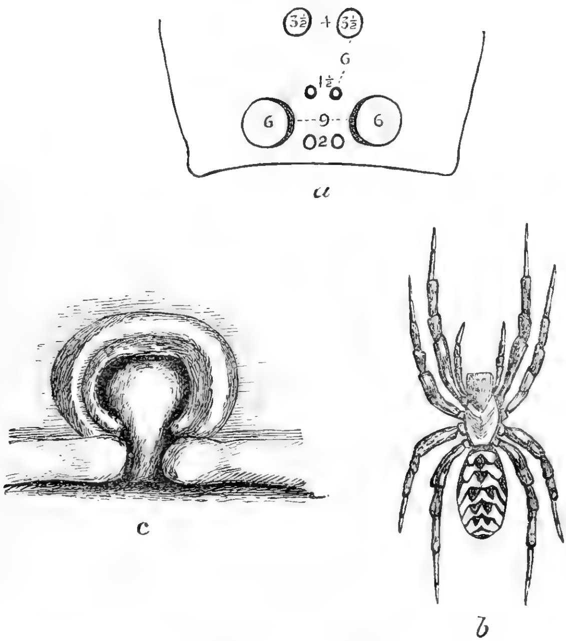
The shape of the *cephalothorax* is a long oval, truncate at the slightly narrowed anterior end. The cephalic part is considerably raised above the thoracic; a short, shallow, longitudinal fovea extends from behind the cephalic part to, but not down, the rear slope.

The pattern of the *eyes* is quite unique. The front laterals are large, one and a half diameters apart, and one third of their diameter from the margin of the clypeus. Four small intermediate eyes one fourth of the diameter of the above are situated between them at the corners of a trapezium, the rear pair, their diameter apart, slightly above the line joining the upper edges of the laterals; the lower pair, rather farther apart, are below the line touching the lower part of the laterals. The lateral eyes of the rear row, rather more than their diameter apart, are about three fifths the diameter of the front laterals and the diameter of the latter away from their own median. The small front median eyes are their diameter from the margin of the clypeus.

The *mandibles* are nearly twice as long as the front patellæ, much kneed at the base, and taper to the anterior end, the fangs being rather long, slightly curved, smooth for the first half and striated longitudinally the second. The falx-sheath is sloping and has two teeth on the inner margin near the upper end. There are three teeth below the fringe of bristles on the outer margin, the middle one being the largest.

The *maxillæ* are upright, convex, rounded in front, and broadest near the anterior end. The *lip* longer than broad, on a narrowed base, is rounded at the sides and broadly truncate in front.

Fig. 1.



Pacificana Cockayni.

a, eyes, × 10; *b*, spider, nat. size; *c*, epigyne, × 10.

The *sternum* is nearly twice as long as broad, truncate in front, and running to a point posteriorly.

The *abdomen* is oval, sparsely covered with short fine hairs.

The *spinnerets* two-jointed, tapering, the second joint quite short. The inferior pair close together, the colulus broad and long.

The *legs* are moderately stout, the metatarsal and tarsal joints tapering to a rather fine point. The superior tarsal claws have about five pectinations at the basal end only, the inferior claw being smooth. At the anterior end of the metatarsi is a ring of short incurved spines and four pairs of spines on the underside of the front two pairs. The tarsi are without spines.

There is a longitudinal seam along the front side of the coxæ, and the chitinous margin of the trochanters is slightly hollowed on the underside, the species in this respect, as in the mandibular fringe, approaching the Lycosidæ.

The measurements (♀) in millimetres are as follows:—

	Long.	Broad.
Cephalothorax....	$9\frac{1}{2}$	$3\frac{1}{2}$ in front.
		5
Abdomen........	12	$6\frac{1}{2}$
Mandibles	4	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs..............	1.	3	7	8	7	=	25
	2.	$2\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	6	=	$21\frac{1}{2}$
	3.	2	$6\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	=	$19\frac{1}{2}$
	4.	$2\frac{1}{2}$	7	8	7	=	$24\frac{1}{2}$
Palpi		$2\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{4}$	3	=	12

There are one male (unfortunately wanting a moult) and four females.

From Wanganui, North Island of New Zealand, Mr. W. Gray was so good as to send me two small pieces of moss-covered bark, each a few inches square. On my first examination I could see no reason of adequate interest to account for their having been sent so long a journey by post. It was only after careful search that I found the lids of no less than five nests of a little *Migas* spider, apparently that first described by L. Koch, *M. paradoxus*.

The doors of the nests fitted so closely, and, although composed of woven felt, so exactly resembled the adjoining bark and lichen as to be quite invisible on a casual inspection. The occupant of one nest had come out and was unhappily crushed, but the other four nests contained live females, one in each. The nests are little silken sacs wedged between interstices of the bark, about $\frac{3}{4}$ inch in depth and $\frac{3}{8}$ inch across the opening.

In the collection made by the 'Challenger' expedition, recently returned to the British Museum (Natural History) after a prolonged absence, is another specimen from Wellington, evidently the same.

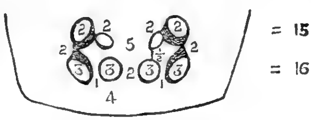
The legs in all the specimens are rather longer in proportion to the cephalothorax than the measurements given by L. Koch, but they agree closely otherwise with his description of his type specimen from Auckland, and I have no reason to doubt their being the same, more especially as the legs are normally carried closely bent up and are not easy to measure.

As in all this group, the tarsi and metatarsi of the front two pairs of legs are flattened and abnormally short. The metatarsi are furnished with a double row of stout curved spines on the underside (in my paper, Proc. Zool. Soc. Lond. 1901, ii. p. 229, by a misprint this character is ascribed to metatarsus iv.).

The superior tarsal claws have one long pectination, with a few uneven rugations on either side.

The front row of eyes is straight, the rear row is slightly recurved.

Fig. 2.



a

b

Migas paradoxus, L. Koch.

a, eyes, × 10; *b*, profile, nat. size.

The cephalothorax and mandibles are yellow-brown; sternum, lip, and maxillæ yellow; abdomen black and rather rugose above, dark yellowish grey below. The space in front of the genital aperture and spinnerets yellow.

The strongly recurved cephalic fovea and rather profuse bespining of lip and maxillæ (in female) are marked features.

I append measurements (in mm.) of one of Mr. Gray's specimens, apparently adult, and of the still larger 'Challenger' specimen:—

Specimen from nest (*W. Gray*).

	Long.	Broad.
Cephalothorax....	$3\frac{1}{2}$	$2\frac{1}{2}$ in front.
		$3\frac{1}{4}$
Abdomen........	4	3
Mandibles	$\frac{1}{2}$ hor^{y}.	2 vert^{y}.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$1\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{4}$	=	$10\frac{3}{4}$
	2.	$1\frac{1}{4}$	$3\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{1}{4}$	=	10
	3.	1	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$	=	$8\frac{1}{4}$
	4.	$1\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$	=	11
Palpi		$1\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{3}{4}$	1	=	$6\frac{3}{4}$

'Challenger' Expedition specimen.

	Long.	Broad.
Cephalothorax	5	$3\frac{1}{2}$ in front. $4\frac{1}{2}$
Abdomen	6	$4\frac{1}{2}$
Mandibles	$\frac{3}{4}$ hor^y.	$3\frac{1}{2}$ vert^y.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	2	5	$4\frac{1}{2}$	3	=	$14\frac{1}{2}$
	2.	$1\frac{3}{4}$	$4\frac{1}{2}$	4	$2\frac{1}{2}$	=	$12\frac{3}{4}$
	3.	$1\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	3	=	$11\frac{1}{2}$
	4.	2	$4\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$	=	$14\frac{1}{2}$
Palpi		$1\frac{3}{4}$	3	$2\frac{1}{2}$	$1\frac{1}{2}$	=	$8\frac{3}{4}$

Migas distinctus, Cambr., from the South Island, described as having a pattern of yellow spots on the back and having more widely separated eyes, will no doubt be distinct from the above; but Mr. Goyen's *Migas Sandageri*, from Mokohinou Islands, near Auckland, now that we know he means recurved by bent forward, would seem from his description to agree exactly with *M. paradoxus* of L. Koch. Mr. Goyen found the nests of *M. distinctus* in clay-banks; those of *M. paradoxus* and *M. Sandageri* are on the trunks of trees. It is interesting to note that M. Simon has found the nests of the allied South-African *Moggridgea* to be built both in the ground and on bark.

VII.—*On new Forms of* Anomalurus *and* Sciurus *from Tropical Africa.* By Harold Schwann.

An examination of some of the more recent African accessions to the British Museum collection which I have been enabled to make with Mr. Thomas's permission shows that the following forms require description.

Anomalurus Beecrofti argenteus, subsp. n.

General colour above silvery grey, more or less suffused with yellowish towards the middle line; basal portion of the hairs on the flanks darker than those on the body, producing an indistinct dark patch on the edge of the membrane; general colour of under surface dirty grey; throat strongly suffused with "orange-rufous," passing into pinkish buff on the stomach and hind limbs; head silvery grey, cheeks and lower jaw silvery white, a white patch on the crown between the ears and a white band running along the shoulders; underpart of forearms and sides of stomach dirty white; outer edge of membrane on upper surface behind forearms covered with stiff black hairs extending backwards for about 1½ inches; tail dirty grey.

Dimensions of the type (measured in skin):—

Head and body about 385 mm.; tail 139; hind foot (s. u.) 41.

Skull: greatest breadth 36; length of upper tooth-series 12·5.

Hab. Abutschi, River Niger, about 150 miles from the coast.

Type. B.M. no. 2. 11. 10. 7. Collected Feb. 1902 by A. J. Braham, Esq.

This subspecies differs very considerably from the type of *Anomalurus Beecrofti* from Fernando Po described by Fraser both in general colour and skull-measurements. The latter, however, in this group are so variable, even among members of the same species, as to be of little value. As an example two adult specimens, both undoubtedly *Anomalurus Beecrofti*, differed by as much as 1·5 mm. in the length of the upper tooth-series. In colour *A. B. argenteus* differs from *Anomalurus Beecrofti* in being of a light silvery grey on its upper surface instead of "yellowish grey." It is also much less suffused with rufous on its under surface.

Sciurus rufobrachiatus ruwenzorii, subsp. n.

Allied to *S. keniæ*, Neum.*, but with a certain amount of fulvous on its muzzle and feet and a pure white streak on the under surface.

General colour above "olivaceous," the hairs brown, speckled with "ochraceous," without the marked rufous suffusion found in *S. nyansæ*. Base of the hairs "slate-grey." Length of the underfur about 15 mm. and of the long hairs 25 mm. Under surface "creamy buff," not sharply defined, gradually passing into the "olivaceous" of the sides. Middle line of under surface with a sharply defined white streak about ½ inch broad extending from the inter-ramia to the inguinal region, its hairs white to their bases.

* SB. Ges. nat. Fr. Berlin, 1902, p. 176.

Top of muzzle dull fulvous, passing into "olivaceous" on the crown. Cheeks and upper surfaces of the feet and forearms grizzled yellowish. Hairs of tail annulated with black and buffy yellow.

Dimensions of the type (measured in the skin):—

Hind foot (s. u.) 51 mm.

Skull: greatest length 52; basilar length 40·5; greatest breadth 29·5; length of upper tooth-series 9.

Hab. Wimi Valley, Ruwenzori. Alt. 2400 m.

Type. Adult male. B.M. no. 95. 3. 5. 2. Collected 6th July, 1894, by G. F. Scott Elliot, Esq.

In colour this subspecies is intermediate between *S. r. nyansæ* and *S. keniæ*, having less fulvous on the muzzle and limbs than the former and more than the latter.

Sciurus rufobrachiatus pasha, subsp. n.

Fur hardly so thick or so long as that of *S. r. nyansæ*; length of long hairs on back about 21 mm. and of underfur 11. General colour above dark brownish, rather warmer than Ridgway's "bistre"; base of the hairs slaty black. Flanks distinctly lighter than back; base of hairs "slate-grey." Under surface very thinly covered with creamy-white hairs, interspersed with a few black ones. Difference in colour between flanks and belly unusually conspicuous, with the line of demarcation well defined. An indistinct white patch on throat and chest, hardly constituting a streak. Top of muzzle and round orbits dull orange-buff. Fore and hind feet and outer side of forearms rich "ochraceous rufous." Underside of thighs and lower limbs sparsely covered with whitish-buffy hairs. Tail like back for its basal two inches, the remainder annulated with black and dirty white.

Dimensions of the type (measured in the skin):—

Head and body 249 mm.; tail 234; hind foot (s. u.) 49.

Skull: greatest length (c.) 50; basilar length 39; greatest breadth 31·5; length of upper tooth-series 10.

Hab. Bellima, Monbuttu.

Type. Adult male. B.M. no. 87. 12. 1. 31. Collected 13th July, 1883, and presented by Dr. Emin Pasha.

This subspecies, allied to *S. r. nyansæ*, is more strongly suffused with rufous on the back and base of tail, while it is of a much lighter colour on the feet and belly. *S. kaffensis*, O. Neumann *, from the other side of the Nile, differs by "die schöne rostfarbene" annulation of the caudal hairs. It may be mentioned that an allied form from Southern Nigeria

* *Op. cit.* p. 57.

is also remarkable for the almost naked condition of its under surface, but is distinguishable by the absence of any rufous colour on the limbs.

The four members of the *S. rufobrachiatus* group found in Central and Central East Africa may be distinguished as follows :—

A. Fulvous or reddish on muzzle and feet.
  a. A marked white streak along under surface .... *S. r. ruwenzorii.*
  b. No white streak along under surface.
    a'. Underside of forearms and thighs deep rufous colour; belly well haired, dull buffy ...... *S. r. nyansæ.*
    b'. Underside of thighs with no rufous suffusion; belly thinly covered with whitish-grey hairs . *S. r. pasha.*
B. No fulvous colouring on feet or muzzle .... *S. keniæ.*

VIII.—*On new Species of* Lycænidæ *from Sierra Leone.* By D. Cator.

I feel pretty sure that the *Pseuderesiæ* here described are not the only new ones that I have lately discovered, but I await further material, which I hope to find before very long.

They need a deal of hunting, as their haunts are in shady places and they are most difficult to capture on the wing—firstly, because of their sombre colouring on the underside and the small amount of colour above, so that they can be seen only at intervals whilst flying; and, secondly, because if not taken at the first attempt they will not probably give another opportunity, as they easily take fright. If, however, they can be seen at rest they can easily be caught if they are not too high up, but they need much looking for; they rest on twigs and creepers bare of leaves, but, excepting one or two species, seem to be distinctly uncommon.

Pseuderesia Bakeriana, sp. n.

♂.—*Upperside.* Fore wings black, outer margin faintly scalloped, inner margin up to beyond vein 1 orange from near the base to beyond the middle: hind wings orange, with very broad black posterior borders decreasing rapidly towards costa. *Underside.* Both wings greyish black, hind wings rather the paler of the two: fore wings with red irrorations on the costa, a squarish red patch on the costa beyond the cell, which is confluent with the red irroration up to the posterior margin and which broadly occupies the whole of that margin; in this marginal red irroration is a short black macular stripe, lower part of cell and below vein 4 to inner margin spotless and paler: hind wings with three interrupted irregular transverse reddish stripes, bordering the third a broad blackish band, edged exteriorly by a band of fine reddish irrorations, beyond which is another dark band, followed again by fine reddish irrorations to the margin; fringes white, intersected with blackish.

♀. *Upperside.* Both wings orange: fore wings distinctly more rounded than in male; costal edge, base, cell and rather beyond irregularly black, apex very broadly, outer margin broadly black: hind wings like the male. *Underside.* Fore wings (with outline of pattern as above) orange, fading into yellowish on the inner margin; costa blackish, three dark spots in the cell and one larger beyond it; apex very broadly finely irrorated with reddish on a blackish ground; outer margin similarly irrorated, but less broadly: hind wings like the male, but paler and without reddish.

Exp. wings, ♂ 31–33, ♀ 30–32 mm.

I have much pleasure in naming this after my friend Mr. G. T. Bethune-Baker, who has assisted me so much in working out my captures. Found so far in March, April, May, and October, but probably flies from October to May, which covers the dry season in Sierra Leone.

Pseuderesia nigra, sp. n.

♂.—*Upperside.* Both wings entirely black, with white fringes tessellated with black. *Underside.* Fore wings black, shading into dark greyish on the inner margin; traces of three black spots in the cell, with a red one between the second and third; apex darkly spotted, in front of which is an oblique row of four red spots, two being below the apex and two on the posterior margin: hind wings grey, of a peculiar texture, the wing having the appearance of having been denuded of scales, with various black and red spots; the base of the wing is suffused with red, with a small black spot palely encircled below the costal vein near the base; in the cell are two black spots, palely edged, the small one at the base and the other large, directly below which is another large black one; on the costa is a large black patch reaching to the upper angle of the cell, beyond and touching which is a red irregular spot; transverse stripe from apex to inner margin very decided, composed of a black-spotted stripe edged externally by an equally decided red-spotted stripe, the two central spots in each being confluent and very large, margin spotted with a black lunular stripe; the ground has a suffusion of red beyond and below the cell; all the red spots are very bright, approaching vermilion.

♀.—*Upperside.* Both wings bright ochreous: fore wings with costa broadly dark brown, very broadly dark brown from the end of the cell and tapering down the posterior margin to the anal angle; cell with three spots in it and several below; ground-colour suffused with brown below the cell almost to the inner margin; fringes brown, intersected with white: hind wings with costa broadly brown, posterior margin very broadly dark brown, increasing in width from the apex to the inner margin, base suffused with brown; fringes intersected with white. *Underside.* Fore wings pale orange, base suffused with blackish; costa blackish, cell with three spots, increasing in size, and one below the cell touching the second and third cell-spots; apex as in the male, but the oblique orange spots are preceded by a very broad blackish band: hind wings ochreous grey, with pattern as in the male, only the red spots are replaced by orange ones.

Exp. wings, ♂ 34, ♀ 30 mm.

This species may prove to be a subspecies of *P. variegata*, S. & K., but it is a beautiful and striking form. Besides the types described above, I have one male with a small orange patch on the upperside of the fore wing. Caught in February and April.

Pseuderesia fusca, sp. n.

♂.—*Upperside.* Fore wings black, with white fringes intersected with black: hind wings black, with an orange-coloured costa increasing in width from the base to below the apex on the outer margin; fringes whitish, intersected finely with black. *Underside.* Fore wings dark grey, with a small black dash closing the cell and a small black spot at the origin of vein 2; beyond the cell a curved transverse row of small blackish spots, followed by a similar more obscure submarginal row: hind wings ochreous brown, with a small dark spot near the base below the costal vein, followed by three small oblique dark spots—one below the costa, one closing the cell, and one below the cell; beyond the cell is a transverse, fine, interrupted, blackish macular stripe from the costa to the internal vein, beyond which is the rather obscure posterior marginal row of blackish dots; margin finely dark.

♀.—*Upperside.* Both wings black: fore wings with a broad orange-yellow patch a third from the base on the inner margin to near the outer angle, extending obliquely across the wing to above vein 4, where it suddenly narrows and is inversely oblique to the costa : hind wings like those of the male, but not so dark. *Underside.* Ochreous grey, inner marginal area of fore wings yellowish ; pattern as in the male, but rather more distinct, owing to the lighter ground-colour.

Exp. wings, ♂ 27–29, ♀ 26–28 mm.

Liptena albicans, sp. n.

Upperside. Both wings white : fore wings with the costal half slightly tinged with cream-colour ; costa finely blackish (rather wider near the base), apical area rather broadly dark grey to black at extreme apex : hind wings with fringe cream-coloured. *Underside.* Both wings whitish, slightly cream-coloured : fore wings have costa to costal vein pale orange-yellow, continued finely to the apex; on the costa close to the apex are three dark dots or lines, which, however, are not always present; outer margin orange-yellow, edged internally finely with black, intersected at the veins as far as vein 3, the fringe of this part also being black, inner marginal area pure white: hind wings with the posterior margin very finely cream-coloured, edged internally by a fine black line; fringes whitish.

Exp. wings 29–31 mm.

This species is near *L. decipiens*, Kirby, but the underside of the wings has no trace of any marginal band at all. It very often flies high among the trees, settling occasionally, and not, as a rule, moving far away. Found in March, April, and June.

BIBLIOGRAPHICAL NOTICES.

Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History). Vol. III. By Eugene W. Oates and Capt. Savile G. Reid. London : Printed by Order of the Trustees of the British Museum. 1903.

The present volume contains brief descriptions of the eggs of 907 species, ranging from the Parrots to the Bulbuls (Pycnonotidæ).

Though the greater part of the book had been written by Mr. Oates, he was, owing to protracted ill-health, obliged to relinquish the work, a fact which we must all deplore. The Museum, however, is fortunate in having secured the services of Capt. Savile Reid for the completion of the remaining volumes.

No change has been made in the method of treatment, which, as we have already remarked, seems to us wanting in fulness and to miss a great opportunity for suggestive generalizations. Perchance Capt. Reid may be induced to give us a general summary on the study of oology in the last volume. Nowhere is the need for such a summary so well exemplified as in the case of the treatment of the eggs of the Common Cuckoo.

This volume is illustrated by ten coloured plates, remarkable for their extreme beauty. The selection of the figures has obviously been most carefully made.

The Geological Structure of Monzoni and Fassa. By Marie M. Ogilvie Gordon, D.Sc., Ph.D. 1902–03 [1903]. 8vo. 180 pages, with 14 photographs, 33 figures, 4 geological sections (black and white), 8 geological sections (coloured), 1 table of stratigraphical succession, 1 coloured geological map, and 1 reference contour and fault map. Edinburgh: Turnbull and Speers. London: Simpkin, Marshall, & Co.

This memoir is a "Special Part" of Vol. viii. of the 'Transactions of the Edinburgh Geological Society,' published in 1903. The date of "1902" on the titlepage refers to the year when it was *read* before the Royal Society, as stated in the *Prefatory Note.* According to the generally accepted bibliographical and nomenclatorial rules only the date of *publication* can be taken for the chronological status of a book. An abstract having been printed elsewhere, the Royal Society, by its rules, could not itself print the paper.

The Alpine Range, as a whole, is well known as a region that has been subjected to repeated movements; and, indeed, it cannot be positively said that the cracks in the rocks and their displacements are even now in a state of absolute equilibrium. In the South Tyrol the elevated areas of Triassic strata, rugged and precipitous, are characterized by more or less isolated, rudely columnar or sharply peaked mountains, which have long been objects of wonder to the tourist and of study to the Geologist. To the former it has attractions in its picturesque aspects; but, if his reflections reach farther and deeper than the common notions of mystery and romance among the bizarre cliffs, peaks, and gorges, he may well desire to know the "why and wherefore" of their real history and outcome. This country has for a long time been carefully examined by many Continental Geologists, to whose published observations and descriptions Miss Ogilvie (afterwards Mrs. Ogilvie Gordon) has referred in several papers. Attention had, however, been especially drawn to the fossils of Saint Cassian &c. Difficulties, however, were found in determining the relationships of the strata and the fossils. Of late years the lady-student above mentioned directed her energies to the elucidation of the doubts and difficulties which seemed hitherto to be beyond solution. Aided and guided especially by the advice of Baron von Richthofen among her Continental and of

Professor Lapworth among her British friends, Mrs. Ogilvie Gordon, D.Sc., Ph.D., entered more fully into her projected work in the Tyrol. After hard field-work, making important contributions to our knowledge of Alpine Geology, both as to the arrangement of strata and the occurrence of fossils, she completed in 1901 the excellent geological map which accompanies the paper before us. This brilliant and solid geological work has been steadily continued and improved by the same lady, as shown by her contributions to scientific periodicals *, with elaborate and trustworthy descriptions of the region in explanation of its complex structure.

In these researches Dr. Ogilvie Gordon has always kept in touch with the Continental Geologists working at the same problems.

The Triassic masses in this region consist largely of Dolomites; and these are said by the Author to be isolated by faults. Folded by many successive creeping movements of the Earth's crust, intersected by slip-faults and thrust-faults, they have also suffered much by local subsidences, and by repeated cross-faultings, with shear-planes and their crush-breccias.

The outlines of the mountains in some places have been likened to that of upraised coral-reefs; and, if really such, the dolomite condition would not be strange, for it is known that corals become dolomitized. Careful scrutiny, however, detects fossiliferous stratification in some of the dolomite masses, but whether due to shells or to beds (not reefs) of Coral on bases of calciferous Algals is not settled.

Both volcanic and deep-seated igneous rock-matter play important parts in the make-up and physical character of the country. The igneous magma has come up to the fissures of weakness in the various rocks, either to spread out on the top or to lose itself in the cross-cracks or in the side-planes and cleavage-lines. They take the Geologist far afield in his science in finding and explaining the origin, material, age, and mode of passage of the different veins, dykes, and sills. Some of the intrusions appear to have been of an age previous to the Triassic, some to have been contemporaneous with it, and some decidedly to be of later (Tertiary) date.

The following is given in a Table opposite page 19, in this "Special Part" of vol. viii. Trans. Geol. Soc. Edinburgh [1903], as the succession of the Triassic formations in the South Tyrol:—

UPPER TRIAS. About 370 mètres, in the vicinity of Fassa.	Dachstein Limestone or Dolomite. 320 mètres. Raibl Marls, &c. 50 mètres.

* Especially the 'Geological Magazine,' 1892, pp. 145, 147, and 381, 382; Quart. Journ. Geol. Soc. vol. xlix. 1893, pp. 1–77; Geol. Mag. 1894, pp. 1–10 and 50–60; Q. J. G. S. vol. lv. 1899, pp. 563–634; Geol. Mag. 1902, pp. 309–317; and, lastly, Trans. Edinb. Geol. Soc. 1903, vol. viii. "Special Part," pp. 1–179.

MIDDLE TRIAS. About 510 mètres.	Schlern Dolomite or Dolomitic Limestone (including at the base the Clpit Limestone). 350 mètres.
	Cassian Marls. Wengen Shales, Tuffs, &c. } 60 mètres.
	Buchenstein Limestones. 20–40 mètres.
	Mendola Limestone or Dolomite. 40–60 mètres.
LOWER TRIAS. About 500 mètres. (maximum).	Passage-beds. Crinoid Limestone, Oolites, and Rauchwackes. 60–90 mètres.
	Upper Werfen Marls and marly Limestone. *Naticella costata* zone. 100–160 mètres.
	Blue shales and marls. 35 mètres.
	Micaceous layers or Rauchwackes. 25 mètres.
	Lower Werfen. Red and grey marls and shales. *Pseudomonotis Clarai* zone. 130 mètres.
	Lingula tenuissima zone. 20 mètres.
	Poikilitic marls and limestone. *Natica gregaria* zone. 40 mètres.
PERMIAN. About 70 mètres.	*Bellerophon* Limestone, gypsum, &c.
	Gröden Sandstones, Quartzites, or Breccias.
	Quartz-porphyry.

It is indicated also in this Table:—That the Schlern, Cassian, and Wengen beds are equivalent to Salomon's "Marmolite Limestone." That the Mendola limestone and the Passage-beds are equivalent to Salomon's "Alpiner Muschelkalk." That "the Passage-beds are the age-equivalent of the uppermost horizons of the '*Myophoria beds*' or 'Reichenhall Limestone' in the North Tyrol and Bavaria-Roth horizon with salt, gypsum, &c." The Upper Werfen is equivalent to Richthofen's "Campil Strata" and the Lower Werfen to his "Seisser Strata."

The numerous fossils collected by the Author in the field, except the Wengen-Cassian fossils of Sella Pass (pages 26–28) were almost all from the Werfen series, and were identified for her by Dr. Broili, of Munich.

The igneous rocks received great attention from the Author in the field and have been carefully described, from her preparations, by Mr. Gibb, of Aberdeen; and to indicate the important part played by them in nature and described in this Memoir, we may with advantage quote the following from pages 29–30:—

"This paper therefore confirms the conclusion I previously formed when I investigated Enneberg and Buchenstein, viz., that the copious flows of augite-porphyrite, regarded as extrusive were in reality *intrusive*, and had been intruded pre-eminently into fault-planes and lines or horizons of weakness and crust-deformation. The previous investigators of Fassa Valley failed to recognise the presence of the innumerable crush-planes with extremely low hade, and the branch-connection of many of them with leading cross-faults, and consequently overlooked the correlation of the igneous invasions with pre-existent deformational structures.

"As the presence of igneous rock undergoing consolidation amidst the Triassic succession only served to still farther accentuate and concentrate the differential strains at special horizons of the crust, during the Tertiary movements the same crush-zones were again and again the seat of crush-movements, and were invaded afresh by molten material. In the immediate vicinity of the larger igneous masses, the sedimentary deposits tended to subside; thus the local horizontal crust-strains increased in intensity. During protracted periods of crush and deformation, the earlier intrusions suffered, together with the original thrust-masses and downslip-slices. They were cleaved and faulted, locally altered, sheared or fragmented just as their sedimentary roof and floor. Later dykes and veins ramified in them and in the environing sediments, and the direction of these later dykes often gives valuable evidence of the local horizontal crust-strains associated with continued local subsidences."

And at pages 13–14 of the Introduction it is conclusively stated that

"In the Fassa and Monzoni district there are the same evidences as in the Sella country of cross-folding and cross-thrusting. But now I furnish a mass of new evidence to show how greatly extended in time these movements were, how extremely complex their deformational effects, and how essentially the history of intermittent intercalations of igneous material was knit up with a long history of local subsidences taking place within the Periadriatic region of the Alps and producing effects which inevitably interfered with the movements of Alpine distribution."

MISCELLANEOUS.

A Correction to "Notes on some Medusæ from Japan." By R. Kirkpatrick, F.Z.S.

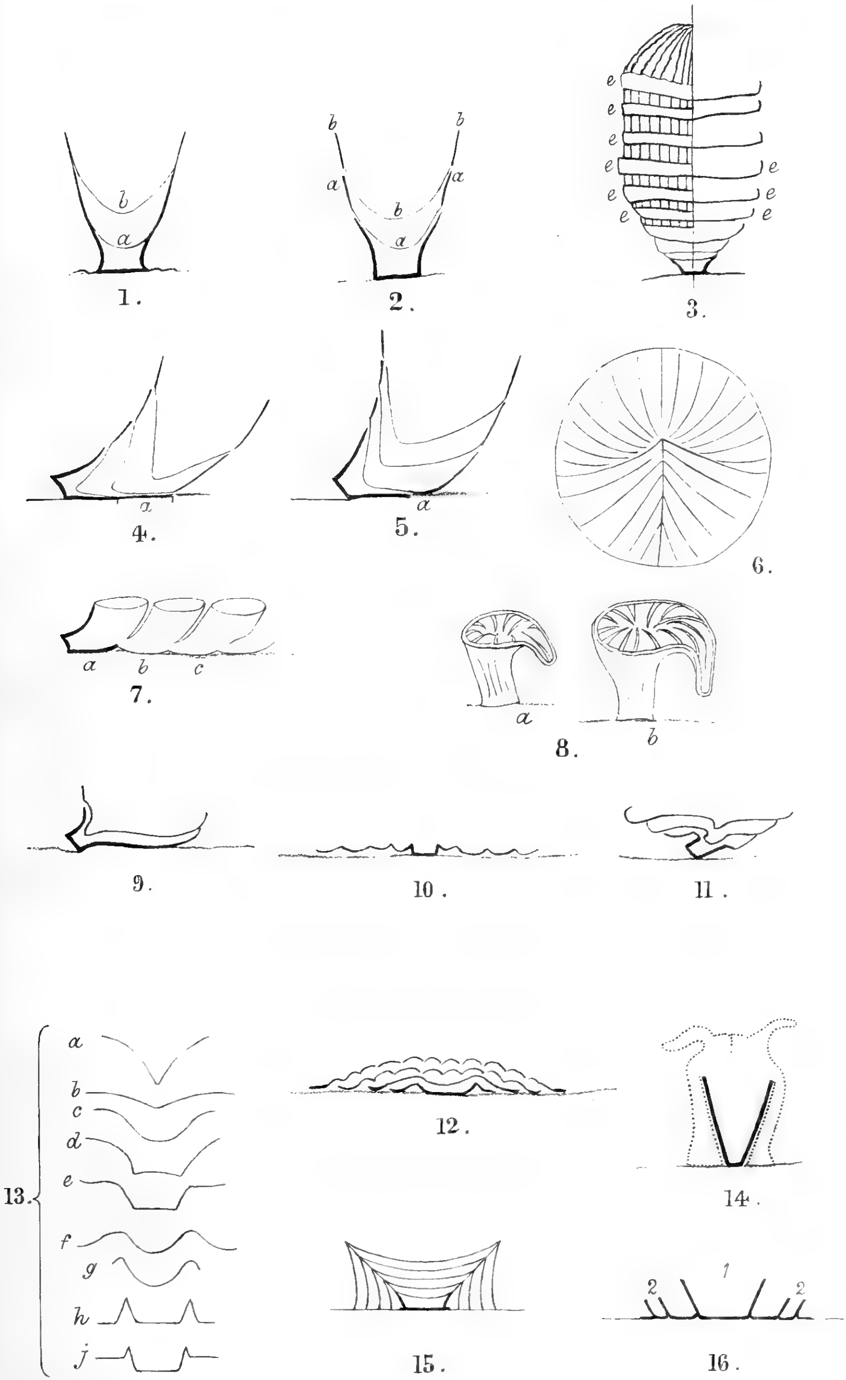
In a short paper entitled "Notes on some Medusæ from Japan," published in the 'Annals' for December 1903, I gave an account (p. 616) of a Medusa which I thought belonged to an undescribed genus and species, and to which I applied the names "*Gonomeandrus chrysostephanus*." This Medusa, however, was described and figured by Tilesius in 1818 (Mém. Acad. Sci. St. Pétersbourg, 1818, tom. vi. p. 554, pl. xviii.) under the name *Medusa saltatrix* (from Nagasaki).

Haeckel ('System der Medusen,' Zweiter Nachtrag, p. 636) places Tilesius's species under *Polyorchis*, though he had, in manuscript, referred it to a new genus, *Spirocodon*.

In 1886 Goette (Sitzungsber. Akad. Wiss. Berlin, 1886, xxxix. p. 832) refers this species to the genus *Spirocodon*, Haeckel, and places the latter in a new subfamily, *Spirocodontidæ*, between the subfamilies *Polyorchidæ* and *Berenicidæ* of the family *Cannotidæ*.

I am much indebted to Mr. E. T. Browne for suggesting that the specimen described by me was the *Medusa saltatrix* of Tilesius and for calling my attention to the above-mentioned references to the literature on the subject.

As there has been no figure of *Spirocodon saltatrix* since the "leidliche Abbildung" published by Tilesius in 1818, I trust that the carefully drawn figures of Mr. Highley, published in connexion with my notes, will prove of interest.



H.M.B. del.

Mintern Bros. lith.

THE PROTOTHECA OF THE MADREPORARIA.

J. Green del. et lith. Mintern Bros. imp.

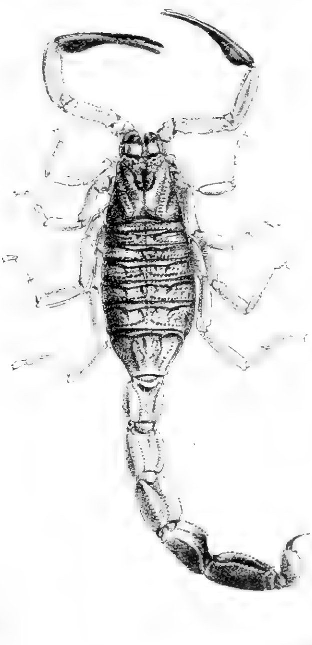
COLPOGLOSSUS BROOKSII.

W. J. BURCHELL'S TRAVELS IN BRAZIL 1825–30.

Rio July 1825 — Sept. 1826. Santos Sept. – Dec. 1826.
Porto Real Nov. 1828 – Apr. 1829. Pará June 1829 – Feb. 1830.

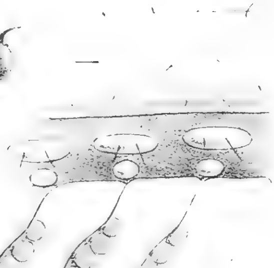
2.

1.



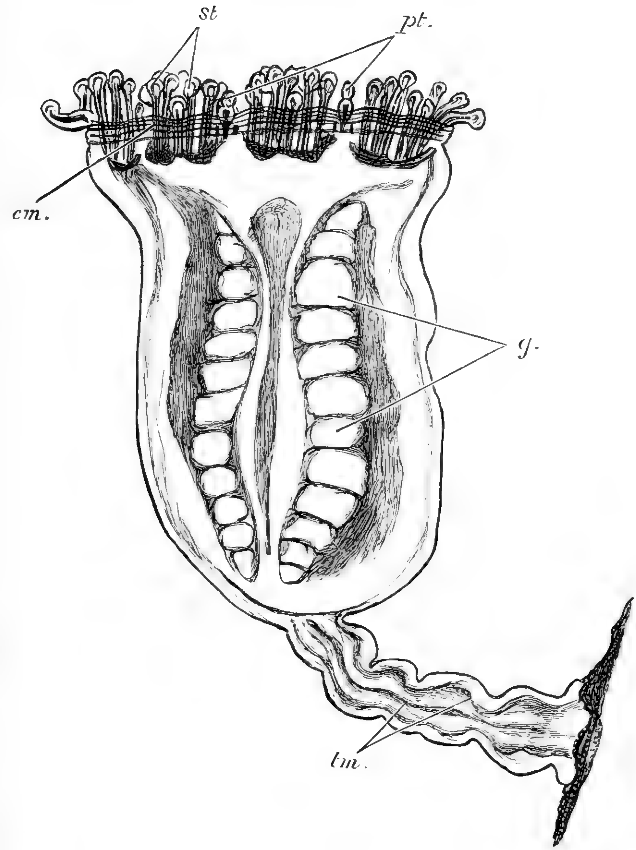
3.

4.



J. Green del. et lith.

Mintern Bros. imp.



DEPASTRUM CYATHIFORME, Gosse. ×15.

pt. Primary tentacles.
st. Secondary ,,
cm. Circular muscle.
tm. Muscles of tænioles.
g. Gonads.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 74. FEBRUARY 1904.

IX.—*Notes on* Mantidæ *in the Collection of the British Museum (Natural History), South Kensington, with Descriptions of new Species.* By W. F. Kirby, F.L.S., F.E.S.

The undescribed species of Mantidæ in the National Collection are not very numerous; but I here describe a series of interesting forms in advance of my 'Catalogue of Orthoptera.' It is proposed to include the Gressorial Orthoptera (Forficulidæ, Hemimeridæ, Blattidæ, Mantidæ, and Phasmidæ) in the first volume, leaving the Saltatorial groups (Gryllidæ, Phasgonuridæ, and Locustidæ) to be included in the second volume.

Mantidæ.

Eremiaphilinæ.

Genus Theopompa, Stål.

Theopompa Westwoodi, sp. n.

Exp. al. 75–102 mm.

Female.—Head pink, mouth-parts paler; eyes and ocelli very prominent; a strong transverse ridge on the face just below the antennæ.

Prothorax dark reddish brown above, sides and under surface paler; an angular projection on each side in front, though the prothorax attains its greatest width further back, at about one third of its length, after which it narrows gradually towards the extremity. Sides of mesothorax above and upper surface of metathorax and abdomen mostly black, or interalary spaces and base of abdomen pruinose blue; the under surface, the extreme tip of the abdomen, and the appendages pale.

Front legs bone-colour or pale flesh-colour, with most of the spines tipped with black; coxæ conspicuously pale and marked with two small black spots above; femora with the outer side longitudinally excavated and strongly granulated on the basal half, and edged below towards the tip with three strong spines; the inner surface edged with numerous spines; ridged in the middle and longitudinally excavated above; below the ridge a long black basal blotch runs nearly to the middle; beyond this the ridge is marked with an interrupted black line, and there is another rounded black blotch below it before the extremity. Middle and hind legs flesh-colour, spotted with darker.

Tegmina hyaline, with pink nervures on the costal and internal areas and on the disk; otherwise pink, varied with darker at the base, below the anterior radial, and along the other principal nervures; there are about six oblong spots on the basal third of the anterior radial, which is branched at its extremity; the upper branch of the posterior radial forms a short wide fork at the extremity, most distinct on the right side.

Wings brownish hyaline, darker towards the costa at the base, and the costal and apical areas varied with lighter and darker spaces; the branches of the anterior ulnar vein long.

The male is much smaller than the female and less pink, with the basal half of the wings brownish.

Hab. Ashanti; Tamsoo, Gold Coast.

Allied to *T. heterochroa*, Gerst., but larger, the wings lighter, more uniform in colour, and differently veined.

Genus Humbertiella, Sauss.

Humbertiella ocularis.

♀. *Humbertiella ocularis*, Sauss. Mém. Soc. Genève, xxiii. p. 16 (1872).

Exp. al. 46 mm.

Male.—Body and legs reddish above, testaceous beneath. Head and prothorax more or less varied with black above; legs spotted and streaked with black above, the black and testaceous markings forming long alternate streaks on the middle and hind tibiæ and tarsi.

Tegmina of a slightly yellowish hyaline; a row of oblong black spots along the mediastinal nervure, the rest (except the costal and internal areas) marked all over with round brown spots along the nervures. Wings brownish hyaline, with obsolete brown spots towards the tips.

Hab. Borneo.

Resembles *H. indica*, Sauss., ♂, but in that species the spots are much smaller, linear, and do not extend to the wings, and the abdomen is much darker above. It must also much resemble the male of *H. ceylonica*, Sauss.

Humbertiella (?) *Brunneri*, sp. n.

Entella Brunneri, Fruhstorfer, MS.

♂.—Long. corp. 21, exp. al. 25 mm.

♀.—Long. corp. 25, exp. al. 28 mm.

Clay-colour, more or less mottled with light brown; head and pronotum without conspicuous elevations; pronotum with the shoulders rounded off, but otherwise with the outline nearly as in *H. indica.*

Tegmina reddish, with yellowish nervures, frequently expanded, especially in the female, into indistinct spots; the subcostal nervure with a black line more or less broken into long spots. A large somewhat ill-defined pale stigma, bordered before and behind with blackish; the anal area and nearly the half of the lower and outer border almost transparent. Wings dark orange towards the base in the male, more reddish towards the costa; a broad smoky-brown border, intersected by white transverse nervures; above the fold the border is narrower, darker, and slightly edged with hyaline at the extreme apex of the wing. The female differs in the basal part of the wing being bright yellow, with no reddish shade.

Hab. Lombok.

This curious species seems to me to be more nearly related to *Humbertiella* than to *Entella* or to *Hapalomantis*, to which Westwood refers a Bornean species (*H. semirufula*), the female of which (Rev. Mant. pl. i. fig. 1) appears to be nearly related to our *Humbertiella Brunneri*, except that the extremity of the pronotum is distinctly narrowed in the figure.

Genus Pyrgomantis, Gerst.

Pyrgomantis Jonesi, sp. n.

Long. corp. 45, exp. al. 55 mm.

Male.—Yellowish brown or light brown (perhaps green during life); tegmina and wings with the costal area yellowish; smoky brown towards the base, with the transverse nervures mostly white below the middle; outer part of wings and tegmina smoky hyaline.

Hab. South Nigeria (*Dr. S. A. Jones*).

Resembles *P. singularis*, Gerst. (which I cannot distinguish from *P. nasuta*, Thunb. & Sauss.), but easily recognizable by the coloured wings and by the protuberance on the head, which is broader and more obtuse.

Chœradodinæ.

Genus Chœradodis, Gerv.

Chœradodis squilla.

Chœradodis squilla, Sauss. Mitth. schweiz. ent. Ges. iii. p. 72 (1871); Mém. Soc. Genève, xxi. p. 13, pl. iv. figs. 3, 3 *a* (1871).

Hab. Ceylon.

The insects figured by Westwood as *C. squilla* agree with *C. cancellata*, Fabr., as identified by Wood-Mason, and not with the former species.

Mantinæ.

Genus Hapalopeza, Stål.

Hapalopeza maculata, sp. n.

Long. corp. cum tegm. 20 mm.

Yellowish green (probably green during life); face with two round black spots below the ocelli, and two larger ones on the vertex; behind these, two, wider apart, being just within the eyes, and between these are two other small reddish spots, and low down on the occiput are two more black spots. Antennæ black, with the first and third joints pale. Pronotum greenish in the middle and reddish on the sides, with four large black spots, two on the widest part and two before these. Legs greenish, the knees, tips of spines, and tips of tibiæ and tarsi darker; front femora with two small reddish or brownish marks on the basal half.

Tegmina subhyaline, strongly iridescent, with the subcostal nervure reddish; the other nervures mostly brown.

Hab. Ceylon (*E. E. Green*).

Allied to *H. tigrina*, Westw., which is possibly not distinct from *H. nitens*, Sauss. Some specimens of *H. maculata* are more reddish and uniform in colour than that described, with the spots on the head much smaller and less distinct; but the four large spots on the pronotum and the two small spots on the front femora seem to be always constant.

Genus Carvilia, Stål.

Carvilia costalis, sp. n.

Mantis cincta, var. *a*, Gerst. Decken's Reisen in Ost-Afrika, iii. (2) pp. 14, 15 (1873).

Long. corp. 52, exp. al. 50 mm.

Female.—Tawny brown; head with the base of the labrum black, and a black oval transverse depression, on the lower edge of which the two upper ocelli stand; head transverse, twice as broad as the front of the prothorax.

Prothorax half as long again as the meso- and metathorax taken together; suddenly expanded above the anterior coxæ, the frontal lobe carinated and granulated above, and the whole length of the prothorax set with rather small teeth on the sides.

Abdomen expanded, colour darker than the rest of the body.

Front legs testaceous; coxæ granulated and denticulated behind, and edged in front with a row of about 15 small teeth, of which 4 or 5 are larger than the others, and are black beneath, except at the tips. Coxæ marked with three blackish bands above, and below with a spot at the base, and a large dusky space before the extremity. Femora with 3 strong teeth on the upper edge and about 12 on the lower, the latter black beneath. Tibiæ with about 14 spines, those towards the extremity black at the tips, and the terminal spine wholly black; on the upper and outer surface the femora are marked with three blackish bands.

All the tarsi blackish; middle and hind legs otherwise dull reddish, with no distinct markings.

Tegmina blue-black, with traces of a pale transverse band across the centre; costal area yellowish, and the apex and hind margin tawny brown; hind wings blue-black, the margins paler, and the costa narrowly reddish.

Hab. Abyssinia.

Gerstaecker may be right in treating this insect as a variety of his *M. cincta*, but it is very different in appearance from the typical form of that species.

Genus Sphendale, Stål.

Sphendale xanthoptera.

Mantis xanthoptera, Oliv. Enc. Méth. vii. p. 637. n. 61 (1792).
Mantis ochroptera, Licht. Trans. Linn. Soc. Lond. vi. p. 29. n. 29 (1802).
Mantis nympha, Stoll, Spectres, Mantes, p. 19, pl. i. fig. 22 (1813).

The locality of Stoll's specimen is given as Negapatam.

A female from Nepal, fairly agreeing with his figure, was ticketed *Mantis obscura*, Fabr., by Bates; but the type of the latter species is a male, and came from "Equatorial Africa" (probably Sierra Leone).

Sphendale robusta, sp. n.

Thespis robusta, Bates, MS.

Long. corp. 63, prothor. 17, exp. al. 39 mm.

Female.—Brown, front legs slightly marbled with black; tegmina unicolorous, except the internal area, which is blue-black, except at the base; wings with the costal area yellowish, with a black spot in the middle; otherwise light violet-brown, with white cross-nervures.

Hab. Nepal.

Closely allied to *S. xanthoptera*, Oliv., but the front coxæ and the sides of the prothorax are much more finely denticulated, the prothorax is slightly and the abdomen considerably broader, and the tegmina and wings are much more uniform in colour.

Genus Photina, Burm.

Photina gracilipes, n. n.

Cardioptera reticulata, Sauss. Mém. Mex., Mant. p. 196 (1871), nec Burm.

Hab. Para (?).

Saussure has enumerated two species under the name of *Cardioptera reticulata*, and Westwood has renamed Burmeister's species *Mantis Burmeisteri* (Rev. Mant. p. 15). But in such a case it is the second species, not the first, which requires another name.

Genus Leptocola, Gerst.

Leptocola gracillima.

Leptocola gracillima, Gerst. Mitth. Ver. Neu-Vorpommern, xiv. p. 92 (1883).

Euchomena Stanleyana, Westw. Rev. Mant. p. 33 (1889).

This curious species occurs in various parts of Western Africa, from the Cameroons to the Congo.

Vatinæ.

Genus Heterochæta, Westw.

(Arc. Ent. i. p. 161, pl. xli., 1845.)

Heterochæta orientalis, sp. n.

Long. corp. 115, long. pronot. 50, exp. al. 120 mm.

General colour reddish grey ; head deeply concave in front, semicircular, the vertex forming a narrow transverse carina, at least in the female, and the eyes curving outwards and forwards, very large, and ending in a large conical spine. Pronotum narrowed in front and strongly granulated, carinated, laterally serrated before the enlargement above the coxæ, which is moderate, and bordered by a narrow rounded ridge. Hind part of prothorax with a middle carina and distinctly raised at the extremity. Front coxæ minutely serrated above and very strongly and irregularly dentated below, but more strongly in the female than in the male. Two teeth near the base and one before the extremity are the largest. Middle and hind femora with small dentated lobes at the extremity beneath.

Tegmina varied with reddish, and subhyaline grey, the reddish colour increasing and becoming more uniform towards the extremity ; inner margin hyaline. Wings on the costal area almost hyaline, with transverse dark spots ; apex yellow, preceded by a large steel-blue blotch. The rest of the wing is clear subhyaline yellow, divided by narrow undulating steel-blue bands in the male, which are broader and anastomose in the female.

Hab. Luitpoldhette, East Africa (♂) ; German East Africa (♀) ; British East Africa (immature ♂).

It is probably this species to which Gerstaecker alludes (Mitth. Ver. Neu-Vorpomm. xiv. p. 94, 1883) as a variety of the very distinct West-African *H. tenuipes*, Westw.

Genus Pseudochæta, nov.

Allied to *Heterochæta*, Westw. ; eyes shorter, obtusely conical, and ending in a blunt point instead of a long spine ; ocelli very prominent ; middle and hind femora with rounded denticulated lateral lobes ; cerci jointed and laminated.

Pseudochæta Strachani, sp. n.

Long. corp. 114, prothor. 36, cercorum 8, exp. al. 103 mm.

Female.—Body and legs shining fawn-colour, the latter indistinctly mottled with darker; prothorax with the dorsal carina well marked; laterally denticulated throughout and slightly expanded above the front coxæ; front coxæ slightly curved, attenuated beyond the middle, and slightly expanded again before the extremity; dorsal and lateral carinæ finely denticulated, the front lateral carina with about 6 moderately large teeth; front femora half as long again, attenuated and distinctly curved beyond the middle, with long pale spines tipped with black, and the lower carina denticulated to the base; front tibiæ slender, not more than half as long as the femora, with only 6 spines on the outer carina, including the terminal one, but with a great number of curving spines on the inner carina, gradually increasing in length, and terminating in an immense curving hook about two fifths as long as the tibiæ. First joint of the tarsi slender, curved, about half as long as the tibiæ and two fifths longer than the remaining joints of the tarsi. Middle femora and tibiæ rather short (especially the femora) and attenuated in the middle; all the carinæ very finely denticulated; femora with an inner and tibiæ with an outer terminal spine. Hind femora and tibiæ long, rather slender, of nearly equal length, and all the carinæ very finely denticulated; femora with an inner terminal spine, tibiæ with an inner and outer one.

Tegmina subhyaline, clouded with fawn-colour on the costal half; wings subhyaline, clouded with pink along the costa, below which are several rows of light brown and subhyaline blotches, and towards the centre the wing is ornamented with large irregular spots and bands of lighter yellow and steel-blue.

Abdominal laminæ slightly narrowed at the base, otherwise uniformly broad, and obtuse at the ends.

Hab. Lagos (*Dr. Strachan*).

This very interesting species has a strong superficial resemblance to *Heterochæta orientalis* from East Africa, described above.

X.—*The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.*

III. *Rhipidocérides et Malacodermes recueillis par W. J. Burchell dans ses voyages en Afrique australe* (1810–1815) *et au Brésil* (1825–1830)*; avec la description de quatre espèces nouvelles.* Par J. BOURGEOIS.

I HAVE added to Mons. Bourgeois' memoir all the observations and data I can find recorded in Burchell's manuscript notes. Such additions are placed between square brackets. The numbers by which the specimens are brought into relation with the present series of papers are printed in heavy type, to distinguish them from Burchell's reference numbers.—E. B. POULTON, Dec. 9, 1903, Oxford.

RHIPIDOCERIDÆ.

RHIPIDOCERA, Latr.

1. *marginata,* Kirby, 1 ♂.—Brésil.

[No. 215. Sept. 15, 1825, Rio. Burchell went for an excursion on this day "along the Aqueduct (from Sta. Theresa to the ridge above the valley of Laranjeiros)," but the words in his "Notes of Brazilian insects" probably indicate that he captured the insect in the house at Rio. "*Lampyris.* Non lucet. Caught in my room; perhaps brought in with the plants."]

MALACODERMATA.

Lycidæ.

LYCUS, Fabr.

Lycus in sp.

2. *ampliatus,* Fåhr., 1 ♂.—Afrique australe.

[The specimen is numbered 82. The corresponding number in Burchell's manuscript "Catalogus systematicus Insectorum in Itinere per Africam australem extratropicam" proves that the insect was captured on March 12, 1814, "in plantis" at Wagenbooms River, north of Plettenberg Bay. Burchell was in much uncertainty as to the determination of the species. He gives the names "*rostratus* ¿, Fab.," with an inverted query, "*L. palliatus* ex verb. Lichtens[tein]." He also added the word "new" in pencil, and suggested the specific name "*scutatus*, B.," underlining it according to his custom. The specimen was also examined by Dr. W. E. Leach, of the British Museum, as is proved by a paper in his handwriting, dated by Burchell Nov. 28, 1818. This manuscript, which is bound into the "Catalogus," is a letter and list of the numbers upon over one hundred forms of Burchell's South-African insects, with determinations or such statements as "new," "unknown," "not described," "to be examined," &c. The letter speaks of other lists to follow "next week," but no more have yet been found. A postscript says "Do send me on Monday by post your names for the new species" [see above, pp. 48, 49]. In nearly fifty cases such suggested names were written by Burchell in Leach's list. No. 82 is stated to be "new or not described," and the name "*scutatus*" is written opposite to the number here as in the "Catalogus."

"1 Duplicate L." indicates that one specimen was given to Leach for the British Museum. The letters "? S. L." in the "Catalogus" indicate that Burchell thought, but was not sure, that the species 82 also occurred at Sierra Leone, to use his own words, "according to a small collection sent to the Horticultural Society, and which I saw at the Linnean Society, 2. 8. 22."

There are three other references to no. 82 in Burchell's handwriting:—

(1) A series of notes headed "The following notes are the result of a collation of the whole of my African collection of insects, with the Banksian Cabinet (now belonging to the Linnean Society), the greatest part of which is named in the handwriting of Fabricius. 1823 to 1824"; and then, apparently added later, "but I fear some labels had been misplaced." In this list we find "82. *Lycus rostratus* ¿. Specimina Banksiana sunt paulò minora."

(2) Another undated collation headed "The following Notes are the result of a collation of all my African insects with the figures in Olivier's 'Entomologie.'" Here we find "82. *Lycus latissimus*."

(3) The third reference is on a single sheet in Burchell's handwriting, headed "Remarks on my African Insects by Mr. Wm. McLeay, 1 April, 1824." McLeay's opinion, as recorded by Burchell, was "all the *Lyci* are distinct species."]

3. *palliatus*, F., var. *pallulatus*, Dalm., 1 ♂.—Afrique austr.

[No. 81. Nov. 18, 1813, Uitenhage, Cape Colony.]

Chlamydolycus, Bourg.

4–9. *Burchelli*, sp. n., 3 ♂, 3 ♀.—Afrique australe.

[All captured at Uitenhage, Cape Colony, Nov. 18, 1813.]

♂. Breviter ovatus, fere opacus, supra ochraceus, thoracis disco (limbo antico excepto), elytrorum regione scutellari, macula magna laterali ad expansionem elytrorum, sutura trienteque apicali nigris; subtus niger, nitidiusculus, abdominis lateribus ochraceis; rostro breviore quam in *L. elevato*; prothorace transverso, subtrapeziformi, basi longitudine fere duplo latiore, apicem versus parum attenuato, antice subrotundato, lateribus medio paululum coarctatis, medio longitudinaliter sat profunde sulcato, angulis posticis extus vix productis, apice retusis; elytris in dimidio anteriori singulatim in expansionem magnam, supra concavatam et valde reflexam, infra autem convexam et declivem rotundato-dilatatis, dein ad apicem singulatim rotundatis, fortiter reticulatis, intervallis reticuli grosse rugoso-punctatis, costis 2 parum elevatis instructis; abdominis segmento penultimo postice in medio paululum triangulariter inciso, ultimo (8°) elongato-triangulari, bivalvato, omnino nigro; pedibus nigris, trochanteribus femorumque basi (tertii paris præcipue) plus minusve rufescentibus.

Long. 10–13 mill.; lat. max. thorac. $2\frac{1}{2}$–4 mill.; lat. max. elytr. 8–11 mill.

♀. A mare differt elytris subparallelis, expansione elytrorum ad laminam elongatam, angustissimam, immaculatam redacta; abdominis segmento ultimo (7°) semilunato, integro.

Long. 10–14 mill.; lat. 6–8 mill.

Très voisin de *L. Poultoni*, Bourg. (Ann. Soc. ent. Fr. 1902, p. 739); en diffère surtout par la taille moindre, le rostre un peu plus court, le milieu de l'abdomen noir dans les deux sexes (chez *Poultoni* ♂ l'abdomen est entièrement ocracé) et par l'expansion humérale de la ♀ à peine marquée, réduite à une lame très peu saillante et allongée, d'où résultent, dans ce sexe, des élytres presque parallèles.

[The females are numbered 78 [**7**], 79 [**8**], and 80 [**9**]. The numbers in brackets are those of the specimens in the present paper. No. 78 was submitted to Leach and marked "not described," the name *oblongus*, B., being suggested by Burchell both here and in the "Catalogus," where "new" is written in pencil. In the Banksian Collation Burchell wrote opposite 78–80 "*L. proboscidens*? [Fab.] qui figuram habet elytrorum apice majus angustatam." In the Olivier Collation the same name is given to no. 80. The "Catalogus" mentions "5 duplicates" and a single "L.," indicating that one specimen was given to the British Museum.

The males are numbered 86 [**4**] and 87 [**5**], and one bears the date 18. 11. 13 [**6**] without a number. No information is to be found concerning these three specimens, except the locality and date and the fact that there were "4 duplic. L."]

Merolycus, Bourg.

10, 11. *rostratus*, L., 2 ♂.—Afr. austr. [Uitenhage, Cape Colony, Jan. 16, 1814.]

12. ——, var. *pyriformis*, Murray, 1 ♂.—Afr. austr.

[Burchell's no. 85 captured at the same date and locality as **10** and **11**. "Mares gaudent elytris latioribus.—Fœm. angustiorib. Vix volantem vidi. Hab. in floribus" (Catalogus). In the Banksian Collation Burchell wrote "85. *Lycus*. Similis colore formâ *Lyco rostrato* qui tamen abunde differt rostro, et elytris paulo majoribus."]

Calopteron, Guér.-Mén.

13. *tropicum*, L. (*fasciatum*, F.), var. humeris immaculatis, 1 ♀.—Brésil. [Porto Real (now Porto Nacional), March 3, 1829.]

Le type de l'espèce a les élytres tachées de jaune aux épaules et paraît plus spécialement répandu en Guyane; j'en ai vu cependant plusieurs exemplaires du Brésil.

14–17. *brasiliense*, Cast. (*sinuaticolle*, Luc.). Color. typic.: elytris fusco-nigris, macula humerali magna fasciaque lata transversa pone medium flavis; abdominis segmentis primis medio flavo-maculatis (Bourg. Comptes Rend. Soc. ent. Belg. 1879, p. xv). 1 ♂, 3 ♀.

[The male [**14**] bears the number 808, indicating capture, Oct. 22, 1825, on the excursion from Rio into Minas Geraës. The detailed locality is given as "In a Roça (about 4 miles S.S.W. of the house of Discoberto) on the road towards Nepomucena." The single specimen captured is named "*Lycus*." The dates and localities of the other specimens are respectively:—[**15**] Feb. 9, 1826, by the River Pacaqué, Organ Mountains; [**16**] Feb. 21, 1826, Organ Mountains; and [**17**] Jan.15, 1827, Cubatão, "given by Thomas Smith."]

18, 19. ——, var. *α*: elytris flavis, fascia dorsali interrupta apiceque late nigrescentibus (Bourg. *loc. supr. cit.* p. xvi). 2 ♀.—Brésil, Cubatão.

[**18**. Dec. 8, 1826. "Cubatão, at the Rio das Pedras at the Citio (where I resided) at the foot of the ascent up the great range of mountains."

19. Jan. 15, 1827. "At Rio das Pedras and Cubatão."]

20. *brasiliense*, var. γ: elytris fusco-nigris, fascia transversa obsoleta, sæpius interrupta pone medium flava, humeris vix flavescentibus; abdomine omnino nigro (Bourg. *loc. supr. cit.* p. xvi). 1 ♀.—Brésil.

[Nov. 2, 1825. Excursion into Minas Geraës, "at Francisco Manoel's."]

21. *serratum*, L., 1 ♀.—Brésil.

[The specimen bears the date "2?. 6. 29." On June 2, 1829, Burchell was at "Sitio das Pedras," on the Rio Tocantins, a little above Pará.]

22. *limbatum*, F., var. *affine*, Luc. (nec Taschenb.), 1 ♀.—Brésil, Cubatão.

[Dec. 8, 1826. See no. **18**.]

23. *sexvittatum*, Taschenb., Giebel's Zeits. 1874, p. 96. 1 ♂.—Brésil, Organ Mountains.

[Feb. 15, 1826. "Along the road 1½ mile S. of the house." Evidently near the River Pacaqué in the Organ Mountains.]

CELETES, Newm.

24. *Burchelli*, sp. n., 1 ♂.—Brésil, Cubatão.

♂. Elongatus, subparallelus, sat dense tenuiter pubescens, vix nitidus; capite brunneo, mandibulis palpisque testaceis, oculis maximis, valde prominentibus, nigris; fronte concavata; antennis brunneis, articulo secundo minimo, transverso, testaceo, sequentibus, a tertio inde, flabellum compressum, articulum ipsum longitudine multo superantem, a basi emittentibus, ultimo compresso, elongato-elliptico, præcedente duplo longiori; prothorace trapeziformi, parum transverso, antice attenuato, medio longitudinaliter carinato, ochraceo-flavo, disco fuscescente, margine antico medio angulato-lobato et utrinque sinuato, lateribus sat coarctatis, angulis anticis bene distinctis, posticis extrorsum valde productis, apice subacutis; scutello subquadrato; elytris basi latitudine thoracis, apicem versus paululum dilatatis, subparallelis, brunneis, humeris fasciaque transversa mediana ad marginem dilatata ochraceo-flavis, 4-costatis, costis 2 et 4 multo elevatioribus, intervallis costarum a clathris transversis quadrato-areolatis; corpore subtus brunneo, trochanteribus femorumque summa basi genubusque flavescentibus. Long. 6 mill.; lat. 2 mill.

[Captured at 10 P.M. on Dec. 18, 1826, between the "Middle Part of the ascent up the" Sierra da Cubatão and the "Upper Part" of the same ascent.]

PLATEROS, Bourg.

25. *apicalis*, Germ., 1 ex.—Brésil, Minas Geraës, near Nepomucena.

[Nov. 3–6, 1825. See above, page 45. On 3rd and 4th at Francisco Manoel's, 5th at João Alfonso's, 6th at Capitão Leite's. "On the 3rd took a stroll up the hill to a Roça and got many insects." "4th . . . . ascended the hill into the forest northward of our Rancho and took insects, till wet through in a thunder shower. In the evening caught some insects by the candle."]

26. *variicostatus*, sp. n., 1 ♀.—Brésil, Minas Geraës.

Subparallelus, supra fere planatus, subopacus, tenuissime pubescens, nigro-fuscus, prothorace antice et lateraliter sat late flavo-marginato, trapeziformi, basi longitudine paullo latiore, antice subrotundato, basi utrinque sinuato, lateribus fere rectis, angulis anticis sat bene distinctis, posticis extrorsum versus paulum prolongatis, subacutis, disco postice longitudinaliter canaliculato, antice carinulato; elytris 9-costatis, costis inæqualibus, alternis (præsertim 4, 6 et 8) magis elevatis, sexta a medio inde attenuata, intervallis costarum a clathris transversis punctato-areolatis; corpore subtus nitidiusculo, tenuiter pubescente, fusco, trochanteribus femorumque summa basi rufescentibus; abdominis segmento ultimo ogivali (♀).
Long. 7 mill.; lat. $2\frac{1}{2}$ mill.

Espèce voisine de *P. inæqualis*, Bourg. (Ann. Soc. ent. Fr. 1899, p. 99), mais de coloration différente.

[Oct. 23, 1825. "*Lampyris.*" At Discoberto, Minas Geraës.]

Lampyrididæ.

HYAS, Cast.

27. Sp.?, 1 ♀.—Brésil, Minas Geraës.

[Oct. 21, 1825. "*Lampyris.*" "In a rossa at Discoberto and along a channel (on the margin of the forest) which conducts water to the house."]

CLADODES, Solier.

28. *lamellicornis*, Mots., 1 ♂.—Brésil, Rio.

[Jan. 1, 1826. "Catéte and Práia de Flaméngo.]

ÆTHRA, Cast.

29. *maledicta*, Ern. Oliv., Ann. Soc. ent. Fr. 1888, p. 79 (*lateralis*, Cast., nec Guér.-Ménev.). 1 ♂.—Brésil, Cubatão.

[Dec. 9, 1826. "At Rio das Pédras; in the Forest."]

LUCIDOTA, Cast.

30. Sp.?, 1 ex.—Brésil, Minas Geraës.

["*Lampyris*." Oct. 25, 1825. "At Discoberto, near João Pedro's house."]

31. Sp.?, 1 ex.—Brésil, Minas Geraës.

["*Lampyris*." Oct. 16, 1825. On the previous day Burchell was "at the Discoberto do Antonio Velho."]

PHOTINUS, Cast.

32. Sp.?, 1 ex.—Brésil, Minas Geraës.

["*Lampyris*." Oct. 16, 1825. See no. **31**.]

33. Sp.?, 1 ex.—Brésil, Organ Mountains.

[Feb. 12, 1826. "By the River Pacaqué."]

34. Sp.?, 1 ex.—Brésil, S. Paulo.

[June 19, 1827.]

35, 36. Sp.?, 2 ex.—Brésil, Minas Geraës.

["*Lampyris*." Oct. 13, 1825. On Oct. 12 Burchell was at Parahíba.]

CRATOMORPHUS, Mots.

37-40. *giganteus*, Drury, 4 ex.—Brésil, Cubatão.

[1826 [**37**], Dec. 6, "at Mr. Eric Smith's sitio at Rio das Pédras"; [**38**] 7 P.M. Dec. 7th, probably the same locality; [**39, 40**] Dec. 10, "Rio das Pédras," 2 examples.]

41. ? *concolor*, Perty, 1 ex.—Brésil, Pará.

[Jan. 25, 1830.]

Aspidosoma, Cast.

42–52. *lineatum*, Schönh., 11 ex., dont l'un avec la mention manuscrite : "luce intermittente."—Brésil.

[The dates and localities of the specimens are as follows :—
42, 43. Dec. 29, 1825 (2 examples). From Rio de Janeiro to Catombí, Bárra Vermélha, and Rio Comprido.
44. Jan. 26, 1826. Rio de J. "A botanical and entomological excursion to the Bárra Vermélha, Morro de Ladeira, and Catombí."
45. April 19, 1829. Porto Reál (now Porto Nacional).
46. June 18, „ Pará.
47. Aug. 21, „ Pará, S. José.
48. Sept. 1, „ „ „ [arsenal).
49. Sept. 2, „ „ „ (between S. José and
50. Sept. 19, „ „ „
51. Nov. 14, „ „ „
52. Jan. 11, 1830. Pará. "Luce intermittente."]

53. ? *cassideum*, Mots., 1 ex.—Brésil.

[Pará, Jan. 21, 1830, 9 p.m.]

54. ? *impressipenne*, Mots., 1 ex.—Brésil.

[Feb. 11, 1826. Organ Mountains, "in a walk to the Ipé trees."]

55. Sp. ?—Brésil.

[Santos, Sept. 28, 1826, 7 p.m.]

56–61. *roseiceps*, Bourg., Revue d'Entom. 1884, p. 286 (décrit par erreur de Nouvelle-Calédonie).—Brésil, 6 ex.

[**56.** Jan. 1, 1826. Rio. Catéte and Práia de Flaméngo.
57. Sept. 20, 1826. Sántos. In the Forest above the Monastery of S. Bento. "*Lampyris*: the common sort flying in the evenings: and its larva, also giving fits of light." One of these larvæ [**57** a] captured by Burchell on the same day, Sept. 20, is also in the collection.
58, 59, 60. Sept. 28, 1826, 7 p.m. (3 examples). Sántos.
61. Nov. 26, 1826. Sántos.

57 A. Cette larve rappelle, par sa forme générale, celle de l'*Aspidosoma candelarium*, Reiche, décrite et figurée par Goureau dans les 'Annales de la Société entomologique de France,' 1845, pl. 7. ii. figs. 1–6; mais elle en diffère (autant, du moins, qu'il est permis d'en juger sur un exemplaire piqué et déjà vieux) par le premier arceau thoracique un peu plus allongé et plus atténué en avant, ainsi que par les 2[e] et 3[e] plus grands, sensiblement plus longs que les suivants. Les tubercules stigmatifères des côtés des segments abdominaux ne sont pas saillants comme dans la figure citée ci-dessus, mais cela tient sans doute à l'état de dessication de cette larve. Quant aux pattes, elles sont conformées de même, frangées de quelques soies à leur bord interne et terminées par un double crochet.—Long. 9 mill.; larg. max. 2½ mill.]

62. Sp.?—Brésil.

[Rio, aqueduct. March 12, 1826.]

63. Sp.?—Brésil, Minas Geraës.

[Oct. 25, 1825. At Discoberto, near João Pedro's house. "*Lampyris*?"]

LAMPYRIS, L.

64–66. Sp.?, 3 ♂.—Afrique australe. *L. conspicuæ*, Gyll., vicinus, sed scutello abdomineque flavis.

[No. 88 [**66**], "13 Duplic. L L," was captured at 7.30 P.M. on Oct. 6, 1814, at Nowsakamma River, Mossel Bay. "Abdominis pars alba lucem reddit. v. J." (Catalogus). The reference is evidently to an undiscovered Journal of South-African travel. Leach considered the species new, and Burchell suggested the name *uliginaria*, B., for it, but in his Banksian Collation doubtfully sets it down as "*Lampyris marginata* ¿."

No. 92 [**64**], "6. Dupl. L L," was captured at 8 P.M. on Oct. 3, 1814, at Sylvan Station, north of Georgetown. Leach considered it as possibly the same form as that figured by Olivier ("pl. i. f. 5 *b*?"), and Burchell suggested the name "*sylvatica*, B." In his Olivier Collation Burchell noted the same resemblance as follows:—"92. *Lampyris mauritanica* quoad figuram (Genus 28, Tab. i. fig. 5 *b*) sed fig. 5 *a* est valde diversa."

The third specimen [**65**] bears only the date 3. 10. 14 (when Burchell was at "Sylvan Station"), with the figure 7 and an imperfect letter, which probably indicates P.[M.].]

Amythetes, Illig.

67–71. *apicalis*, Germ., 5 ♂.—Brésil, Rio de J.

[Sept. 15, 1825. Along the Aqueduct (from Sta. Therésa to the ridge above the valley of Laranjeiros). Five specimens are mentioned in the "notes," with the following remarks:—"*Lampyris* (*Lycus*). Antennæ uno latere latissime pectinatæ nigræ. Elytr. rufescentia, apicibus nigris. Ex sylvaticis herbosis. Noctu valde lucens."]

72. Sp.?, 1 ♂.—Brésil, Pará.

[Dec. 15, 1829, 12 P.M.]

Megalophthalmus, Gray.

73–78. *ptiliniformis*, sp. n., 6 ♂.—Brésil, Pará.

♂. Oblongus, pallide fusco-griseus, flavido pubescens; capite fusco, mandibulis palpisque testaceis; oculis nigris; antennis articulo primo flavo, sequentibus infuscatis, ramulis pallidis, immaculatis; prothorace rugoso-punctato, transverso, trapezoidali, margine antico leviter rotundato, lateribus fere rectis, subparallelis, basi sat profunde bisinuata, angulis posticis leviter productis, disco infuscato, levissime carinulato, pone medium tuberculis 2 sat elevatis, glabris, nitidiusculis notato; elytris basi paulo dilutioribus, rugoso-punctatis, singulatim 3-costatis, costa prima pone medium evanescente; pectore flavo, abdomine nigro, segmentis ventralibus 5 et 6 albido-cereis; pedibus pallide fuscis.
Long. 5 mill.

Voisin de *M. obscurus*, Ern. Oliv. (Ann. Soc. ent. Fr. 1895, p. 146), dont il diffère surtout par la première côte élytrale abrégée postérieurement.

Je lui conserve le nom inédit sous lequel l'avait désigné Westwood.

[**73.** Dec. 28, 1829. Pará. This specimen bears a label in the handwriting of Professor Westwood, "*ptiliniformis*, Westw., sp. nov."

74, 75, 76. Jan. 11, 1830, 8 P.M. Pará (3 examples); two of these bear the number "1454," a reference number of which the meaning was contained in an "8vo (long) red-coloured volume" which did not reach Oxford. "This red vol. has not been found, J. O. W." is appended in pencil by Prof. Westwood to Burchell's allusion to it. The last entry in the "Brazilian notes" deals with the number 1345, for March 18th, 1829; so that the missing volume contains Burchell's recorded observations between this date and Feb. 10th, 1830, the day he sailed from Pará. The localities are fortunately preserved in the "Index."

77. Jan. 13, 1830, 8 P.M. "1454." Pará.

78. Jan. 24, 1830. "1454." Pará.]

Luciola, Cast.

79–82. Sp.?, 4 ♂.—Afrique australe. *L. caffræ*, Bohem., similis, sed major, pronoto dense reticulato-punctato, medio longitudinaliter late nigro-fasciato.

[Three specimens bear Burchell's nos. 89 [**80**], 90 [**81**], 91 [**82**], and were considered by Burchell to be the same as no. 88, viz. no. **66** of the present paper. They were captured with no. 88 at 7.30 P.M. on Oct. 6, 1814, at Nowsakamma River. The possibility of the accidental transposition of labels must, however, be borne in mind. The fourth specimen bears the no. 93 [**79**], and was captured at 8 P.M. Sept. 2 and 26, 1814, at Sylvan Station. "Vespere ad lucernam volabat. Elytra antennæ oculi et pedes nigra. Reliquæ partes pallide flavæ. 1 Duplic." Catalogus. The Banksian Collation contains the note "93. Lamp. aff. *Lamp. flabellico* in statura et forma, cui thorax fusco-niger."]

Photuris, Le Conte.

83. *mœsta*, Germ., 1 ♀.—Brésil, Minas Geraës.

[Oct. 28, 1825. In the Forest on the West and on the East side of S. João de Nĕpomucéna.]

84, 85. *fruticola*, Mots., 2 ex.—Brésil, Rio de J.

[**84.** March 16, 1826. In the upper part of the valley of Catombi, and along the road thence to Rio Comprido and Matto Porcos.

85. April 9, 1826. "*Lampyris.* About the middle of twilight, these begin to fly in great numbers about meadows and bushy places; they are not seen for more than about an hour."]

86, 87. *lineola*, Blanch., 2 ex.—Brésil.

[**86.** Dec. 9, 1826, 8 P.M. At Rio das Pedrás; in the Forest, Cubatão.

87. March 2, 1829. Porto Real (Nacional). The specimens are numbered 1334. The following notes refer to them:—

"1334. *Lampyris.* Probably the same species as 1330 [see below]. It is common here, in certain nights or states of the weather, and perhaps at least foretels fair weather for that night. Its light is at intervals, and only (as in all the genus) when flying. When taken it emits and withdraws its light much more rapidly; as [it] seems as if the effect of breathing, whereas in flying the light and dark intervals are both much longer (abt 5 seconds more or less). 2. 3. [29]."

Burchell had captured what he took to be the larva of *P. lineola* on March 1, 1829, in his garden at Porto Real. The following note refers to it. The specimen itself has not been found.

"1330. Larva of (*Lampyris?*). Caught in the garden crawling on the ground at night, and detected by means of a small spot of light at the head; but on being touched it instantly emitted a much stronger light from every part or joint of the abdomen which previously was quite dark. The light proceeded only from the underpart: the back was dark at all times. 1. 3. [29]."

The sudden increase of light which follows disturbance strongly supports A. R. Wallace's interpretation of the luminosity of glow-worms as aposematic.]

88. Sp.?, 1 ex.—Brésil, Minas Geraës. Sat magna, elongato-elliptica, prothorace flavo, elytris fusco-nigris, anguste (quadrante apicali excepto) albido-limbatis.

[Oct. 26, 1825. At Discoberto; near João Pedro's house. "*Lampyris*."]

Cantharididæ.

Chauliognathus, Hentz.

89–91. *fallax*, Germ., var., 3 ex.—Brésil, Minas Geraës.

[**89**. Oct. 22, 1825. "In a Roça (about 4 miles S.S.W. of the house of Discoberto) on the road towards Nepomucena. *Lampyris*."

90. Oct. 30, 1825. (In the forest) on the N.E. side of the arraial of São João de Nĕpomucéna.

91. Nov. 3–6, 1825. See no. **25**, p. 94.]

92. Sp.?, 1 ♂.—Brésil, S. Paulo. [Feb. 2, 1827.]

93. Sp.?, 1 ♀.—Brésil, Porto Real (Nacional).

[Jan. 11, 1829. "*Staphylinus*. Caught on the ground at the back door, probably where it was attracted by animal substances." This label may have been accidentally transposed.]

94. Sp.?, 1 ex.—Brésil, Porto Real. [Feb. 8, 1829. Boracão.]

95. Sp.?, 1 ex.—Brésil, Minas Geraës. [Nov. 3–6, 1825. See no. **25**, p. 94.]

96. Sp.?, 1 ex.—Brésil, Organ Mountains. [Feb. 18, 1826, 9 P.M.]

CANTHARIS, L.

97, 98. *viridescens*, F., 2 ex.—Afr. australe.

Le Catalogue de Münich indique par erreur *viridescens*, F., comme synonyme de *smaragdula*, F., espèce brésilienne qui a avec la première une certaine analogie de coloration, mais en est néanmoins bien distincte.

[Both these specimens bear a V, of which the meaning is as follows, in Burchell's words :—" Sent to me by Villet as Cape Insects, and were received at Fulham during my absence in Brazil " (Catalogus).]

99. *bivittata*, F., Syst. Eleuth. i. 1801, p. 302, 1 ex.—Afr. australe. (Omis au Catalogue de Münich.)

[No. 95. Captured Dec. 27, 1813, between Bethelsdorp and Uitenhage, Cape Colony, " in mimosa vtt [?]." Burchell puts only *Telephorus* in the Catalogus. In the Olivier Collation we find " 95. *Telephorus*?? similis *Lampyro vittatæ*."]

100. Sp.?, 1 ex.—Brésil, Minas Geraës. [Oct. 28, 1825. See no. **83**, p. 99.]

101, 102. Sp.?, 2 ex.—Brésil.

[**101.** Feb. 12, 1826. Organ Mountains. By the River Pacaqué.

102. Nov. 8, 1828, 10 P.M. Córrego Raiz. Between Chapáda and Porto Real (Nacional).]

DISCODON, Gorh.

Biol. Centr.-Amer., Coleop. iii. 2, p. 78.

103, 104. *cinctus*, Cast., 2 ex.—Brésil, Minas Geraës.

[**103.** Oct. 23, 1825. Discoberto. " *Lampyris*."
104. Nov. 1, 1825. Near Nepomucena.]

105. Sp.?—Brésil, Cubatão. [Foot of Sierra, Dec. 14, 1826, 9 P.M.]

106. Sp.?—Brésil, Organ Mountains. [Feb. 12, 1826. By the River Pacaqué.]

107. Sp.?—Brésil [Minas Geraës. Oct. 16, 1825. At Discoberto on 15th.]

108, 109. Sp.?, 2 ex.—Brésil [Organ Mountains. Feb. 12, 1826. River Pacaqué.]

Daiphron, Gorh.

Biol. Centr.-Amer., Coleop. iii. 2, p. 66.

110. Sp.?—Brésil [Minas Geraës. Oct. 14, 1825. At Parahíba on 12th. Discoberto on 15th. "*Lampyris.*"]

Melyrididæ.

Hedybius, Er.

111. ? *oculatus,* Thunb., 1 ♀.—Afr. austr.

[No. 96. "*Malachius.*" The origin of the specimen is given in the only other word in the Catalogus, viz. "Bouch." This indicates "From Mr. Bouchenroeder's collection at Cape Town (115 insects), of which perhaps some may not be African at all: and it would therefore not be safe to admit them without careful examination into my Cape Fauna."]

[The collection also contains two Lampyrid larvæ in addition to **57** A :—

112. July 11, 1827. S. Paulo. The specimen bears the number 1211, referring to the following note, which is accompanied by a slight sketch:—"1211. *Lampyris.* Two luminous spots on the same ring at the hinder part of the abdomen. It crawls with its feet, but assists with the tail by bending it under in the manner of some caterpillars, and resting the point on the ground as a fulcrum pushes on the body forwards. 11. 7. [27]."

113. July 26. Pará. The larva is numbered 1402, referring to a record in the lost note-book.]

XI.—*Rhynchotal Notes.*—XX. By W. L. Distant.

HETEROPTERA.

Fam. Capsidæ. (Part I.)

This paper represents the first results of a revision of the Capsidæ contained in the British Museum, and the examination of Walker's types. The arrangement is largely that of the earlier propositions of Reuter, with some qualifications which express my own views as to the classification of this very difficult family; and these will be more fully explained in my second volume dealing with the Rhynchota of British India, which is now passing through the press.

Division Herdoniaria.

Allied to the *Myrmecoraria*, Reut. Cuneus always discernible; head prominent, sometimes very large, always with a distinct longitudinal impression between the eyes; anterior constricted area of the pronotum somewhat broad and long, but never broader, and generally narrower, than the posterior area; second joint of the antennæ either very strongly or slightly apically incrassated; scutellum sometimes spined.

The genus *Herdonius*, Stål, I take as typical of the Herdoniaria, and also include the genera *Zacinthus*, Dist., *Zosippus*, Dist., *Xenetus*, Dist., and *Minytus*, Dist. *Saturniomiris*, Kirk., *Systellonotus*, *Allodapus*, and probably some other described genera may also ultimately be included.

Fulgentius, gen. nov.

Body subelongate. Head moderately large, distinctly longitudinally centrally incised; first joint of antennæ very little longer than head, second joint longest, somewhat thickened towards apex, third shorter than second but longer than fourth; rostrum imperfectly seen in carded specimen; pronotum moderately tumid, the lateral margins oblique, the anterior margin distinctly carinate, and transversely impressed before middle, anterior margin less than half the width of posterior margin, the last a little sinuate before scutellum, which is tumid; corium, including cuneus, about as long as abdomen; cuneus about as broad at base as long; membrane with a long basal cell; legs moderately long and slender; tibiæ somewhat longly setose.

Fulgentius mandarinus, sp. n.

Black; antennæ, eyes, legs, and membrane piceous; anterior margin of pronotum, first joint of antennæ (excluding apex and base of third joint) and apices of femora ochraceous; corium with a transverse fascia before middle and between clavus and lateral margin, and about basal half of cuneus, greyish white; body beneath black, imperfectly seen in carded specimen, but apparently with a greyish spot near posterior coxæ; body above very finely and obscurely pilose.

Long. 8 mm.

Hab. China; Namoa Islands (*J. J. Walker*, Brit. Mus.).

NICHOMACHUS, gen. nov.

Moderately elongate. Head broad, including eyes much wider than anterior margin of pronotum, narrowed and moderately deflexed in front of the prominent and exserted eyes, lateral margin sinuate, disk strongly longitudinally sulcate; antennæ with the first joint short, shorter than anteocular portion of head, second and third joints longest and subequal in length, fourth shorter but longer than first; rostrum reaching the posterior coxæ; pronotum strongly constricted at about one third from anterior margin, forming a distinct narrow anterior lobe, posterior lobe tumid, about twice as long and much broader than the anterior lobe; scutellum very strongly conically gibbous and longly though sparingly pilose; corium (excluding cuneus) a little shorter than the abdomen, its lateral margins sinuate, broadest at the area of the interior angle, cuneus longer than broad; membrane thickly and finely reticulate, with a single, narrow, short, lateral cell.

Allied to *Systellonotus*, from which it differs by the broader head, larger and exserted eyes, conically raised scutellum, &c. But for the longitudinally impressed head might be located in the Pilophoraria.

Nichomachus Sloggetti, sp. n.

Cinnamon-brown; eyes, scutellum, base and apical margin of corium, cuneus, disks of meso- and metasterna, and abdomen beneath black; an oblique transverse fascia in basal black area of corium, a transverse fascia to clavus beyond middle, and a basal fascia to cuneus white; antennæ (excluding basal joint), posterior lobe of pronotum, and apices of femora infuscated; membrane shining brownish ochraceous; two transverse subbasal fasciæ to abdomen beneath pale luteous; head and pronotum finely granulate; scutellum smooth, shining, sparingly longly pilose; clavus, corium, and cuneus finely and thickly punctate, shortly, obscurely, rigidly pilose.

Long. $5\frac{1}{2}$ mm.

Hab. Cape Colony; Deelfontein (*Col. Sloggett*, Brit. Mus.).

Division MIRARIA.

Genus EIONEUS.

Eioneus, Dist. Biol. Centr.-Amer., Rhynch. i. p. 416 (1893).

Eioneus lineatus.

Miris lineata, Butl. Proc. Zool. Soc. 1877, p. 89.

Hab. Galapagos Islands.

Genus MIRIS.

Miris ruficeps, sp. n.

Very pale ochraceous; first joint of antennæ and posterior femora and tibiæ thickly speckled with sanguineous; lateral margins of pronotum and a central line traversing pronotum and scutellum pale greyish; first and second joints of antennæ strongly pilose, first joint moderately incrassate, almost as long as head and pronotum together, second joint about twice as long as first; tibiæ thickly and rather longly pilose.

Long. 9 mm.

Hab. Cape Colony: Grahamstown (Brit. Mus.); British East Africa (*Gregory*, Brit. Mus.).

Genus CREONTIADES.

Creontiades, Dist. Biol. Centr.-Amer., Rhynch. ii. p. 237 (1883).
Kangra, Kirk. Tr. Ent. Soc. 1902, p. 257.

Creontiades stramineus.

Capsus stramineus, Walk. Cat. Het. vi. p. 120 (1873).
Kangra Dudgeoni, Kirk. Tr. Ent. Soc. 1902, p. 257.

Creontiades sinicus.

Capsus sinicus, Walk. Cat. Het. vi. p. 120 (1873).

Creontiades angulifer.

Capsus angulifer, Walk. Cat. Het. vi. p. 126 (1873).

Creontiades filicornis.

Capsus filicornis, Walk. Cat. Het. vi. p. 96. n. 161 (1873).
Megacœlum filicornis, Uhler, Check-list N.-Am. Hem. p. 18.

Head centrally longitudinally sulcated.

Creontiades incertus.

Capsus incertus, Walk. Cat. Het. vi. p. 111. n. 250 (1873).
Resthenia incertus, Atkins. Cat. Capsidæ, p. 58 (1890).

Genus PANTILIUS.

Pantilius australis.

Lopus australis, Walk. Cat. Het. vi. p. 57 (1873).

Head ochraceous, eyes fuscous; first joint of antennæ testaceous, second ochraceous, with its apical third black; pronotum pale greenish, its anterior area ochraceous, lateral margins and posterior angles purplish red; scutellum pale greenish, its basal margin and a central line ochraceous; clavus and corium mostly pale purplish red, apical area of clavus and lateral margins of corium pale greenish; cuneus ochraceous, its margins purplish red; membrane brownish ochraceous, the veins purplish red; body beneath and legs ochraceous; tibiæ pale greenish; apices of posterior femora, bases and apices of posterior tibiæ and the tarsi purplish red, apices of tarsi piceous; scutellum finely transversely striate, excepting on the basal margin and central linear fascia; corium a little widened from base and attenuated posteriorly; bases of apical margin of corium carinate.

Long. 10 mm.

Hab. New South Wales: Tasmania; Hobart (*J. J. Walker*, Brit. Mus.).

Genus ZANESSA.

Zanessa pictulifer.

Capsus pictulifer, Walk. Cat. Het. vi. p. 126 (1873).

Genus KOSMIOMIRIS.

Kosmiomiris lucidus.

Capsus lucidus, Walk. Cat. Het. vi. p. 124 (1873).
Kosmiomiris rubroornatus, Kirk. Tr. Ent. Soc. 1902, p. 253.

Note.—In this division *Miraria* and near the genus *Pantilius* I place *Pœas Reuteri*, Dist. (Biol. Centr.-Am., Rhyn. i. p. 428, tab. xxxvii. fig. 5),—head distinctly sulcated; and for the same reason *Jacchinus tabascoensis*, Dist. (*loc. cit.* p. 430, tab. xxxvii. fig. 10).

Division CYLAPARIA.

Valdasaria, Dist. Biol. Centr.-Amer., Rhynch. i. p. 242 (1883).
Monalonionaria, Reut. Ann. Soc. Ent. Fr. lxi. p. 398 (1892).
Eucerocoraria, Kirk. J. Bomb. Nat. Hist. Soc. 1902, p. 294.
Cylaparia, Kirk. Wien. ent. Zeit. xxii. p. 13 (1903).

The name of this division was originally founded on that of the neotropical genus *Valdasus*, Stål; this having since been proved to be but a synonym of *Cylapus*, Say, it is necessary to alter the divisional name as above.

ARGENIS, gen. nov.

Head broad, not horizontally produced in front of eyes, which touch but exceed the width of the anterior margin of the pronotum, distinctly longitudinally centrally impressed, or very finely sulcate; antennæ with the first joint longer than head, but shorter than pronotum, second joint almost twice as long as first, third joint about one third shorter than second; eyes large, globose; pronotum coarsely punctate, transversely constricted before middle, posterior lobe tumid, centrally very obscurely carinate, posterior angles subprominent and a little tuberculous; scutellum triangular, the apex somewhat acute; corium long, cuneus passing apex of abdomen; membrane somewhat small; body beneath obscurely seen, owing to typical specimen being carded.

Argenis incisuratus.

Capsus incisuratus, Walk. Cat. Het. vi. p. 121. n. 282 (1873).

Hab. Ceylon.

Walker's very inadequate description of this species contains the erroneous statement:—"Prothorax with no transverse furrow."

Genus SYSINAS.

Sysinas tibialis.

Capsus tibialis, Walk. Cat. Het. vi. p. 109. n. 245 (1873).
Resthenia tibialis, Atkins. Cat. Capsidæ, p. 61 (1890).

Genus Helopeltis.

Helopeltis clavifer.

Dulichius? clavifer, Walk. Cat. Het. iv. p. 170. n. 2 (1871).
Helopeltis braconiformis, Walk. *loc. cit.* vi. p. 165 (1873); Waterh. Tr. Ent. Soc. 1886, p. 459, pl. xi. fig. 4.

Division —— ?

Genus Disphinctus.

Disphinctus fasciatus.

Capsus fasciatus, Walk. Cat. Het. vi. p. 122. n. 284 (1873).
Disphinctus anadyomene, Kirk. Trans. Ent. Soc. 1902, p. 264.

Disphinctus politus.

Monalonion politum, Walk. Cat. Het. vi. p. 163. n. 7 (1873).
Disphinctus formosus, Kirk. Journ. Bomb. Nat. Hist. Soc. xiv. p. 295, pl. A. fig. 10 (1902).

Genus Hyalopeplus.

Hyalopeplus vitripennis.

Capsus vitripennis, Stål, Freg. Eug. Resa, Ins. p. 255 (1859).
Hyalopeplus vitripennis, Stål, Œfv. Vet.-Ak. Förh. 1870, p. 670.
Capsus lineifer, Walk. Cat. Het. vi. p. 122. n. 285 (1873).
Hyalopeplus lineifer, Kirk. Tr. Ent. Soc. 1902, p. 18.

Division Loparia.

Genus Resthenia.

Resthenia incisus.

Capsus incisus, Walk. Cat. Het. vi. p. 92. n. 151 (1873).

Resthenia jamaicensis.

Capsus jamaicensis, Walk. Cat. Het. vi. p. 101. n. 189 (1873).
Heterocoris jamaicensis, Atkins. Cat. Capsidæ, p. 42 (1890).

Genus Lopidea.

Lopidea floridana.

Capsus floridanus, Walk. Cat. Het. vi. p. 97. n. 163 (1873).
Lopidea marginata, Uhler, Proc. Calif. Ac. iv. p. 249 (1894).

Walker's description is faulty. The first joint of the antennæ is not "red," as described, but inclining to fuscous brown; the ochraceous lateral margin to the corium is also omitted in the diagnosis.

Genus Lomatopleura.

Lomatopleura coccineus.

Capsus coccineus, Walk. Cat. Het. vi. p. 93. n. 152 (1873).
Lomatopleura hesperus, Kirk. Trans. Ent. Soc. 1902, p. 252, pl. v. fig. 1.
? *Lomatopleura cæsar*, Reut. Œfv. Vet.-Ak. Förh. 1875, no. 9, p. 67.

Division Phytocoraria.

Capellanus, gen. nov.

Elongate; head subtriangular, moderately produced; antennæ with the basal joint short, about as long as head, second joint three times as long as first, third shorter than second; pronotum short, truncate at base; scutellum subtriangular; corium long and with cuneus about reaching apex of abdomen; posterior femora incrassated; cuneus longer than broad.

Allied to *Phytocoris*.

Capellanus sparsus.

Lygus sparsus, Dist. Biol. Centr.-Amer., Rhyn. i. p. 434, tab. xxxvii. fig. 19 (1893).

Hab. Guatemala (type, Brit. Mus.).

Genus Paracalocoris.

Paracalocoris sobrius.

Capsus sobrius, Walk. Cat. Het. vi. p. 115. n. 264 (1873).

Very pale ochraceous; two large obconical spots at the base of pronotum and the corium purplish brown; lateral margins of pronotum and corium, two small central spots on anterior disk of pronotum, and a rounded spot on corium near inner base of cuneus black; membrane pale fuliginous, cellular marginal veins purplish red; first joint of antennæ purplish brown, second and third joints black, base of third luteous.

Paracalocoris leprosus.

Capsus leprosus, Walk. Cat. Het. vi. p. 111. n. 253 (1873).

Paracalocoris sericeus.

Capsus sericeus, Walk. Cat. Het. vi. p. 117. n. 272 (1873).

Pronotum anteriorly thickly cinereously tomentose, containing two central piceous spots.

Paracalocoris capensis, sp. n.

Somewhat pale ochraceous; corium pale castaneous, its lateral margin ochraceous; cuneus ochraceous, its apex and basal and inner margins castaneous; membrane subhyaline, slightly tinged with pale fuliginous; body beneath, rostrum, and legs pale ochraceous; eyes, lateral margins of pronotal collar, two small rounded discal spots to pronotum, a lateral spot to mesosternum, and the apex of rostrum black; basal joint of antennæ purplish red, second joint ochraceous, its base black and its apical area purplish red (remaining joints mutilated); body above strongly greyishly pilose; basal joint of antennæ finely thickly pilose.

Long. 7 mm.

Hab. Cape of Good Hope (Brit. Mus.).

Genus Neurocolpus.

Neurocolpus nubilus.

Capsus nubilus, Say, Hem. New Harm. Ind. p. 22. n. 10 (1831).
Capsus hirsutulus, Walk. Cat. Het. vi. p. 95. n. 158 (1873).
Neurocolpus nubilus, Kirk. (part.) Tr. Ent. Soc. 1902, p. 252, nec *mexicanus*, Dist.

Genus Calocoris.

Calocoris norvegicus.

Cimex norvegicus, Gmel. Syst. Nat. iv. p. 2176 (1788).
Capsus contiguus, Walk. Cat. Het. vi. p. 95. n. 159 (1873).
Capsus stramineus, Walk. Cat. Het. vi. p. 96. n. 160 (1873).

Calocoris laticinctus.

Capsus laticinctus, Walk. Cat. Het. vi. p. 127. n. 308 (1873).
Capsus ustulatus, Walk. *loc. cit.* p. 128. n. 309.

In the Phytocoraria I now place the Neotropical genus *Calocorisca*.

Division Capsaria.

Genus Lygus.

Lygus australis, nom. n.

Capsus innotatus, Walk. Cat. Het. vi. p. 116. n. 269 (1873), nom. præocc. Reuter (1871).

Lygus suffusus.

Capsus suffusus, Walk. Cat. Het. vi. p. 117. n. 270 (1873).

Lygus æthiops, nom. n.

Capsus limbatus, Walk. Cat. Het. vi. p. 117. n. 271 (1873), nom. præocc. Fallén (1829).

Lygus pallidulus.

Capsus pallidulus, Walk. Cat. Het. vi. p. 116. n. 267 (1873).

A single specimen in very bad condition constitutes the type of this species.

Lygus illepidus.

Capsus illepidus, Walk. Cat. Het. vi. p. 115. n. 265 (1873).

Lygus? conspersus.

Capsus conspersus, Walk. Cat. Het. vi. p. 116. n. 268 (1873).

The type is in bad condition and without antennæ.

Lygus maoricus.

Leptomerocoris maoricus, Walk. Cat. Het. vi. p. 146. n. 110 (1873).

Anterior area of pronotum pale ochraceous, sometimes with two dark spots.

Genus Pœciloscytus.

Pœciloscytus solitus.

Capsus solitus, Walk. Cat. Het. vi. p. 116. n. 266 (1873).

Type in very bad condition.

Genus Camptobrochis.

Camptobrochis strigulatus.

Capsus strigulatus, Walk. Cat. Het. vi. p. 94. n. 155 (1873).

Genus Pœcilocapsus.

Pœcilocapsus marginatus.

Capsus marginatus, Walk. Cat. Het. vi. p. 96. n. 162 (1873).

Pœcilocapsus limbatellus.

Capsus limbatellus, Walk. Cat. Het. vi. p. 93. n. 153 (1873).
Pœcilocapsus (*Metriorrhynchus*) *affinis*, Reut. Œfv. Vet.-Ak. Förh. 1875, no. 9, p. 74.

Genus Deræocoris.

Deræocoris patulus.

Capsus patulus, Walk. Cat. Het. vi. p. 120. n. 279 (1873).

Genus Liocoris.

Liocoris partitus.

Capsus partitus, Walk. Cat. Het. vi. p. 119. n. 276 (1873).

Genus Bothriomiris.

Bothriomiris simulans.

Capsus simulans, Walk. Cat. Het. vi. p. 125. n. 295 (1873).
Bothriomiris marmoratus, Kirk. Tr. Ent. Soc. 1902, p. 271, pl. v. fig. 9, pl. vi. fig. 16.

Division Bryocoraria.

Genus Physetonotus.

In the 'Biologia Centrali-Americana' (Rhynchota, vol. i. p. 285) I followed Stål in placing his *Eccritotarsus pallidirostris* in the genus he had himself founded. I, however, placed it in a distinct section of the genus—"b. *Body ovate. Pronotum prominently gibbous.*" Subsequently Dr. Reuter (Ann. Soc. Ent. Fr. lxi. p. 394, 1892) has proposed the genus *Physetonotus* for the reception of these species, making *P. atratus*, Dist. (*Eccritotarsus*), the type. The following species must also be included:—

Eccritotarsus pallidirostris, Stål; *E. incurvus*, Dist.; *E. gibbus*, Dist.; *E. porrectus*, Dist.; *E. impavidus*, Dist.; *E. perobscurus*, Dist.; *E. tenebrosus*, Dist.; *E. nocturnus*, Dist.; *E. marginatus*, Dist.; and *E. procurvens*, Dist.

Araspus, gen. nov.

Ovate, posteriorly widened. Head deflected from in front of eyes, which are large, projecting beyond but not touching anterior margin of pronotum. Antennæ with the first joint slightly longer than head, a little thickened towards apex; second joint considerably longer than first, very prominently incrassate and pilose on its apical half; third joint slender; remainder mutilated. Rostrum apparently reaching the intermediate coxæ (the type a carded specimen); pronotum with the basal margin rather more than twice the width of anterior margin, basal margin truncate, becoming oblique towards posterior angles; scutellum tumid, basally foveate; corium convexly rounded posteriorly; cuneus a little longer than broad; legs of moderate length, posterior femora thickened.

Araspus partilus.

Lopus partilus, Walk. Cat. Het. vi. p. 56. n. 27 (1873).

Hab. New Guinea (Brit. Mus.).

MERTILA, gen. nov.

Elongately oval. Head rather long and depressed in front of insertion of antennæ, of which the first joint is shorter than head and attenuated at base; second joint much longer than first, it and the remaining joints pilose. Rostrum not quite reaching the intermediate coxæ. Pronotum with an anterior collar, which has its anterior and posterior margins carinate; subimpressed or distinctly constricted before middle, the depression including two transverse callosities; posterior area a little tumid; posterior margin about twice the breadth of anterior margin, sometimes as long as broad. Scutellum small, subtriangular, callous, foveate at base; hemelytra much longer than abdomen; membrane with a single triangular cell; legs moderately short and slender.

Mertila malayensis, sp. n.

Orange-red; apex of first and the whole of the second joint of antennæ, eyes, apex of rostrum, corium (excluding basal area), cuneus, membrane, extreme apices of femora, tibiæ, tarsi, and sometimes abdomen beneath, indigo-black; head with a distinct central ridge and a broad foveation on inner side of eyes; pronotum a little hollowed between the anterior callosities; upper surface very finely and obscurely pilose; tibiæ finely setose.

Long. 5–6 mm.

Hab. Singapore (*H. N. Ridley*, Brit. Mus.).

Mertila ternatensis, sp. n.

In colour resembling *C. malayensis*, but with the first and second joints of the antennæ entirely indigo-black and the legs entirely orange-red; body much more elongate; pronotum nearly as long as broad, very distinctly constricted before middle, the lateral margins of the anterior lobe convexly produced; corium distinctly coarsely punctate, the suture behind claval apex divided and forming an oblong foveation; apical half of membrane bronzy brown; abdomen beneath orange-red.

Long. 6 mm.

Hab. Ternate (*J. J. Walker*, Brit. Mus.).

Division —— ?

SABELLICUS, gen. nov.

Resembling *Deræocoris*, from which it differs principally by the structure of the antennæ. Head elongately depressed in front of insertion of antennæ, of which the first joint is as long or a little longer than the head, prominently incrassated, and sometimes compressed from immediately beyond base, somewhat longly marginally pilose, with a distinct spur on outer side of apex; second joint much longer than first, slender at base and regularly and moderately incrassated towards apex; remaining joints mutilated in type. Eyes large, almost touching anterior margin of pronotum. Pronotum with the basal margin about twice as broad as anterior margin, with a distinct pronotal collar, and with the posterior angles subtuberculous; rostrum reaching the intermediate coxæ; cuneus slightly longer than broad, the fracture profound; anterior legs robust, the tibiæ moderately incrassate; intermediate and posterior legs mutilated in type.

Sabellicus apicifer.

Capsus apicifer, Walk. Cat. Het. vi. p. 124. n. 293 (1873).

Hab. Celebes: Makian (Brit. Mus.).

Type in bad condition.

Sabellicus sordidus.

Lopus sordidus, Walk. Cat. Het. vi. p. 57. n. 29 (1873).
Leptomerocoris antennatus, Walk. *loc. cit.* p. 145. n. 109.

XII.—*A Contribution to the Characteristic of Corals of the Group Rugosa.* By Prof. N. YAKOVLEFF.

WHILE engaged in investigating the Upper Palæozoic coral *Lophophyllum proliferum* *, regarding which there have lately

* N. Yakovleff, "Fauna of the upper Portion of the Palæozoic Deposits of the Donetz Basin," Transactions of the Geological Committee, new series, no. 12 (1903).

been published the interesting researches of Duerden *, I had, in the first place, the opportunity of verifying the results of Duerden's labours, which are of certain importance in establishing the general characteristics of the Rugosa, and, secondly, of adding a few data to these characteristics.

As is known, the distinguishing feature of the Rugosa is considered to be the fact that they possess four primary septa, of which two—the *main septum* and the *counter septum*—are in the plane of symmetry of the coral, and the other two—the alar septa—on either side of the plane. Besides, in the quadrants between the primary septa the secondary septa are arranged pinnately as regards the main septum in the quadrants which adjoin it, and parallel with regard to the counter septum in the counter quadrants.

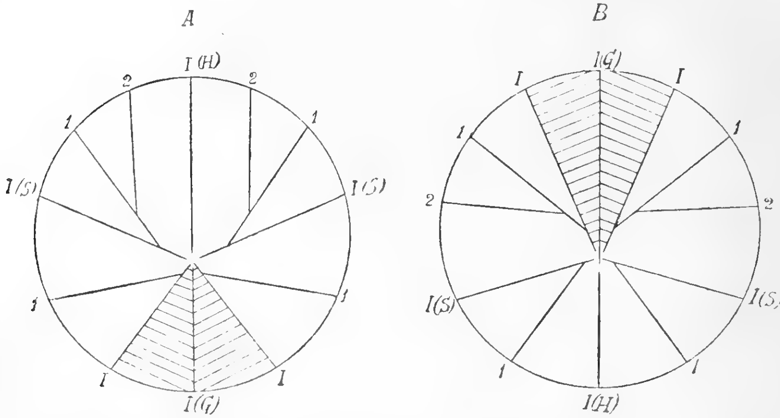
The septa belong to two cycles, of which one consists of large and the other of small septa. It is interesting to observe the way in which the septa are developed in the coral. As proved by Duerden, the septa of one cycle—the small ones—appear comparatively late, simultaneously, and at a certain height. As to the septa of the other cycle—the principal ones—their mode of development has led Duerden to approximate the Rugosa to the group of now living Actinia—Zoantheæ,—their development precluding the possibility of approximating them, as is generally done, to the Hexacoralla, which form a skeleton, and of regarding the former as the progenitors of the latter.

The section (fig. A, p. 116) nearest to the pointed end of the coral is 2·1 mm. in diameter, and represents twelve septa, of which (according to Duerden) *are to be regarded as primary not four, as usually accepted for the Rugosa, but six septa*, which are marked in the figure by the cipher I. Four of them are: the main septum I (H), the counter septum I (G), and the alar septa I (S)—the two remaining septa I being situated next to the counter septum, and forming with it interseptal chambers in which (and exclusively in them) no new septa of the same cycle are developed.

Comparing figures A and B, we notice that the difference between them is but slight, consisting chiefly in this, that the main septum in the Russian specimen is situated on the convex side of the coral, and in the American on the concave side. The same coral in both specimens is bent in an opposite direction. The observed relationship between the degree of development of the main septum and the counter septum in a radial direction

* J. E. Duerden, "On the Relationships of the Rugosa to the living Zoantheæ," Ann. & Mag. Nat. Hist., May 1902, p. 381.

is in all probability owing to the direction of the bend; the *primary septum on the concave side* (in the Russian specimens the counter septum and in the American specimens the main septum) *is short and the primary septum on the convex side is long* (figs. A and B). It seems to me that, with regard both to



A and B, the corresponding sections of the Russian and American specimens (the latter after Duerden, modified as regards the main septum and the counter septum, see below, at end) of *Lophophyllum proliferum*; the portions of the sections turned upwards lie on the convex side of the coral. The primary interseptal chambers in which no new septa are formed are striated. I, I (H), I (G), I (S), the primary septa; 1, 2, the later principal septa.

the main septum and the counter septum, the fact may be easily explained by supposing that the bend of the coral on the concave side causes a contraction, affording less space for the development of the septa than on the convex side; the former is characterized by contraction, the latter by distention.

This assumption is strengthened by another peculiarity of the coral, viz. that of the four primary interseptal chambers, in which the successive principal septa are generally developed, the two situated nearest to the convex side develop the septa more rapidly (in greater number). These chambers are not the same in the Russian and American specimens: in the former (fig. A) they are contiguous with the main septum, in the latter they are separated from it as well as from the counter septum by other primary chambers.

In examining the two specimens (figs. A and B) we must also notice that in two of the four primary chambers *no new septa are formed—invariably in those primary chambers which* *adjoin the counter septum*,—either on the convex or concave side, and whether it be long or short.

We thus arrive at a more complete *definition of the primary counter septum*: it is that (1) *in relation to which the contiguous septa are arranged in a parallel direction*, and (2) *which has adjoining primary interseptal chambers, containing no secondary principal septa.*

Duerden is not correct in stating that the main septum and the counter septum lie respectively on the convex and on the concave side of the coral independently of the arrangement of the contiguous septa. This very arrangement has been regarded by palæontologists as characteristic of the primary septa, and, as will be seen from the above, it is more permanent than has hitherto been known.

XIII.—*On the Distribution of Marine Animals* *.

By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

THE distribution of land-animals is a subject which has always been fraught with deep interest to naturalists—more especially as certain regions are characterized by the forms inhabiting them. Thus it would be anomalous to find, for instance, a marsupial in Africa, an armadillo or a sloth (*Bradypus*) in Asia, or a stag in Australia. The chief barriers, moreover, to the general distribution of such forms have been mountain-chains, deep tracts of the sea, barren regions such as the great deserts, and the vicissitudes of temperature. Yet certain aerial forms, such as the bats, are more or less cosmopolitan, and the shrews, the pigs, and the mice are almost so. In weighing the statement, however, that the distribution of certain of these forms, such as the pigs, has been extended by their swimming powers across arms of the sea, it has to be borne in mind that even marine animals do not always avail themselves of the lines of migration at their disposal.

As three fourths of the surface of the globe are composed of water—for the most part continuous throughout—a vast field exists for the distribution, under natural conditions, of its inhabitants, from mammals to Protozoa. Pelagic types may thus range from pole to pole and from the eastern shore of the Isthmus of Panama round the world to the western.

* Notes of an Introductory Lecture, 16th October, 1903.

Attempts have been made to divide this vast area into regions characterized by special features. For instance, Prof. Forchhammer, of the Chair of Mineralogy in the University of Copenhagen, in 1862 described no less than eleven regions distinguished by the mean quantity of solid matter in the water, the tropical regions containing the greatest amount.

For facility in describing the collections made by the 'Challenger,' seven regions of the ocean were made, viz. the North Atlantic, the South Atlantic, the South Indian or Kerguelen, the Australian, the Philippine or Japanese, the North Pacific, and the South Pacific. Taking the seals, sirenians, and whales as a basis, Dr. Sclater has comparatively recently (1899) made six regions, viz. North Atlantic, mid-Atlantic, Indian, North Pacific, mid-Pacific, and Antarctic. This classification is useful in emphasizing, amongst other things, the fact that even with the continuous medium, which permits migration in various directions, certain forms cling to special areas. It lacks, however, corroboration from the other divisions of marine animals, and embraces so wide a subject that further consideration of all the facts is desirable.

In passing therefore the distribution of the chief groups of marine forms under review, the first amongst the marine mammals are the sea-otters (*Enhydris*), which often swim 10 to 15 miles from land, and are confined to the area of the North Pacific. They do not appear to be spreading, but, as Beddard says, persecution by man has made them more purely oceanic.

The eared seals are chiefly confined to the south Polar ocean. Three species are found all over the North Pacific area, whilst two frequent the west coast of South America (Sclater). The walruses are Arctic, the same species probably occurring in the North Atlantic and the North Pacific, though the latter by some is considered distinct. The seals (Phocidæ) are most numerous in the Arctic and Antarctic seas and in certain intermediate areas. In the North Pacific three out of four seals are identical with those in the North Atlantic. The true seals of the Antarctic Ocean are all distinct from those of the Arctic seas (Sclater). Thus the seals, as a whole, do not support the theory of the bipolarity of marine forms.

The peculiar range of the living Sirenians and their structural features would seem to point to an inaptitude for migration, especially in the case of the manatees, yet the dugong and Steller's sea-cow might have passed from islet to coast-line and spread over a greater area, unless temperature or other circumstance (*e. g.* food) had proved inimical.

It might be supposed, again, that species so active and so powerful as the whales would range over the whole ocean, from the Arctic to the Antarctic seas. Yet in viewing their distribution it appears that, with the whole stretch of the ocean at their command, they, with the exception of the dolphins, frequent special areas. Thus the right- or whalebone-whales are confined to the temperate and cold regions of both hemispheres. The Arctic right-whale haunts the neighbourhood of ice, under which it frequently takes refuge. Temperature may thus have an important bearing on its distribution; but, granting this, it has also to be remembered that nowhere but in such waters could it find a pelagic fauna so rich in large *Cliones* and other Pteropods and of large Copepods intermingled with Medusæ, on which it delights to feed. Moreover, nowhere could it, one of the most timorous mammals, find such vast solitudes, where it can roam without molestation. The same causes probably affect the distribution of the southern right-whale, and it is at least known that its active pursuit led to its rarity in European waters, for it is less rigidly confined to the Antarctic seas than the northern species to the Arctic. Another species of small size (*Neobalæna*) is confined to the seas of Australia and New Zealand. Food, environment, and temperature may have an important bearing on limitation in this case.

Of the toothed whales the sperm-whales and the Ziphioids have an extensive range, being, as Beddard says, "equally at home in the calm seas of the tropics and in the stormy waters of the Antarctic ocean," as well as in the North Atlantic. The former, as a rule, is an inhabitant of the deeper waters far from land, probably because the cuttlefishes, which form a favourite article of diet, are most plentiful there, yet it also feeds on fishes, even, like the porbeagle shark, stripping the fishermen's lines, and occasionally swallowing a shark or a seal. This varied dietary is consistent with its wide range in the ocean.

In the family of the Dolphins, *Beluga* is for the most part Arctic, only rarely being seen on European shores; but it ascends rivers, *e. g.* the St. Lawrence, as Prof. Prince, the Dominion Commissioner of Fisheries, tells me, for 150 miles, apparently after salmon. The narwhal frequents the same oceanic region. The common porpoise is Northern Atlantic and Pacific; another occurs off South America and in the Pacific; whilst *Neomeris* is found in the seas of India, the Cape, and Japan. The dolphins frequent all the oceans, seas, and great rivers of the world, and they are capable of adapting themselves to every vicissitude of climate. Nor do their layers of fat seem to present notable differences in the several regions. As they are piscivorous, their food is obtained without difficulty in every ocean and river. The killer (*Orca*) is likewise cosmopolitan, its chief food consisting of seals and porpoises. *Globicephalus melas* has also a wide range—from the northern seas to the Cape and New Zealand—and *Tursiops* is nearly as extensively distributed.

On the other hand, most of the species of *Sotalia* are fluviatile, occurring in China and with *Inia* and *Pontoporia* in the Amazons and other rivers of South America, whilst one species (a vegetable feeder) frequents the Cameroon River.

With a distribution so complex, in an element which offers no obstacle (except temperature, safe surroundings, and food) to a cosmopolitan range for every species of marine cetacean, the question as to the explanation of these diversities presents itself. Why does *Beluga* not frequent European seas, or *Berardius* of New Zealand stretch far northwards into the Pacific? Beyond the answer that each finds in its special area suitable environment and the food best fitted for it, no answer is at present available. Hereditary tendencies, peculiarities of structure, and habit are, perhaps, responsible for the pertinacity with which the anomalous dolphins, like *Platanista*, cling to fresh water, though it is true one genus (*Sotalia*) is found equally in the Amazon and the sea. Nor does the distribution of the whales throw much light on their origin. So far as facts warrant, it would appear that the toothed whales are the primary forms from which those with whalebone have been evolved, but whether from a marine or a freshwater form cannot yet be answered with certainty, though the number of oceanic species shows that the sea at least proved a congenial area. The enormous lapse of time necessary for the development of the various groups further indicates that the ocean-basins are of great antiquity, though they may not always have had the same conformation.

The distribution of certain birds (which pass most of their time at sea), such as penguins, auks, grebes, divers, and guillemots—all, with the exception of the first, possessing the power of flight,—is limited to the colder areas; yet there is no serious impediment to their ranging over a much larger field except the difficulty of a secure breeding-place and the question of temperature. Food is everywhere abundant. In all probability it is the safety and convenience of their "rookeries" which keep the penguins to the southern seas.

A few Batrachians, Mr. Boulenger tells me, live in brackish or salt water, such as *Rana limnocharis*, *Bufo halophila*, and to a certain extent the European *Bufo viridis* and *Bufo calamita*; but as their eggs only develop in fresh water, their opportunities for oceanic distribution are limited and need not at present be further dealt with.

In addition to the semimarine Iguanids—*Amblyrhynchus*, which enters the sea (by diving) to feed on seaweeds, *Tropidurus*, and the various turtles,—marine reptiles are only found amongst the snakes, if the estuarine crocodiles and Trionychoids, which occasionally wander some miles seawards, are passed by. As Mr. Boulenger * observes, "no better instance of gradual modification from terrestrial into marine forms could be found than in the snakes living at the present day, amongst which are also to be found the only recent reptilian types that, being viviparous, never leave the water." These are the Hydrophids or sea-snakes, the largest of which is about 12 feet long. They are, as described by the author just mentioned, found in the Indian and western South Pacific Oceans, ranging from the Persian Gulf to North Australia, one species (*Hydrus bicolor*) stretching throughout the Indian and tropical Pacific Oceans, the extreme points being the Cape of Good Hope and Guayaquil.

As snakes are most abundant in tropical and subtropical regions, it would appear that certain land-snakes in these parts had gradually adapted themselves, probably in connexion with food, to marine life—so much so that some are never known to leave the water. Yet their distribution has been limited, perhaps partly by temperature, though they probably have extended considerably from their original centre. It may be also that they are kept in check by the large predatory forms, such as Elasmobranchs and Cetaceans.

The marine fishes are, perhaps, more actively and characteristically pelagic than any other group. As already shown, the obstacles which oppose the distribution of land-animals are absent—food and temperature chiefly requiring consideration, though the abundance of the former in every sea almost removes it from such a category. Another factor, it is true, is the pelagic or demersal condition of the eggs, since the latter habit might be supposed to have the effect of making the proximity of the shores, or at least of the bottom, a necessity at certain seasons. Yet one of the best known and most widely distributed amongst pelagic fishes, the herring, has demersal eggs.

* Nat. Science, vol. i. p. 45 (1892).

Mr. Wallace thinks that temperature and the depth of the water are of primary importance in the distribution of the marine fishes, for many species are adapted for shores and shallows. Yet it is difficult to see how either acts; for example, some shore-fishes, like the five-bearded rockling, have pelagic eggs and still more actively pelagic young, so that the question is complex. It must be admitted, however, that many peculiar fishes frequent the great abysses (the temperature of which does not vary much).

Is temperature sufficient to explain the varied distribution of the vast variety of fishes? Does it make impassable barriers, for instance, between the temperate and the tropical and subtropical regions? Such can hardly be the rule in every case, since, as Mr. Boulenger has pointed out *, the grey mullet (*Mugil capito*) ranges from Scandinavia to the Cape, and is as much at home at the mouth of the Congo as off the shores of Northern Europe. Yet some, such as the cod, prefer the colder northern waters, and range from the shores of Norway to those of North America; whilst others, like *Chætodon* and the Sphyrænidæ, choose the warmer waters of tropical and subtropical regions. The variations in temperature which a fish is capable of enduring are not, perhaps, sufficiently known, but the northern plaice survives in the warmer waters of Australia after a protracted journey of thousands of miles. Prof. Prince †, moreover, in an interesting article on "Adaptation in Fishes," mentions that Prof. Jordan found in the volcanic geyser area of the Yellowstone Park suckers and chubs in water of 85°–88° F., and young trout in a temperature about 75° F. It is long since the eggs of the flounder were heated in a test-tube at St. Andrews, and yet they survived and healthy larvæ were hatched from them.

Moreover, in roughly grouping the fishes under Dr. Sclater's six oceanic regions the families seem to be inextricably interwoven throughout, some occurring in every area or ranging from the North Atlantic to the Indian Ocean, and thence to the Pacific. A few features given by Mr. Wallace from Dr. Günther's work are noteworthy. Thus six families out of about eighty are confined to the northern seas, and amongst them are the suckers and the sturgeons. One family (one genus and one species) is restricted to New Zealand waters. Four inhabiting the depths of the ocean are only found in the Atlantic, whilst thirteen families occur only in

* Poiss Ben. Congo, p. 355.

† 'The Ottawa Naturalist,' vol. xiv. no. 11, p. 216.

the Pacific. Two families (Lycodidæ and Gadidæ) inhabit the Arctic and Antarctic seas only, though one species of the latter (Gadidæ) exists in the Indian Ocean. One extensive genus (*Diagramma*, family Pristipomatidæ) is confined to the Pacific, with the exception of a single species in the Mediterranean. One family (Notacanthi) has representatives in Greenland, the Mediterranean, and West Australia. Lastly, the single representative of the family Lophotidæ is found only in Japan and the Mediterranean. Similar results follow in considering the classification of Prof. Palacky, of Prag *. Further and more minute investigation of the several areas may reduce the number of these anomalies; but it is difficult to unravel the tangled web of the distribution of fishes.

In glancing at the families most widely distributed it is found that a considerable proportion of them have pelagic eggs, but others, such as the blennies, gobies, and pipe-fishes, have demersal eggs, and the fishes themselves are not noted for swift progression or nomad habits. From the fact that some cosmopolitan forms, such as the Clupeoids, have both pelagic and demersal eggs within the limits of the family, this condition would not seem to be the chief factor associated with their distribution. Some families have representatives on the shores of Britain, Chili, and Kamschatka, whilst others frequent the open sea in all parts of the world. Fishes, like the wrasses, which occur on the European and American shores and extend to Japan and New Zealand, increase the complexity of the problem. The facts of distribution, indeed, may be associated with the origin of the fishes from pre-existing forms, for the families could scarcely have arisen as the result of variation since the land and water had their present conformation. Again, the occurrence of isolated species or genera at points widely distant from other members of the family indicates, amongst other things, that the production of species by variation is in some cases very slow.

The comparatively recent origin of the Teleosteans has made no noteworthy limitation in the distribution of the families, in contrast with the much older group—Mollusca—some of which are found in the Lower Silurian, though the latter comprises forms less actively pelagic. Mr. Wallace thinks fishes less cosmopolitan than mollusks, a feature he attributes to the antiquity of the shell-fishes; but it may be due to other causes, such as food and temperature, which keep

* 'Die Verbreitung der Fische' (Prag, 1895).

fishes to certain areas, for their powers of progression in a continuous element are great.

The pelagic Tunicates, such as *Salpa*, *Doliolum*, *Pyrosoma*, and the Appendicularians, are practically cosmopolitan, ranging from the northern seas to the Antarctic. Thus Prof. Herdman found *Salpa runcinata fusiformis* in water at a temperature of 80° in the Gulf of Manaar, and the same species occurs in the Antarctic seas. He has noticed that some fixed forms, like *Styela plicata*, are also cosmopolitan or range from the seas of Europe to those of Australia. He has also drawn special attention to the large size and the abundance of the Tunicates in the Antarctic regions. Simple Ascidians, again, are perhaps more common in shallow than in deep water, and few extend to the abyssal zone. Compound forms appear to attain their greatest development in the south temperate zone. Botryllidæ are partial (if not confined) to the northern hemisphere. Distomidæ are found in the northern and southern hemispheres, whilst Polyclinidæ are southern (Herdman, 'Challenger').

In the present state of our knowledge it can scarcely be said that the sea can be mapped into regions by the distribution of the Ascidians, or that there is any clue to their origin from pre-existing forms by their occurrence in modern seas. Temperature has little influence on the distribution of the simple forms, for they range from nearly freezing-point upwards (Herdman), though, as pointed out in a former Introductory Lecture, they are more conspicuous on the seaweeds of the west than the east coast of Scotland.

Out of fifty-eight families of marine mollusks forty-eight are cosmopolitan, but the limitation of a whole family to an area occurs very seldom. For example, while most of the cones are tropical, Wallace points out that *Pleurotoma* is cosmopolitan. In the same way the volutes are tropical, but *Mitra* occurs in Greenland. The cowries are also characteristic of warm regions, yet one species is found in Britain and one in Greenland. Of the cuttlefishes some, like the argonaut and pearly nautilus, are characteristic of warm seas, whilst the majority are cosmopolitan, their enormous numbers in the great oceans being only occasionally in evidence by their destruction of fishes on the lines, by the occurrence of their beaks in the stomachs of numerous fishes (from the cod and *Lampris* to sharks), and by their forming the chief article of diet for the sperm-whales.

That the mollusks have had ample time to spread themselves over the great oceans is proved by their antiquity, many, like both groups of truly pelagic forms (the Heteropods and Pteropods), ranging back to the Silurian period.

Their complex distribution is not easily explained. Was the *Pleurotoma* of Greenland evolved from the same stock as the cones of the tropics, or did each arise from pre-existing forms in the special areas? Why are the pearl-oysters (Aviculidæ) tropical or subtropical, like the giant-clam (*Tridacna*)? Why should the conditions accompanying the formation of pearls in the former be limited to special regions, even though the presence of certain fishes be necessary?

The marine Insecta are comparatively few, and it will suffice to take the two genera described by Dr. Buchanan White * from the collection of the 'Challenger.' Thus five species of *Halobates* occur in the Atlantic, but only one is restricted to it. Six species are found in the Indian Ocean west of long. 100° E., whilst (chiefly) in the West Pacific eight species are met with, of which four are restricted to that region. The metropolis of the genus appears to be the Indian Ocean and West Pacific, for nine out of the eleven known species occur there, and White thinks even originated there, and that currents have carried them eastward. The other genus (*Halobatodes*) is represented only in the Indian Ocean and the China Sea. The Halobatidæ are therefore chiefly inhabitants of the warmer seas, and though they have not spread over the whole ocean, they are widely distributed.

In the class Crustacea the distribution of marine forms is remarkably wide, just as the number of some of the smaller forms like the Copepods swarm in every sea, from pole to pole. Thus a species of the Amphipod *Podocerus* extends, Mr. Stebbing informs me, from the waters of New Zealand to 77° 7′ N., and another from Tahiti to the Faroës. The higher Crustacea are sensitive to temperature, as is evident from the behaviour of such forms as the shore-crab in summer and winter, and, as Mr. Stebbing observes, by the paucity of species in Arctic, Antarctic, and very deep waters. Yet, as this experienced author states, there are Amphipods and Isopods which abound most and attain their greatest size in Arctic waters. The comparison of the Copepods (*Calani* &c.) from the feeding-grounds of the right-whale with those in European waters is equally pronounced, the size of the Arctic forms being much greater. Mr. Stebbing mentions that every fresh expedition tends to show the intimate relationship

* 'Challenger,' vol. vii. pp. 77 & 78.

of the marine Crustaceans from north to south and east to west. "Land-crabs and river-crabs are chiefly confined to warm climates. Again, very few crabs occur at either end of the globe, but that does not prevent the discovery of many crabs living in deep and therefore very cold water in the intermediate zones. There is, besides, a sort of zonal facies, which an expert in each group would probably recognize. There are circumpolar Amphipods, Isopods, and Sympods (Cumacea), which one would regard with great suspicion if it was said they had been collected at the tropics. But, nevertheless, the deep-water communication accounts for the closest family connection between members of the Lithodidæ found far north and far south." (*Stebbing.*) The same author is of opinion that in some cases there may be isolation and restricted distribution, these seldom going beyond specific distinction. Yet as regards the Crustacea it is difficult to make regional areas of demarcation in the ocean. It would also be difficult to say that any family of marine crustaceans is exclusively tropical and another as exclusively Arctic, and though certain forms are found in deep water (*e.g.* the Japanese *Thaumatocheles*), yet representatives of the same family may occur in shallow water.

In dealing with the families of the marine Polychæta it is also impracticable to map out the ocean in regions to suit their distribution, for almost every family has representatives in diverse regions; and although of some it may be said that they are more prominent in tropical or subtropical waters, yet other representatives range to the poles.

As examples of families usually considered characteristic of the warmer parts of the sea are the Euphrosynidæ and Amphinomidæ, yet examples of both occur in Norway and of the former in Greenland; indeed their range is almost cosmopolitan. The Eunicidæ likewise are often conspicuous in tropical and subtropical seas, yet the abundance and size of some from the shores of Norway and from the North Atlantic show the cosmopolitan distribution of the group. With our present knowledge it can hardly be said of any family that it is, on the one hand, a purely northern or a purely southern, or, on the other hand, a purely temperate or a purely tropical one. Some Annelids range from Greenland to Japan, from Norway to the Cape and New Zealand, and many are cosmopolitan.

In considering how it has happened that the same form is found in Greenland, Europe, and Japan, some, like Sir John Murray, would suppose that such had been universally distributed in the ocean at a former period, but that physical changes had subsequently restricted the range. Others see in this condition proof of the enormous powers of dispersion at the disposal of marine organisms, and the origin, in the several areas, from a pre-existing form.

Moreover, whatever may be the conditions (and Sir J. Murray thinks the quantity of carbonate of lime secreted by marine organisms is determined by the temperature of the water and therefore chiefly chemical rather than physical) in regard to coral-reefs, northern Annelids (*e. g. Filigrana implexa* and other Serpulidæ) have no difficulty in forming considerable masses of calcareous tubes *. Temperature appears to have no appreciable influence on the abundance and size of these calcareous tubes in cosmopolitan species. Nor is there a distinction in regard to the calcareous secretions of the Polyzoa and Echinoderms of the extreme north from those in the tropical oceans.

The families of the Nemerteans have a range as wide as that of any previous group, and the type of structure varies little whether the form be arctic, tropical, or antarctic. Of no special region of the ocean can it be said that its Nemertean fauna is diagnostic, for with advancing knowledge (largely due to the labours of Mr. R. C. Punnett) the distribution of the types is always extending. There is no evidence, moreover, that the arctic and antarctic forms have other relationships than those which spring from a cosmopolitan distribution.

So far as can be ascertained, the families of the Echinoderms correspond with those of other groups in regard to distribution. Some range from the arctic to the antarctic seas, and, as Mr. Bather observes, from the eastern shores of America round the world to the western, the same species thus occurring on the opposite shores of the Isthmus of Panama. It has, however, to be remembered that a communication existed between the respective sides up to a recent period. Some, again, range to great depths as well as have a wide distribution.

As in other groups, some forms suggest a northern area and some a tropical, but on the whole it cannot be stated that there are special regions of the ocean characterized by special families of Echinoderms, though it is true that certain types, like the Pentacrini and Elasipoda, occur in deep water.

* Murray thinks that those forms secreting a large quantity of carbonate of lime would be killed by the lowering of temperature at the poles—like those with pelagic larvæ.

Further, the slightly pelagic *Ophiopteron* of Amboyna, one of the Moluccas, is not so widely distributed as some other types devoid of such an apparatus for progression.

The distribution of the Cœlenterates, such as zoophytes, jelly-fishes, sea-anemones, corals, and sea-fans, presents special features, for some are more purely tropical, others more characteristic of the colder areas, whilst not a few—like *Campanularia*, *Obelia*, and *Eudendrium*—are cosmopolitan. Thus the coral-reefs are tropical and subtropical, yet some stony corals, such as *Lophohelia* and *Caryophyllia*, occur in temperate seas. The jelly-fishes and sea-anemones are cosmopolitan, though some, like *Cestus*, are characteristic of the warmer seas. Alcyonarians range from tropical to cold regions, those in the former, however, according to Prof. Hickson, being distinguished by the abundance of their spicules or by massive skeletal structures.

Sponges are often widely distributed, some forms being common to the North Atlantic and the Cape, others to the latter and Australia; whilst European types range to South Africa and America.

The Foraminifera, Radiolarians, and other types of the Protozoa (e. g. *Noctiluca*) have an extensive distribution, the former ranging from the Arctic to the borders of the Antarctic Ocean, and forming vast deposits in many areas. The distribution of *Noctiluca* and the pelagic forms like *Ceratium* is equally wide; nor is there any hard-and-fast line separating the distribution of families or larger groups from each other.

In connexion with regional distribution in the ocean, it has been supposed by some that the fauna of the deep water (abyssal region) is peculiar, but many families found there have representatives in shallower water and even between tide-marks. Thus amongst the deep-water fishes the Murænidæ include the eels so common between tide-marks in the Channel Islands and elsewhere. The Clupeidæ comprise the herring, sprat, and anchovy—widely distributed pelagic fishes which come near the shore to spawn. The Ophidiidæ are almost universally spread from Greenland to New Zealand, and the family includes the sand-eel of our shores. In the same way the Pediculati, another family of deep-water fishes, has a representative, viz. the frog-fish, in shallow bays. A considerable number of Mollusca are also inhabitants of the depths of the sea, but representatives of the same families or even genera occur in shallow water; and so with the marine Polychæta and other Invertebrates down to the Foraminifera—only arenaceous forms of the latter are more abundant in abyssal regions, and it is said that no Brachyurous crustacean has been met with below 1000 fathoms (*Canon Norman*).

Sir John Murray thinks that migration into the deep sea took place from the mud-line (viz. about 100 fathoms), and that there is little evidence, from the observations made in the 'Challenger,' to show that the deep sea has been peopled since the earliest geological times. The uncertainty on this head, however, is apparent by the statement of Prof. James Geikie that it was the absence of these abysses in early times (Palæozoic) which enabled many forms to become cosmopolitan. Murray, again, considers that the fauna of the deep water is less ancient than that of many shores (*Lingula* and *Heliopora*) and freshwaters (*Ceratodus*). In considering the deep-water fauna, however, it is well to bear in mind the difficulty of bringing the animals up for investigation.

A brief glance may now be taken at the bipolarity of marine animals as promulgated by Pfeffer and Murray. The latter, especially from his experiences in the 'Challenger' expedition, has put forward a strong claim on this head. He is of opinion that there are a large number of identical and closely allied species in the extra-tropical regions of the northern and southern hemispheres, which, so far as known, are not represented in the intervening tropics—even though the climatic conditions as regards temperature are the same. He thinks that the identical species now living towards both poles, or their immediate ancestors, had a world-wide distribution, which involves a nearly uniform temperature throughout the whole body of the ocean (probably in Middle Mesozoic times), and that as the poles cooled these animals were drawn towards the equator. As we go back to the Palæozoic period, he affirms, the tropical zone of temperature slowly widens. Murray further supports his theory by pointing out that pelagic larvæ are absent in the cold waters of the arctic and antarctic regions; yet this may have been accidental, and due to the depth at which the tow-nets were used. Certainly the Sponges, Cœlenterates (Zoophytes), Echinoderms, Annelids, and Molluscs of these regions have ciliated pelagic larvæ. This bipolar theory has been opposed by Ludwig for the Sea-Cucumbers, Ortmann for the Crustaceans, and D'Arcy Thompson generally, whilst many of the appearances may be explained by the cosmopolitan distribution of the various types.

In summing up, therefore, it would appear that the distribution of marine animals has features which diverge from those which characterize the distribution of land-animals—according to the views now prevalent; and, further, that the absence of impassable barriers does not, of necessity, lead to a cosmopolitan habit in those which can avail themselves of the opportunity. In the case of land-animals much weight has been placed on this check to migration, so that it is a prominent feature in the literature of the subject. Further, the conditions in the ocean tend to the permanence of the various types, which, with their wide distribution, varied sites, and uniform medium, have much to favour them in the struggle for existence. The vast or cosmopolitan distribution of many forms is thus conspicuous.

Again, in the present state of knowledge, the division of the ocean into regions characterized by special faunistic features can with difficulty, to say the least, meet with support from all the groups of marine animals.

This preliminary survey of the subject, moreover, is interesting insofar as it discloses no serious obstacle to the introduction of European food-fishes, shell-fishes, crabs, and other forms to various parts of the world—especially those of primary importance to man. If, for instance, the same or a closely allied shell-fish or annelid can live and flourish equally in the waters of Britain and those of the Cape, there is probably no insuperable barrier to the transference of a valuable food-fish from the one to the other. The recent transmission of adult plaice from Scotland to Australia has already met with success, and the same experiment may soon be carried out at the Cape.

Though at present, broadly speaking, no definite plan of distribution amongst the families of oceanic forms is discernible—very few families being monopolized by one region to the exclusion of the others,—future investigators may enable such a plan to be outlined; yet the number of cosmopolitan forms, and of others which range almost as widely, will always give a tone to the picture of the sea in contrast with that of the land.

XIV.—*Descriptions of new Frogs and Snakes from Yunnan.* By G. A. Boulenger, F.R.S.

In a recent number of these 'Annals' * I described a new gecko, *Gehyra yunnanensis*, obtained at Yunnan Fu (altitude

* Vol. xii. 1903, p. 429.

about 6000 feet) by Mr. John Graham, of the China Inland Mission. The Natural History Museum has since received from the same gentleman further collections made in the same district, and among them I had the pleasure of finding examples of two new frogs and five new snakes, of which descriptions are here offered.

Rana pleuraden.

Vomerine teeth in two small oblique groups between the choanæ. Head moderate, as long as broad; snout obtusely pointed, prominent, as long as the orbit; canthus rostralis obtuse; loreal region oblique, concave; nostril equally distant from the eye and from the end of the snout; interorbital region narrower than the upper eyelid; tympanum very distinct, two thirds to three fourths the diameter of the eye. Fingers and toes rather slender, obtusely pointed; first finger extending beyond second; toes half-webbed; subarticular tubercles rather feeble; a small oval inner metatarsal tubercle. The tibio-tarsal articulation reaches between the eye and the tip of the snout. Skin smooth or with small warts; a moderately broad, very prominent, dorso-lateral glandular fold; no other folds on the body. Olive-brown or greyish above, spotted with black; a light vertebral streak usually present; a dark brown or blackish band on each side of the head, passing through the eye and involving the tympanum; a whitish streak along the upper lip; limbs with more or less regular black cross-bars; sometimes a light line along the inner side of the leg, continued to the outer toe; hinder side of thighs marbled black and yellow; lower parts white, throat sometimes brownish. Male with a vocal sac on each side, forming loose folds on the throat, and a very large flat gland on each side of the body, above and behind the shoulder.

From snout to vent 63 mm.

Several specimens.

Callula verrucosa.

Snout rounded, not prominent, as long as the eye; interorbital space as broad as the upper eyelid. Fingers slender, with slightly swollen tips, first a little shorter than second; toes moderate, nearly half-webbed, the tips blunt, not swollen, fifth considerably shorter than third; subarticular tubercles well developed; metatarsal tubercles two, oval, compressed, the inner very large. The tibio-tarsal articulation reaches the shoulder or between the shoulder and the eye. Upper parts with large smooth warts; a fold from the eye to the shoulder. Dark greyish brown above, uniform or with six longitudinal rows of small darker spots; lower parts uniform dirty white.

From snout to vent 46 mm.

Three specimens, from the garden of the Mission station.

Closely allied to *C. picta*, Bibr.

Polyodontophis Grahami.

Rostral once and a half as broad as deep, just visible from above; suture between the internasals nearly as long as that between the præfrontals; frontal much longer than its distance from the end of the snout, shorter than the parietals; loreal as long as deep; one præocular; two postoculars, only the upper in contact with the parietal; temporals 2 + 2; eight upper labials, fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields, which are longer than the posterior. Scales in 17 rows. Ventrals 185; anal divided; subcaudals 83. Reddish brown above, with three dark brown longitudinal lines, which become more and more indistinct after the anterior fourth of the body; head dark brown, with a black streak on each side and a black bar behind the parietals; a white streak along the upper labials and another behind the occipital bar; lower parts white, with a black dot at the outer end of each shield; on the posterior part of the body and on the tail these dots are confluent into a black lateral line.

Total length 350 mm.; tail 60.

A single specimen.

Intermediate between *P. collaris*, Gray, and *P. sagittarius*, Cant.

Tropidonotus quadrilineatus.

Eye moderate. Rostral broader than deep, just visible from above; internasals broadly truncate anteriorly, a little longer than broad, nearly as long as the præfrontals; frontal once and a half as long as broad, as long as its distance from the end of the snout, much shorter than the parietals; loreal as long as deep; one præ- and two postoculars; temporals 2 + 1; seven or eight upper labials, third and fourth or fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields, which are shorter than the posterior. Scales in 19 rows, all keeled, the dorsals strongly. Ventrals 153; anal entire; subcaudals 51. Pale olive-brown above, with two black vertebral lines, widening on the nape and occiput, and a broad black lateral band extending from the eye to the end of the tail; black lines on the sutures between the upper labial shields, which are white; lower parts bright yellow.

Total length 435 mm.; tail 65.

A single male specimen.

This species appears to be allied to *T. Pealii*, W. Sclater, from Assam.

Tropidonotus octolineatus.

Eye moderate. Rostral broader than deep, just visible from above; internasals broadly truncate anteriorly, as long as broad, nearly as long as the præfrontals; frontal once and a half as long as broad, a little longer than its distance from the end of the snout, much shorter than the parietals; loreal as long as deep; one præ- and two postoculars; temporals 2+2; nine upper labials, fourth, fifth, and sixth entering the eye; five lower labials in contact with the anterior chin-shields, which are a little shorter than the posterior. Scales in 19 rows, dorsals moderately keeled, laterals feebly, outer row smooth. Ventrals 152; anal divided; subcaudals 58. Pale greyish brown above, with two black longitudinal lines, separated by five series of scales, these lines widening on the nape and passing into the dark brown colour of the upper surface of the head; a black lateral band extending from the eye to the end of the tail; a black zigzag lateral line, formed by the outer edges of the ventral shields; an interrupted black line on each side of the belly, formed by a short streak on each shield; upper lip and lower parts yellow, the outer ends of the ventral shields reddish; black spots or vertical bars on the upper lip.

Total length 610 mm.; tail 125.

A single female specimen.

This species is most nearly allied to *T. parallelus*, Blgr.

Tropidonotus pleurotænia.

Eye moderate. Rostral broader than deep, just visible from above; internasals narrowly truncate anteriorly, a little longer than broad, a little shorter than the præfrontals; frontal once and a half as long as broad, longer than its distance from the end of the snout, shorter than the parietals; loreal as long as deep; one præ- and three postoculars; temporals 2+1; eight upper labials, third, 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 19 rows, feebly keeled, two outer rows smooth. Ventrals

148; anal divided; subcaudals 66. Yellowish olive above, with two very indistinct darker streaks along the back; a blackish lateral band, extending from the eye to the end of the tail; scales of outer row greyish, edged with black; upper lip white, with some black on the sutures between the shields; lower parts uniform bright yellow.

Total length 350 mm.; tail 85.

A single male specimen.

Allied to *T. modestus*, Gthr.

Pseudoxenodon sinensis.

Very closely allied to *P. macrops*, Blyth, with which specimens from Sze Chuen have been confounded by Günther and by myself. Distinguished by having usually only seven upper labials, third and fourth entering the eye, 19 or 20 scales on the middle of the body as well as on the neck, a smaller number of ventrals, viz. 144 to 158 instead of 160 to 175, and a different coloration, the upper labial shields being marked with black bars corresponding to the sutures, and the quadrangular dark brown spots on the anterior part of the belly being absent.

The numbers of ventral and caudal shields are as follows in the specimens examined:—

♀. Kia-ting-fu, Sze Chuen, 1070 f. (*Pratt*)	158+ ?
♀. " " " "	158+55
♂. Son-pan-ouei, Sze Chuen, 10,000 f. (*Styan*)	144+67
♂. Yunnan Fu, 6000 f. (*Graham*)................	155+67
♀. " " "	154+62

In a fresh condition this snake is olive-green above, with black and yellow or orange spots, the latter usually forming a vertebral series, at least on the posterior part of the body; a blackish streak along each side of the nape, sometimes united in a point on the occiput; an oblique black streak from the eye to the angle of the mouth; frequently a light cross-band between the eyes; loreal region and upper lip bright yellow or orange, the labial shields with black lines corresponding to the sutures between them; belly yellow or orange in front, uniform or speckled with blackish, greenish or dark greyish olive behind, more or less profusely speckled with black.

Total length 780 mm.; tail 140.

XV.—*On some Fishes from the Lakes of the Cameroon Mountain.* By Dr. Einar Lönnberg, C.M.Z.S. &c.

A few weeks ago I received from my friend Gunnar Linnell, residing at Cape Debundscha, a small collection of fish which is of considerable interest, having been obtained from the small isolated lakes of volcanic origin on the Cameroon Mountain, viz. Lake Barombi-ba-kotta and the Elephant Lake.

The natural conditions of the latter lake have been mentioned in my previous paper on fishes from the Cameroon (Ann. & Mag. Nat. Hist. ser. 7, vol. xii., July 1903) and need not be repeated. Concerning the Lake Barombi-ba-kotta, the Swedish civil engineer P. Dusén gives the following information * :—In the middle of the lake is a small islet of basalt. On the western side there is a steep slope about 10 metres in height, but the surroundings are not very high and crater-walls seem to be absent. Mr. Dusén is therefore uncertain whether to regard this lake as a very old crater or a "Maar" formation. The lake receives only a small tributary, the rivulet Manatunge, at the mouth of which basalt-rocks were seen ; but there is no watercourse leading from the lake or draining it, so that it is thus fully isolated. The lake appears to be situated about 20 kilometres from Mungo River as the crow flies, and about twice as far from the nearest sea-shore. Mr. Dusén puts its altitude above the sea-level at 90 m. In these circumstances it is therefore the more interesting to find that it has a fish-fauna consisting of at least five species of Cichlidæ, which have been sent to me by Mr. Linnell, namely :—

Hemichromis fasciatus, Peters.

A small specimen.

Pelmatochromis longirostris, Boulenger.

A specimen in good condition.

Tilapia macrocephala (Bleeker).

A fine large specimen, measuring 189 mm., with quite normal dentition.

Tilapia kottæ, sp. n.

Scales cycloid, without marginal denticulations. About 10 gill-rakers on lower part of anterior arch. An outer series of teeth of moderate size, two or three inner series of very

* Geol. Fören. Förh. no. 155, Bd. xvi. (Stockholm, 1894).

minute teeth. Depth of body $2\frac{1}{2}$ to $2\frac{2}{3}$ in total length without caudal. Length of head $2\frac{2}{3}$ (in younger) to $2\frac{5}{6}$ times (in older specimens) in total length. Snout and forehead with straight upper profile, forming a distinct although blunt angle with the outline of the back. Diameter of eye contained $1\frac{1}{3}$ (in younger) to $1\frac{1}{2}$ times (in older specimens) in length of snout, $3\frac{1}{3}$ (in younger) to 4 times (in older) in length of head, $1\frac{1}{4}$ to $1\frac{1}{3}$ in interorbital width. Maxillary extending almost to the vertical through the anterior border of the eye. Three series of scales on the cheeks; opercle with large scales. Dorsal XV (XVI in one specimen) (11–) 12; last spine longest, $\frac{4}{9}$ to $\frac{1}{2}$ length of head; middle soft rays produced $1\frac{1}{2}$ times as long as longest dorsal spine. Pectoral not extending to origin of anal, pointed, but in all specimens a little shorter than head. Ventral produced, usually reaching vent or a little beyond. Anal III 8, third spine shorter than last dorsal; soft rays produced $1\frac{1}{2}$ times as long as third anal spine. Caudal truncate or a little emarginate. Scales cycloid, 26–27 $\frac{3\text{–}2\frac{1}{2}}{10\text{–}11}$; lat. line $\frac{19\text{–}20}{12\text{–}13}$. Very faint traces of four or five dusky hairs may be seen in some specimens, in others not. A black opercular spot always present, and a blackish spot at the base of the anterior soft rays of the dorsal. Anal often more or less dusky to blackish; in the latter case, the chin, lower jaw, ventrals, and more or less of the opercle and belly as well as lower half of the caudal are blackish to black. In some specimens roundish light spots surrounded by dusky are seen on the posterior part of the soft dorsal and upper half of the caudal. The black-bellied specimens are smaller, but have a larger anal papilla, and an examination of the interior proves that they are males. The larger specimens with light-coloured belly are females. As the genital organs do not contain ripe products, it is evident that the sexual difference in colour is constant, and not confined to the breeding-season. The males measure 10 to 12 cm. in length, the females $12\frac{1}{2}$ to 14 cm.

I am much indebted to Mr. Boulenger, who has kindly sent me a specimen of *Tilapia Zillii* (Gervais) from Lake Menzaleh, Egypt, which he regards as most nearly related to the *Tilapia* from Lake Barombi-ba-kotta. There are, however, several characteristics that show these two fishes to be quite distinct from each other. The shape is different: in *T. Zillii* the profile forms an even bow without the pronounced nuchal angle of *T. kottæ*; in the former species the soft rays of the dorsal and anal fins are much more produced, so that they are about twice as long as the longest anal spine. The number and arrangement of scales also differ; for instance, in *T. Zillii* there are 4–$3\frac{1}{2}$ scales between the lat. l. and anterior dorsal spines, and $2\frac{1}{2}$ between the posterior end of lat. l. and the dorsal, whereas in *T. kottæ* the same numbers are 3 and $1\frac{1}{2}$. The proportions are also dissimilar: in two specimens of exactly the same length the head of *T. kottæ* is 36 °/₀ and that of *T. Zillii* only 31 °/₀ of the total length without caudal. The colour is also different, as *T. Zillii* has 6 to 8 dark bars and sometimes a longitudinal stripe. All these particulars, together with the geographical separation, induce me to establish a separate species, named after Lake Barombi-ba-kotta. According to Mr. Boulenger, *T. Zillii* is distributed from the Algerian Sahara to Lake Rudolph and the Lake of Galilee.

From the *Tilapia lata* group, *T. kottæ* is distinguished by its shorter pectorals &c.

Mr. Linnell has obtained quite a number of specimens of *T. kottæ*, so that the above description is based on several examples.

Tilapia dubia, sp. n.?

It is with much hesitation that I propose this new species, as it is based on only one specimen; but, on the other hand, its markings are so distinct, and it differs so decidedly from the species of *Tilapia* to which it might otherwise be related, that it seems incorrect not to describe it separately.

An outer series of rather large and only slightly notched teeth, about 14 on each side of the upper jaw; on the inner side of this outer row two or three series of minute teeth. Depth of body 2 times in total length without caudal, length of head 3 times. Snout with straight upper profile, as long as diameter of eye, which is contained 3 times in length of head and $1\frac{1}{6}$ times in interorbital width. Maxillary extending to between nostril and eye. Three series of scales on the cheek; large scales on the opercle. Gill-rakers short, 13–14 on lower part of anterior arch. Pectoral pointed, much longer than head, and extending a good deal beyond the origin of anal. Ventral not produced reaching vent but not beyond. Dorsal XVI 13, spines subequal from the fifth, about $\frac{1}{2}$ length of head. Anal III 10, third spine stouter than dorsal spines, but of nearly the same length. (Caudal mutilated.) Caudal peduncle nearly $1\frac{1}{2}$ as deep as long. Scales cycloid, probably about 27–28 $\frac{3}{12}$, lat. lin. $\frac{21}{2}$. An opercular black spot, another at the base of the anterior soft rays of the dorsal. Eight dark bars, the first just in front of the opercular spot, the second from the foremost dorsal spines, the fifth from the dark spot of soft dorsal, the sixth at the end of the dorsal, and the eighth at the base of the caudal. Anal and ventrals dusky to blackish. Total length with the caudal probably about 82–85 mm.

This form is evidently closely allied to *T. Mariæ*, Boulenger, with which it agrees in relative dimensions of head and body, number of rays of vertical fins, and exterior markings. The differences are found in the dentition (as Mr. Boulenger says * respecting *T. Mariæ*, "teeth small, in three series"), and in the shortness of the pectoral in the last-mentioned species, in which it is only as long as head and does not extend to origin of anal. On the other hand, the ventrals of *T. Mariæ* are longer and reach origin of anal. That species has also four series of scales on the cheek. It should also be mentioned that Boulenger's specimens were about the same size as mine, so that the differences are not due to age.

T. Büttikoferi (Hubrecht) seems also to resemble this form in having eight dark bars and similar relative proportions. The teeth of the outer row in that species are also similarly enlarged; but *T. Büttikoferi* differs in having "5 or 6 series of scales on the cheek," smaller number of spines but larger number of soft rays in the dorsal, shorter pectoral (subequal to or shorter than head, not extending to origin of anal), and longer ventral as in *T. Mariæ*. To unite these appears therefore impossible or only apt to cause confusion. When these fishes become more perfectly known, it may be possible to place some series of forms together as subspecies under one and the same species; but this seems rather early yet, and therefore it is best to collect as much knowledge as possible by carefully describing the different varieties.

From the Elephant Lake only one species has been added to the collection †, but it is of interest as being new to science. It is a *Barbus* of the *B. Bynni* group, and I propose to call it

Barbus Linnellii, sp. n.

Depth of body $3\frac{1}{2}$ to nearly 4 ($3\frac{9}{10}$) times in total length

* In his very valuable paper "A Revision of the African and Syrian Fishes of the Family Cichlidæ.—Part II.," Proc. Zool. Soc. London, 1899, p. 98.

† Mr. Linnell informs me that Mr. Räthke, of the German station, Johann Albrechtshöhe, helped him to procure this fish from the Elephant Lake.

without caudal; length of head $3\frac{1}{4}$ to $3\frac{1}{2}$ times in total length. Snout rounded, $2\frac{1}{2}$ times (or slightly more) in length of head. Diameter of eye (of these large specimens) 6 to $6\frac{1}{3}$ times in length of head. Interorbital width about equal to length of snout, thus about $2\frac{1}{2}$ to $2\frac{2}{3}$ times in length of head. Mouth inferior; lips well developed, lower continuous. Barbels two on each side, the posterior a little longer than the anterior, exceeding the latter by a fourth or a fifth of its length; the anterior is equal to diameter of eye or a little ($\frac{1}{5}$ to $\frac{1}{10}$) longer, the posterior is $1\frac{1}{3}$ times diameter of eye; the distance between the barbels is quite intermediate between the length of anterior and posterior barbels. Dorsal III 9; last simple ray rather strong, bony, not serrated, slightly curved, a little more than half as long as head (55 $^0/_0$); free edge of the fin emarginate, its distance from the occiput less than its distance from the caudal. Anal III 5, longest anal ray decidedly longer than longest dorsal ray, and measuring $\frac{2}{3}$ (68 $^0/_0$) length of head. Pectoral about $\frac{3}{4}$ length of head, not reaching ventral, latter below anterior part of dorsal. Caudal peduncle $1\frac{1}{3}$ to $1\frac{1}{2}$ times as long as deep. Scales 20–27 $\frac{4-4\frac{1}{2}}{3\frac{1}{2}}$, 2 (or $2\frac{1}{2}$) between lateral line and root of ventral, 12 round caudal peduncle. Two specimens, respectively 360 and 435 mm. in length.

This *Barbus* is no doubt nearly related to *B. Batesii*, Boulenger, but differs from that species in several respects. Since Mr. Boulenger described* *B. Batesii* on a single specimen from Kribi River, Southern Cameroons, he has received several specimens from 185 to 340 mm. long, and he has in the most friendly way favoured me with a fresh description (for which I owe him my best thanks) of this species, based on the increased material. A comparison with this description reveals that *Barbus Linnellii* differs from *B. Batesii* in several particulars. The former has a comparatively larger head and longer snout. Its interorbital width is larger, but the barbels, and the distance between them, when compared with the diameter of the eye are smaller. The dorsal is lower, but the anal is rather higher when compared with the length of the head. The scales are fewer in number and larger, as may readily be seen. The two forms must therefore be kept distinct, even if *Barbus Linnellii* of the Elephant Lake be regarded as derived from *B. Batesii* through isolation.

The Museum, Gothenburg,
Jan. 6th, 1904.

* Proc. Zool. Soc. 1903, vol. i. p. 25.

XVI.—*Descriptions of new Species of* Lycænidæ *from Borneo and New Guinea.* By Hamilton H. Druce, F.Z.S., F.E.S.

Thysonotis hebes, sp. n.

♂.—*Upperside.* Allied to *T. Piepersii* *, from which it differs by its smaller size, by being of a darker and more purple shade of blue, and by the outer margins of the fore wing being even more broadly black, especially towards the anal angle.

Underside differs from that of *T. Piepersii* by the almost total absence of the yellow basal streak on the costa of the fore wing and the absence of the metallic green borders to the black lunules in the border of the hind wing. There are a few metallic scales at the base of the hind wing and about halfway along the costa from the base.

Thorax black; palpi black, clothed with whitish hairs at the base; abdomen black, ringed with blue scales at each segment; legs black, with grey scales at joints.

Expanse $1\frac{1}{5}$ inch.

Hab. Upper Aroa River, British New Guinea (*Meek*, Mus. Druce).

The two specimens we possess were captured in January and February.

Candalides pruina, sp. n.

♂.—*Upperside.* Uniform deep black, with the costal half of the fore wing from the base nearly to the outer margin dark, shining, hoary purple, with the costal margin and the nervules narrowly black, and a central patch of differently placed scales lying principally on the median nervure and on the bases of the median nervules. When held at an angle the black hind wings show a slight olivaceous tinge. The cilia of the fore wing are black, slightly whitish at the angle, as is also the apex of the hind wing, which is again distinctly white along the abdominal margin, widening out to a small white patch at the base of the abdominal fold.

The *underside* is marked exactly like that of *C. silicea* †, but the black spots are slightly fainter and the apex and costa appear very slightly suffused with greyish.

* *Cupido Piepersii*, Snellen, Tijd. Entom. xxi. p. 16, pl. i. fig. 3 (1878).

† *Holochila silicea*, Grose-Smith, Novitates Zoolog. i. p. 580 (1894); Rhop. Exot. ii., Orient. Lyc. ix. *Holochila*, i. figs. 6, 7, 8 (1896).

Head, thorax, and abdomen black above, whitish beneath; palpi white, tipped with black; legs black and white.

Expanse $1\frac{3}{10}$–$1\frac{2}{5}$ inch.

Hab. Upper Aroa River, British New Guinea (*Meek*, Mus. Druce).

The two specimens we possess were captured, one in January and one in February.

Not nearly allied to any described species.

Tajuria lucullus, sp. n.

♂.—Allied to *T. cato* *, from which it differs on the upperside by being of a more silvery shade of blue and by the blue area on the fore wing extending right up to the anal angle, but not reaching to the upper wall of the cell as in that species. The lobe on the hind wing is considerably smaller, with its black spot larger and the orange crown very indistinct.

On the underside the ground-colour is slightly paler than in *T. cato* and in the fore wing the dark transverse line commences near the costal margin, further from the apex than in that species, and runs almost straight nearly to the inner margin; in the hind wing the dark line is also placed further inwards and the orange blotches near the anal angle are darker, more condensed, and larger than in *T. cato*. The lobe itself is entirely black and the space above the submedian nervure is entirely covered with shining pale blue scales. The black spot between the lower median nervules is larger.

There are indistinct lines closing the ends of the cells in both wings which are absent in *T. cato*.

Thorax and abdomen bluish above, pearly grey below; legs black, with whitish spots; antennæ black above, spotted with white below.

Expanse $1\frac{4}{5}$ inch.

Hab. Kina Balu, Borneo (Mus. Druce).

This insect is closely allied to *T. cato*, but is at once distinguished by the characters enumerated above.

One specimen only, in fine condition.

Tajuria stigmata, sp. n.

♂.—Allied to *Tajuria berenis* †, but differs by being smaller, by the blue on the upperside being darker and of a

* *Tajuria cato*, H. H. Druce, P. Z. S. 1895, p. 601, pl. xxiii. figs. 14, 15.

† *Tajuria berenis*, H. H. Druce, P. Z. S. 1896, p. 674, pl. xxi. fig. 6.

more violaceous hue, and by the possession of a large olivaceous brown band occupying the upper end of the cell and reaching to the black apical border. The lobe is much smaller and black.

On the underside the ground-colour is much as in *T. berenis*, but the transverse lines are placed further inwards from the margins and are much straighter. There are no faint lines closing the cells of both wings, as in *T. berenis*, and the orange patches at the anal angle of the hind wing are paler, more extensive, and not separated by the submedian interspace, as in *T. berenis*. The black lobe is crowned with shining silvery-blue scales.

♀.—*Upperside* differs from male only by the disk of the fore wing being of a slightly paler blue, the apex being less broadly black, and by the total absence of the olivaceous brand.

On the *underside* the dark transverse line is more conspicuous and more distinctly edged outwards with whitish than in the male.

Head, thorax, and abdomen bluish above, pearly white below; legs white-spotted; antennæ minutely white-spotted.

Expanse $1\frac{3}{5}$ inch.

Hab. Kina Balu, Borneo (Mus. Druce).

Distinguished at once from all others of the group by the large brand in the male, which may necessitate the erection of a new genus to contain it.

XVII.—*Two new Mammals from South America.* By Oldfield Thomas.

Oryzomys oniscus, sp. n.

A medium-sized species allied to *O. intermedius* and *O. laticeps*.

Size about as in *O. intermedius*, therefore larger than in *O. laticeps*. Fur close and rather short; hairs of back barely 10 mm. in length. General colour of upper surface dark greyish tinged with buffy, the resulting tone being rather paler than Ridgway's "bistre" and very near that of certain of the darker forms of the *laticeps* group, e. g. *O. perenensis*, Allen. Median area of back noticeably darker than rest. Sides rather, but not conspicuously, more buffy. Whole of under surface and inner sides of limbs greyish white ("grey no. 9"), the bases of the hairs slaty, the tips white. Line of demarcation on sides fairly well defined. Head like body; muzzle rather darker, with dark rims round the eyes. Ears rather large, thinly haired, greyish brown. Outer surface of arms and legs drab-grey; hands and feet pure white. Tail approximately equal in length to the head and body, very finely scaled, practically naked; greyish brown, rather paler for its proximal third below.

Skull closely similar in size and shape to that of *O. intermedius*, therefore decidedly larger than in *O. laticeps*; the palatal foramina are, however, rather shorter than in the former, though not so short as in the latter, and are more widely open. The supraorbital edges are squared or finely beaded, but are without overhanging ledges.

Dimensions of the type (measured in the flesh):—

Head and body 140 mm.; tail 145; hind foot, s. u. 31 (range 30–33), c. u. 33; ear 24.

Skull: greatest length 36·3; basilar length 28; greatest breadth 18·5; nasals 13·7; interorbital breadth 5·6; palate length 15·6; palatal foramina 5·1 × 2·6; length of upper molar series 5.

Hab. S. Lourenço, near Pernambuco. Alt. 50 m.

Type. Adult male. B.M. no. 3. 10. 1. 42. Original number 1573. Collected 23rd July, 1903, by Alphonse Robert. Eight specimens.

This *Oryzomys* is readily distinguished from any species hitherto known. In its colour it is remarkably like some of the forms of the *O. laticeps* group, but is separable from them by its much larger skull and longer palatine foramina. In some of the specimens the darker dorsal area is so marked as to suggest an affinity with *O. sublineatus*, Thos., but the hind feet in that species are conspicuously shorter.

From *O. physodes*, Licht. (Rio Janeiro and Espirito Santo), *O. lamia*, Thos. (Minas Geraes), and *O. intermedius*, Leche (São Paulo to Rio Grande do Sul), of all of which Mr. Robert has obtained specimens, this species in distinguishable by the absence of the rufous or buffy body-colour found in those animals.

Marmosa germana, sp. n.

A large species of the *cinerea* group, with a wholly brown tail.

Fur thick, close, and wavy; hairs of back about 10–11 mm. in length. General colour above pale brown, rather paler than "mummy-brown," rather less yellow than "raw umber" of Ridgway. Under surface soiled buffy greyish, the hairs slaty, with pale buffy tips. Crown of head like back. Dark orbital rings broad, strongly marked, extending forwards on to the sides of the muzzle. Cheeks and chin clearer buffy. Outer sides of arms and legs like back, inner sides like belly; hands and feet practically naked, pale brownish. Tail furry at its base for a shorter distance than usual, the fur, which is coloured like that of the back, extending for only about an inch and being surpassed posteriorly by the outstretched feet; remainder of tail naked, as usual, but instead of being white terminally it is uniformly pale brown to the end, at least above, the under surface being in one specimen slightly paler terminally.

Skull with well-expanded zygomata and broad interorbital region, with overhanging postorbital ledges. Teeth large, of the usual proportions in this group.

Dimensions of the type (measured in skin):—

Head and body 187 mm.; tail 245; hind foot (s. u.) 23; ear 19.

Skull: basal length 39·5; greatest breadth 25; nasals 18·5 × 6·2; interorbital breadth 7·6; breadth across postorbital processes 9·4; breadth of brain-case 15; palate length 23·5; combined length of three anterior molariform teeth 7·7.

Hab. Sarayacu, Oriente of Ecuador.

Type. Female (young adult). B.M. no. 80. 5. 6. 77. Collected by Mr. Clarence Buckley. An old male also in collection.

This opossum shares with *M. regina* * alone of the present group the distinction of having a wholly brown tail, not turning to white at its end. From that species it is separated by its duller and less yellowish belly-colour, broader skull, and larger molars.

XVIII.—*On the Classification of the Crustacea Malacostraca.* By W. T. Calman, D.Sc.

In the course of preparing a general account of the Crustacea for a forthcoming volume of Prof. E. Ray Lankester's 'Treatise on Zoology' I have been led to discard the commonly accepted classification of the Malacostraca and to adopt a scheme which was briefly outlined by Dr. H. J. Hansen some ten years ago. The object of the present

* Ann. & Mag. Nat. Hist. (7) ii. p. 275 (1898).

paper is to discuss somewhat more fully than is possible within the limits of a text-book certain of the facts bearing upon the case, to put into systematic form (with some modifications and additions) the classification suggested by Dr. Hansen, and to invite criticism of the result.

In 1815 Leach *, adopting a basis of classification which had previously been applied by Lamarck to the whole class of Crustacea, divided the subclass Malacostraca into two legions—the Podophthalma and the Edriophthalma—according to the condition of the eyes, movably pedunculate in the one and sessile in the other. Without attempting to summarize the numerous modifications which have been suggested, it may be said that Leach's classification has been accepted in principle by the majority of carcinologists since his time, and is that most generally followed at the present day. As originally defined, the two groups were sharply distinguished from each other not only by the characters given by Leach, but also by the presence in the Podophthalma of a cephalothoracic shield or carapace which was absent in the Edriophthalma, this character giving occasion for the names Thoracostraca and Arthrostraca applied to them by Burmeister †. The progress of research, however, rendered it increasingly difficult to form satisfactory definitions of the two divisions. In particular the recognition by Fritz Müller of a true, though reduced, carapace in the Tanaidæ and the elucidation of the structure of the Cumacea begun by H. Goodsir and by Kröyer provided intermediate links, the Cumacea, indeed, being placed sometimes in the one group and sometimes in the other. Claus ‡ established a third division (Leptostraca) for *Nebalia* and its allies, and the separation of the Stomatopoda from the other Podophthalma, first suggested, I believe, by Huxley §, left in the last-named group only the Schizopoda and Decapoda.

An important departure from the line of classification generally followed was made in 1883 by Prof. Boas ||, who abandoned the group Schizopoda, pointing out that the Mysidæ and Lophogastridæ were by no means closely related to the

* "A Tabular View of the External Characters of Four Classes of Animals which Linné arranged under Insecta . . . . .," Trans. Linn. Soc. London, xi. (1815) pp. 306–400.

† 'Beiträge zur Naturgeschichte der Rankenfüsser,' Berlin, 1834, p. 55.

‡ 'Grundzüge der Zoologie,' 4te Aufl. (1880) p. 573.

§ Introd. Classification Anim. (1869) p. 125; Manual Anat. Invert. Animals (1877), p. 317.

|| "Studien über die Verwandtschaftsbeziehungen der Malakostraken," Morphol. Jahrb. viii. pp. 485–579, pls. xxi.–xxiv. (1883).

Euphausiidæ, with which they had until then been associated. Boas divided the Malacostraca into seven orders—the Euphausiacea, Mysidacea, Cumacea, Isopoda, Amphipoda, Decapoda, and Squillacea. This view was severely criticised by Claus*, who, while admitting points of affinity between Mysidæ and Arthrostraca on the one hand, and between Euphausiidæ and Decapoda on the other, retained the Schizopoda as a central and primitive group, and classed them along with the Decapoda as Thoracostraca.

In 1893 Dr. Hansen†, in a preliminary account of his researches on the morphology of the appendages in Insects and Crustacea (not yet published in full), proposed a still further modification of the classification on the lines laid down by Boas, from whom, however, he differs on many points. While agreeing in discarding the group Schizopoda, Hansen points out that the Euphausiacea do not occupy the primitive position assigned to them by Boas, and he emphasizes their close affinity with the Decapoda, with which he proposes to associate them, opposing to the group thus formed another of equal rank, comprising the Mysidacea, the Cumacea, and the Edriophthalmate orders. Hansen's proposals seem to have attracted little attention, and I am not aware that any writer has adopted the classification suggested, though to me this arrangement of the Malacostraca appears to be the only one which adequately expresses our present knowledge of their morphology.

As Dr. Hansen does not give any names to the two groups which he defines, it may be convenient to state here that I propose the names PERACARIDA (*πήρα*, a pouch) for the division which includes the Mysidacea, Cumacea, Tanaidacea, Isopoda, and Amphipoda, and EUCARIDA for the Euphausiacea and Decapoda.

From this it will be seen that the chief point on which there is divergence of opinion is the retention of the Schizopoda as a natural group. That the Mysidæ present affinities with the Edriophthalma and the Euphausiidæ with the Decapoda is not disputed; but if we adopt Claus's view that the Schizopoda are a central group approximating to the stock from which the other orders have been derived, there is nothing to forbid their association with the other Podophthalma in our taxonomic arrangement. When, however,

* "Neue Beiträge zur Morphologie der Crustaceen," Arb. Zool. Inst. Wien, vi. pp. 1-108, pls. i.–vii. (1885).

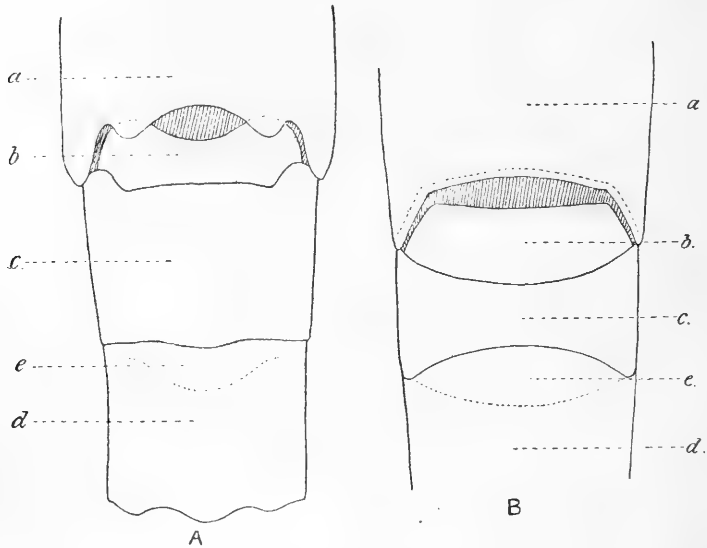
† "Zur Morphologie der Gliedmassen und Mundtheile bei Crustaceen und Insecten," Zool. Anz. xvi. pp. 193–198 & 201–212. Translated in Ann. & Mag. Nat. Hist. (6) xii. pp. 417–434 (1893).

we come to compare the characters (as given, for instance, by Sars *) of the Euphausiidæ on the one hand, with those of the Mysidæ, Lophogastridæ, and Eucopiidæ on the other, we find that, with one important exception, to be discussed presently, the two groups do not agree in one single character which they do not share with the lower Decapods, and for the most part also with the Stomatopoda and Leptostraca. They agree in possessing a carapace, movable eyes, a scale-like exopodite on the antenna, an elongated and ventrally flexed abdomen, and a "tail-fan" formed by the lamellar rami of the last pair of appendages displayed on either side of the telson. This combination of characters goes to make up what might be called the caridoid "facies," and at first sight strongly suggests affinity between the groups exhibiting it. It seems reasonable to suppose, however, that these characters, together with such others as the natatory exopodites of the thoracic limbs, are precisely what we must attribute to the hypothetical stock of the Malacostraca, and that the caridoid form has been retained in each of the divergent branches proceeding therefrom by those members which have adhered most closely to the primitive habits of life, and especially of locomotion. That the stalked eyes and the carapace are primitive features is not now disputed, nor can it be doubted that the possession of an exopodite on the antenna is also primitive, though it has been lost by the Leptostraca. The lamellar form of this exopodite is intelligible as an adaptation to swimming habits, and its reduction or loss corresponds fairly closely in most cases with diminished natatory powers. The fan-like disposition of uropods and telson is another character not shared by the Leptostraca, which, nevertheless, was probably possessed by the primitive Malacostraca, since it occurs in the lower Decapoda and the Stomatopoda, and also, though more or less modified, in Cumacea and many Isopoda. The retention of these primitive characters does not necessarily imply any special affinity between the various groups which exhibited them.

The one character, above referred to, which is stated to distinguish all Schizopoda from the Decapoda is the freedom of the terga of one or more of the posterior thoracic somites from the carapace. In the Mysidæ, Lophogastridæ, and Eucopiidæ at least five of these somites are complete upon the dorsal side and distinct from, although more or less over-lapped by, the carapace. It has been stated that in the Euphausiidæ the last thoracic somite remains distinct, while

* Rep. Schizopoda 'Challenger,' pp. 10 & 11 (1885).

in the Decapoda all are coalesced with the carapace. If this were so it would constitute a strong, though not conclusive, argument in favour of retaining the Euphausiidæ in association with the other families of Schizopoda. As a matter of fact, however, this difference between the Euphausiidæ and Decapoda does not exist.



Junction of thoracic and abdominal regions of the body, from the dorsal side. A. *Nyctiphanes norvegica* (Euphausiacea); B. *Pandalus Bonnieri* (Caridea).

a, carapace; *b*, intermediate plate; *c*, tergum of first abdominal somite; *d*, tergum of second abdominal somite; *e*, articular surface defined by a groove on surface of second somite. The thorax and abdomen are drawn slightly apart, to show the area occupied by soft articular membrane between (indicated by shading).

If the junction of thorax and abdomen in a typical Euphausid such as *Nyctiphanes* be compared with the same region in one of the lower Decapoda (Penæidea or Caridea), a precise similarity of structure is found (see figure). The posterior margin of the carapace is concave on the dorsal side, leaving between it and the apparent anterior margin of the first abdominal somite an area of roughly lenticular outline, which is fully exposed when the abdomen is flexed, and is occupied by a firmly chitinized plate (*b*). Anteriorly this plate is overlapped by the carapace, with which it is connected by soft articular membrane, and posteriorly it is firmly connected with the first abdominal somite. It is to all appearance quite comparable to the articular surface (*e*) on the dorsal aspect of the other abdominal somites, which is concealed beneath the posterior margin of the somite in front when the abdomen is extended, and it only differs from these articular surfaces in being more sharply defined from the somite of which it forms a part. It is possible, though I know of no evidence to support the view *, that this plate is actually the tergal portion of the last thoracic somite, which has become detached from the sternal portion and has coalesced with the succeeding somite, but, in any case, the structure is exactly alike in Euphausiidæ and in the lower Decapods. I have carefully sought for other evidence of a distinct tergal element of the last thoracic somite in Euphausiidæ, but without success, and I can only conclude that the statement of its existence is an error based upon the observation of this intermediate plate without direct comparison with the Decapoda.

One point in which the Euphausiacea appear to agree with a section of the Mysidacea and to differ from the Decapoda is the possession of a single series of branchiæ at the bases of the thoracic limbs. In the Decapoda the gills are arranged in several (typically four) series. Those of the Euphausiacea are attached to the coxopodites of the limbs, corresponding to the podobranchiæ (and epipodites) of the Decapods, from which, however, they differ in their mode of branching. In the Lophogastridæ and Eucopiidæ, on the other hand, the gills are attached to the articular membrane at the base of the limbs, and are, in fact, arthrobranchiæ. As Claus has pointed out, this difference in the place of attachment does not necessarily invalidate the comparison between the branchiæ of the two groups, since he has shown that in certain Decapods the arthrobranchiæ develop as outgrowths from the basal portions of the limbs, and that the pleurobranchiæ had in all probability a similar origin. There is, however, another fact which may have a bearing on this question. In *Gnathophausia* (Lophogastridæ) Sars describes a small tongue-like process, tipped with a group of setæ, on the outer side of the coxopodite of all the thoracic limbs except the first pair, and he regards this as a reduced epipodite. It seems not unlikely that this process, and not the gill itself, is homologous with the epipodial gill of the

* Williamson figures this plate as a separate sclerite in the larva of *Crangon*. "On the Larval Stages of Decapod Crustacea.—The Shrimp (*Crangon vulgaris*, Fabr.)," Rep. Fishery Board Scotland, xix. (3) 1901, pl. v. fig. 156, "*in*."

Euphausiidæ. On the assumption that the primitive Malacostraca possessed at least two epipodial appendages on each thoracic limb (as in *Anaspides*), the distal series may have become modified as branchiæ in the Euphausiidæ and the proximal in the Lophogastridæ. In any case, the form of the gills differs considerably in the two cases, and the only point which they have in common as against the Decapoda is the arrangement in one instead of several series.

Among the characters in which the Mysidacea differ from the Euphausiacea and agree with the Edriophthalmate orders the most conspicuous is the possession by the female sex of a brood-pouch or marsupium, in which the eggs and young are carried. It cannot be doubted that this structure is homologous throughout the whole series which I have named, from this feature, the Peracarida, in spite of real or alleged differences in the mode of its development. It is formed by a series of overlapping plates (which Claus considers, with great probability, to be of the nature of epipodites) attached to the inner side of the coxopodites of some or all of the thoracic limbs. When, as in many Isopoda, the coxopodites are fused with the body, the plates are attached to the sternal surface of the somites. In some cases these plates or oostegites develop as bud-like outgrowths from the bases of the limbs, increasing in size at successive ecdyses as sexual maturity is approached; but in certain Isopoda it has been shown that the course of development is abbreviated, the oostegites growing in the space between the sternal cuticle and the hypodermis, and being set free, completely formed, at a single moult *. Probably some similar process has given rise to the statement that the oostegites arise by splitting of the ventral cuticle in the Cumacea † and in the Isopod *Gnathia* ‡. At the same time it is certain that the formation of the brood-pouch is profoundly modified in certain parasitic Isopods of the tribe Epicaridea. In many of these the oostegites develop in the typical fashion just described, but in the more specialized forms the structure is very different and hard to understand. In *Hemioniscus*, where the development has been worked out in detail by Caullery and Mesnil §, the marsupial cavity is hollowed out

* *Cf.* Leichmann, "Beitr. z. Naturgesch. d. Isopoden," Bibl. Zool. x. (1891).

† G. O. Sars, "Beskr. af de paa Freg. Josephines Exp. fundne Cumaceer," Kongl. Svenska Vet.-Akad. Handl. ix. 13 (1871), p. 19.

‡ Dohrn, "Entw. und Organ. v. *Praniza* (*Anceus*) *maxillaris*," Zeitschr. f. wiss. Zool. xx. (1870) p. 70.

§ "Recherches sur l'*Hemioniscus balani*, Buchholz . . . .," Bull. Sci. France et Belgique, xxxiv. pp. 316–362, pls. xvii. & xviii. 5 figg. in text (1901).

in a thickening of the ectoderm on the sternal surface, and is from the first completely closed. Further research will be required to show what relation this cavity bears to the normal marsupium.

Apart from such exceptional cases, however, the possession of oostegites is a character quite peculiar to the group of orders included in the Peracarida and not found in any other Crustacea. It is true that the Euphausiidæ are described as carrying their eggs in sacs attached to the sternal surface of the thorax, and it has been assumed that these represent the marsupium of the Mysidacea. But, as Sars * has pointed out, the "ovisacs" are apparently formed by the consolidation of some cementing substance which is extruded along with the eggs from the oviducts. The rarity of ovigerous specimens would suggest that the eggs are so carried for only a brief period, while in some of the commonest species they have never yet been observed. This last circumstance is explained by an interesting observation for which I am indebted to Mr. E. W. L. Holt. In *Euphausia pellucida* Mr. Holt finds that the eggs when expelled from the body are not agglutinated together in masses, but are simply carried for a time between the thoracic feet of the female. In *Nyctiphanes Couchii* the egg-sacs have long been known. By the kindness of Mr. Holt I have been enabled to examine well-preserved specimens of both these species, and I find that, as, indeed, is implied by Sars's account, the structures found in *N. Couchii* are more properly described as egg-masses than as sacs, there being no definite enclosing membrane, but simply a film of hardened cement which also penetrates between and holds the eggs together. It is plain that this structure bears no morphological relation to the oostegites of the Peracarida. A very similar arrangement is found in the Decapod *Leucifer*, where, according to Brooks †, the eggs are "attached in a loose bunch of twenty or more to the last pair of thoracic limbs."

A feature which is very characteristic of the Peracarida, and one on which Boas and Hansen lay considerable stress, is found in the structure of the mandibles. In all the orders composing the series, with exceptions in the case of parasitic and other secondarily modified forms, an accessory blade, the *lacinia mobilis* of Hansen ‡, is developed just behind the

* Rep. Schizopoda 'Challenger,' p. 118.

† "*Leucifer*, a Study in Morphology," Phil. Trans. clxxiii. (1882) p. 60.

‡ The term *lacinia mobilis* was first applied by Hansen ('Dijmphna Togtets Zool. Bot. Udbytte' (1887), p. 197) to the accessory blade alone, but he afterwards extended its meaning to include also the row of spines

cutting-edge, and is followed by a row of serrated spines extending towards the molar process. In the Euphausiidæ and Decapoda no *lacinia mobilis* is found in the adult, though in the larvæ of both a group of serrated spines is sometimes present, which disappears in the course of development. Even in the adults of some of the more primitive Decapods, for instance in certain Atyidæ *, a tuft or row of stout bristles is found just below the cutting-edge, and it seems probable that this is a vestige of the spine-row of the Peracaridan mandible.

In distinguishing the Peracarida from the Eucarida, Hansen attaches great importance to certain characters presented by the thoracic limbs. Boas had already pointed out that the Mysidæ and the Edriophthalmate orders have these limbs terminated by a claw-like spine, which is absent in the Euphausiacea and Decapoda. Hansen regards this claw as representing a segment of the limb, and identifies it with the minute terminal segment which he has discovered in the Leptostraca. Boas had further indicated a difference between the two groups in the direction of the articulations of the limbs. In the Peracarida the "knee" or chief ventral flexure of the leg is between the fifth and sixth segments, counting from the base, while in the Eucarida it is between the fourth and fifth. Hansen interprets this difference in the following manner: he assumes that the position of the knee is the same in both cases, that the apparent fourth segment of the leg in Eucarida is equivalent to the fourth plus the fifth in the Peracarida, and that the three segments beyond the knee in the former case are homologous with the two segments and the terminal claw in the latter. If this suggestion be correct, we have a difference of a very marked kind between the two groups. Dr. Hansen will doubtless produce further evidence in its support when his researches are published in full, but at present there are difficulties in the way of adopting it as a basis for classification. In certain primitive Isopoda (Janiridæ &c.) the leg terminates in two, sometimes three, claws, not differing greatly in size or perceptibly in structure, and it is difficult to believe that one of them is to be regarded as the terminal segment while the others are simply modified setæ. Further, in many

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which are often closely connected with it ("Cirolanidæ," Vidensk. Selsk. Skr. (6) v. (1890) p. 276, footnote). In the present paper I have used the term in its original and more restricted sense.

* *Cf.* Calman, "On Two Species of Macrurous Crustaceans from Lake Tanganyika," Proc. Zool. Soc. London, 1899, p. 705, pl. xxxix. fig. 5.

Peracarida the "claw" is coalesced with the segment which carries it, the suture-line between the two disappearing and the place of junction being indicated, if at all, only by the insertion of a minute seta, and it is not impossible that such evidence of the existence of a "claw" may yet be found in the terminal segment of the decapod leg. In the absence of any definite proof that the fourth segment of the leg in the Eucarida represents two fused segments, it seems better to assume for the present that the segments of the legs are serially comparable in the two groups.

Dr. Hansen includes among the characters of the Peracarida the presence of tubular processes for the orifices of the vasa deferentia, which are stated to be absent in the Eucarida. It is true that such processes are present in the majority of the Peracarida, though they are sometimes much reduced and may perhaps be altogether wanting in some cases. They are absent in the Euphausiacea and in the lower Decapoda, but in some Paguridea and in the Brachyura the vasa deferentia terminate in tubular processes which are often of considerable length.

The possession of spermatophores is another character on which it seems unsafe to rely as distinguishing the Euphausiacea and Decapoda from the other orders of Malacostraca. It certainly constitutes an important difference between the Euphausiacea and the Mysidacea, but it can hardly be extended without qualification to some of the other groups. Prof. Gilson applies the term "spermatophores" to the aggregations of spermatozoa found in certain Isopoda *, but not to the sperm-masses of the Macrura †. The distinction which Prof. Giard ‡ makes (in Insects) between spermatophores and "spermotagmata," according to the presence or absence of a definite investing membrane, appears to be hard to recognize among Crustacea and to have little systematic importance §. On the other hand, the form of the spermatozoa appears to afford constant and important characters differentiating the two groups.

* "Étude comparée de la spermatogénèse chez les Arthropodes," La Cellule, i. (1884) p. 158.

† *Op. cit.* ii. (1887) p. 187.

‡ "Sur la spermatogénèse des Diptères du genre *Sciara*," C. R. Acad. Sci. cxxxiv. (1902) p. 1124.

§ Prof. McMurrich describes ("Embryology of the Isopod Crustacea," Journ. Morph. xi. 1895, p. 67) a very definite spermatophore in the Isopod *Jæra* in connexion with the process of "hypodermic impregnation" which he believes to occur in that genus; but his account is not very detailed, and the phenomena which he describes are so remarkable that further investigation is much to be desired.

With regard to these and other points of internal anatomy our knowledge is very incomplete for many of the groups. Nothing is known of the internal anatomy of the Lophogastridæ, and very little regarding the Euphausiidæ and the lower decapods. One point which seems to tell against the system of classification here advocated may be given for what it is worth. This is the presence in all of the Podophthalmate groups (*Anaspides* ?, *Mysidæ*, *Euphausiidæ*, *Decapoda*, *Stomatopoda*) of an unpaired descending artery originating from the posterior end of the heart or from the base of the posterior aorta (superior abdominal artery) and perforating the nerve-cord to become connected with the subneural artery (sternal and inferior abdominal arteries). In the Edriophthalmate orders no similar arrangement is known, the subneural artery, where it exists, being connected with the dorsal portion of the vascular system by paired lateral arteries or by a circumœsophageal ring. In view of the great divergences which may exist in the disposition of the arterial trunks within the limits of a single order (*e. g.* the Isopoda), no great taxonomic importance can at present be attached to such differences.

Besides the characters, summarized in the definitions given below, which hold good throughout the various orders brought together in this classification, there are many connecting characters which serve to link together the individual orders and to indicate their affinities, although they cannot conveniently be included in our definitions. Many of these are discussed in the papers of Boas and Hansen, and we may simply mention as examples the retroverted palp of the maxillula in Lophogastridæ (Mysidacea), Cumacea, and Tanaidacea, the branchial epipod of the first thoracic appendage in the same orders, and the distinct, though immovable, ocular peduncles of the Tanaidacea. On the other side the Euphausiacea share with some suborders of the Decapoda the possession of an appendix interna on the pleopods, and the elaborate copulatory armature of the first pair of pleopods in the former group recalls that of the Penæidea in the latter, although differing in details. The larval development of the Euphausiacea runs closely parallel to that of the Penæidea, and Dr. Hansen's recent discovery * in a species of *Sergestes* of luminous organs resembling, though of somewhat different structure from, those of the Euphausiacea, helps still further to diminish the narrow space which separates the two.

* Proc. Zool. Soc. London, 1903, i. p. 72.

Since the papers of Boas and Hansen were written, the necessity for a rearrangement of the Malacostraca has been rendered still more urgent by Mr. G. M. Thomson's * discovery of *Anaspides*. This remarkable form presents a combination of characters which indicate for it a very isolated place in our classification. It is not merely a schizopod without a carapace. The double series of epipodial lamellæ, the segmentation of the thoracic limbs, the double gnathobasic lobes of the first pair, and the apparent distinctness of the first thoracic somite from the head † are among the characters which remove it from close affinity with any of the commonly recognized orders of Malacostraca. Though *Anaspides* is not by any means like the hypothetical ancestral malacostracan, its unmistakable resemblance to some of the oldest fossil Malacostraca (*Uronectes* &c.) shows that at least it is a very ancient type. In the classification given below I have regarded *Anaspides* and its fossil allies as constituting a division of equal rank with the Peracarida and Eucarida. For this I have adopted the name Syncarida, formerly proposed by Packard for the fossil forms alone.

The details which Mr. Thomson has given of the internal anatomy of *Anaspides* are very remarkable, and further investigation on this point is much to be desired. Unfortunately no specimens have yet reached this country in a state of preservation suitable for anatomical purposes. The mode of development is also quite unknown.

With regard to the other orders little need be said here. Claus's investigations ‡ on *Nebalia* leave no doubt that the

* "On a Freshwater Schizopod from Tasmania," Trans. Linn. Soc. London, (2) Zool. vi. pp. 285–303, pls. xxiv.–xxvi. (1894). *Cf.* also Calman, "On the Genus *Anaspides* and its Affinities with certain Fossil Crustacea," Trans. Roy. Soc. Edinburgh, xxxviii. (4) pp. 787–802, 2 pls. (1896).

† I formerly suggested (Trans. Roy. Soc. Edinb. xxxviii. pt. 4, p. 787) that the "cervical groove" of *Anaspides*, which was described by Thomson as marking off the first thoracic somite from the head, really represented the line of junction of the mandibular with the maxillular somite, on the ground that owing to the forward direction of its lateral portions the lower ends come to lie just behind the mandibles. I am now disposed to doubt the correctness of this view. There appears to be a tendency in those Malacostraca which are without a carapace for the lateral plates (pleural or coxal) of the anterior thoracic somites to become displaced forwards at their distal ends as if to protect the mouth-parts: this is well seen in some Arcturidæ, for instance. It seems quite likely that this groove in *Anaspides* has undergone a similar displacement, and that it really does define the first thoracic somite, which is not distinct in any other Eumalacostraca.

‡ Especially "Ueb. d. Organismus d. Nebaliden und d. syst. Stellung d. Leptostraken," Arb. Zool. Inst. Wien, viii. (1889).

Leptostraca are intimately related to the Malacostraca, and their position seems best expressed by Grobben's * arrangement, which divides the subclass into two main groups, Leptostraca and Eumalacostraca.

The Stomatopoda must form a division of equal rank with the Eucarida and Peracarida. To preserve the consonance of names I propose to term it Hoplocarida. The morphology of the members of this group has been somewhat neglected, and their precise relationship to the other orders is by no means clear. Their internal anatomy is imperfectly known and would doubtless repay investigation †.

Classification here proposed.

Subclass MALACOSTRACA.

Series Leptostraca, Claus, 1880.

Division Phyllocarida, Packard, 1879.

Order *Nebaliacea*, nov. nom.

Series Eumalacostraca, Grobben, 1892.

Division Syncarida, Packard, 1886.

Order *Anaspidacea*, nov.

Division Peracarida, nov. nom.

Orders *Mysidacea.*
Cumacea.
Tanaidacea.
Isopoda.
Amphipoda.

Division Eucarida, nov. nom.

Orders *Euphausiacea.*
Decapoda.

Division Hoplocarida, nov. nom.

Order *Stomatopoda.*

Series Leptostraca.—Abdomen of seven somites, the last of which is without appendages, and a telson bearing a

* "Zur Kenntniss des Stammbaumes und des Systems des Crustaceen," SB. Akad. Wien, ci. (1892) Abth. i. pp. 237–274.

† Kowalevsky states (Biol. Centralbl. ix. (1889) p. 41) that the maxillary gland ("shell-gland") is greatly developed in the Stomatopoda, but I cannot find any description of it. I have observed on the posterior surface of the maxilla in *Squilla mantis* a papilla with a minute terminal pore which may be the aperture of the duct of this gland, but I have had no opportunity of dissecting well-preserved specimens.

pair of movable articulated rami (caudal furca). An adductor muscle runs transversely between the two valves of the carapace. Thoracic limbs all similar, more or less foliaceous, with protopodite of three segments.

Series EUMALACOSTRACA.—Abdomen of six somites (the number may be reduced by coalescence), the last of which typically bears a pair of appendages, and a telson which never bears movable furcal rami *. No adductor muscle of the carapace. Thoracic limbs rarely all similar (Euphausiacea), typically pediform; protopodite of two segments, except in Stomatopoda.

Division SYNCARIDA.—Carapace absent. All the thoracic somites distinct. Eyes pedunculate. Antennal protopodite of two segments. Mandible without lacinia mobilis. Thoracic limbs flexed between fifth and sixth segments. No oostegites. No appendix interna on pleopods. Hepatic cæca numerous. Heart much elongated, tubular.

Division PERACARIDA.—Carapace, when present, leaving at least four of the thoracic somites distinct. First thoracic somite always fused with the head. Antennal protopodite typically of three segments. Mandible with lacinia mobilis (except in parasitic and other modified forms). Thoracic limbs flexed between fifth and sixth segments. Oostegites attached to some or all of the thoracic limbs in female, forming a brood-pouch. No appendix interna on pleopods. Hepatic cæca few and simple. Heart elongated, extending through the greater part of thoracic region, or displaced into abdomen. Spermatozoa filiform. Development taking place within the brood-pouch; young set free at a late stage.

Division EUCARIDA.—Carapace coalescing dorsally with all the thoracic somites. Eyes pedunculate. Antennal protopodite with, at most, two distinct segments. Mandible without lacinia mobilis in adult. Thoracic limbs flexed between fourth and fifth segments. No oostegites. An appendix interna sometimes present on pleopods. Hepatic cæca much ramified. Heart abbreviated, thoracic. Spermatozoa spherical or vesicular, often with radiating appendages. Development as a rule with metamorphosis. A free-swimming nauplius-stage in the more primitive forms.

* The movable appendages of the telson in Euphausiacea are modified setæ (Sars, 'Challenger' Rep., Schizopoda, p. 162).

Division HOPLOCARIDA.—Carapace leaving at least four of the thoracic somites distinct. Two movable segments are separated from the anterior part of the head, bearing respectively the pedunculate eyes and the antennules. Antennal peduncle of two segments. Mandibles without lacinia mobilis. Posterior thoracic limbs with protopodite of three segments. (The relation of the segments of the anterior thoracic limbs to those of the limbs in the other divisions is doubtful.) An appendix interna on pleopods. Hepatic cæca much ramified. Heart much elongated, extending through abdominal and thoracic regions. Spermatozoa spherical. Development with metamorphosis. No free-swimming nauplius-stage.

BIBLIOGRAPHICAL NOTICES.

Memoirs of the Geological Survey of the United Kingdom.—The Cretaceous Rocks of Britain. Vol. II. *The Lower and Middle Chalk of England.* By A. J. JUKES-BROWNE, B.A., F.G.S. With Contributions by WILLIAM HILL, F.G.S. 8vo. Pages xiii and 568. With 93 Illustrations, including one Geological Map, two Plates from photographs, and four from micrographs. E. Stanford, London; J. Menzies, Edinburgh; and Hodges & Co., Dublin. 1903.

IN the first volume of this series A. J. Jukes-Browne and W. Hill, with others, described the Gault and Upper Greensand of England. This second volume, by the same authors, together with many contributors, deals with the Lower and Middle Chalk. The third volume will include the description of the Upper Chalk, with chapters on the economics of the soil, stone, &c., on the water-supply, and the physical features of chalk districts, also a complete catalogue of the fossils found in all the different divisions of the Chalk. The present volume begins with a general and chronological account of the researches that led to the definition of the several stratal divisions of the Chalk; and in the sequel the zones or horizons marked out by the occurrence of particular fossils are carefully explained. This part of the book seems to have been written before the valuable results of the researches by Rowe and Sherborn were published; these and their subsequent work along the cliff-sections of the Chalk will have greatly helped geologists in the study of the strata and zones, and are largely utilized in the chapters on the Middle Chalk.

The Lower Chalk ("Cenomanian" in part) includes all the beds of marls and chalk between the Gault or Upper Greensand and the Melbourn Rock, namely, the so-called "Chloritic Marl" (and the "Cambridge Greensand"), the "Chalk Marl" (with the "Totternhoe Stone" in some districts), and the "Grey Chalk." These are subsequently described as to their characters, range, and fossils, according to the several counties and the northern parts of France.

The Middle Chalk (or Turonian Stage) is defined as consisting of zones marked by the occurrence of certain fossils, such as

3. Zone of *Holaster planus,* including the *Chalk Rock.*
2. Zone of *Terebratulina gracilis.*
1. Zone of *Rhynchonella Cuvieri,* or *Inoceramus mytiloides,* with the *Melbourn Rock* at its base.

These successive divisions are described as distributed in the several counties and in the North of France.

Throughout the long series of Memoirs published by the Geological Survey of Great Britain and Ireland, descriptive of the districts already surveyed, there are frequent allusions to the economic materials procured from the land, and to the relative conditions of the soil and subsoil. About 1871 the Geological Survey made a point of mapping the "Surface Drifts," such as the gravels, brick-earth, and boulder-clay, beginning with those of the Midland Counties, so that the agriculturalists of several wide districts have since then had the opportunity of recognizing and studying the nature and origin of the surface soils in connexion with the notes and explanations frequently given in the 'Memoirs.' In fact, the Secretary of the Board of Agriculture, cognizant of the advantages of geology to the farmer, wishes to advance its publicity and causes copies of the Memoirs to be distributed to scientific centres for recognition and review.

A Treatise on Zoology. Edited by E. Ray Lankester, M.A., LL.D., F.R.S., &c.—Part I. *Introduction and Protozoa.* Second Fascicle. 1903. London: Adam and Charles Black.

It has been found necessary to publish Part I. of Prof. Lankester's 'Treatise on Zoology' in two fascicles, and of these the second forms the subject of the present notice. The decision of the editor not to delay the publication of this volume until the first was ready is undoubtedly, both in the interests of the student and the authors of the several sections, a wise one.

Anything like a complete account of the several contributions to this fascicle would be impossible in the space at our disposal. Four in number, they are the work of Messrs. Farmer, Lister, Minchin, and Hickson, whose names are a sufficient guarantee that the quality of the work is not only sound, but of the best that can be got.

Prof. Farmer contributes a section on Animal and Vegetable Cells, wherein he traces the history of the cell from the epoch-making discovery by Hooke in 1665 "of the chambered structure of plants" to the latest revelations of the modern microscope. Wide though this survey is, and admirable in its treatment, we yet feel some surprise at the omission of any reference to the views of Mr. Sedgwick on the subject of the cell-theory.

The section on the Foraminifera by Mr. J. J. Lister is a monument of thoroughness. Embracing all the results, of any consequence, of the work of others in this field, he has added much that is new, presenting his facts with great clearness and force. We have only one small omission to notice, and that is the absence of Sherborn's 'Bibliography of the Foraminifera' and his 'Index to the Genera and Species of the Foraminifera' from the list of "Literature referred to."

Scarcely less valuable is the section by Prof. Hickson on the Infusoria (Corticata Heterokaryota). It is refreshing to remark in reading this section, and also other sections of this treatise, a more philosophical method of treatment than is to be found in any other similar work.

But the bulk of this book is devoted to what may justly be called the masterly treatise on the Sporozoa by Prof. E. A. Minchin. Remembering the part that many of these lowly organisms play as parasites and the ravages they commit, there can be no doubt but that the decision to make this section as complete as possible will be commended. To the medical man, as well as to the biologist, it will prove a source of great help, inasmuch as the author's account of the life-history of the malaria parasite is the first which has appeared in a general work on natural history in this country. Besides this, however, there is much else in the section that is now, for the first time, placed before the student in a readily accessible form, and a very great deal that is the result of laborious research on the part of the author himself.

Like the earlier parts, the tone of this volume is seriously dignified and the matter of the very best of its kind possible. There is a wealth of illustrations, all of which are excellent and many are new. We await with impatience the appearance of the first fascicle.

We regret to announce the death of Dr. William Francis, for many years one of the Editors of this Magazine, which took place on the 19th January. A short notice will appear next month.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 75. MARCH 1904.

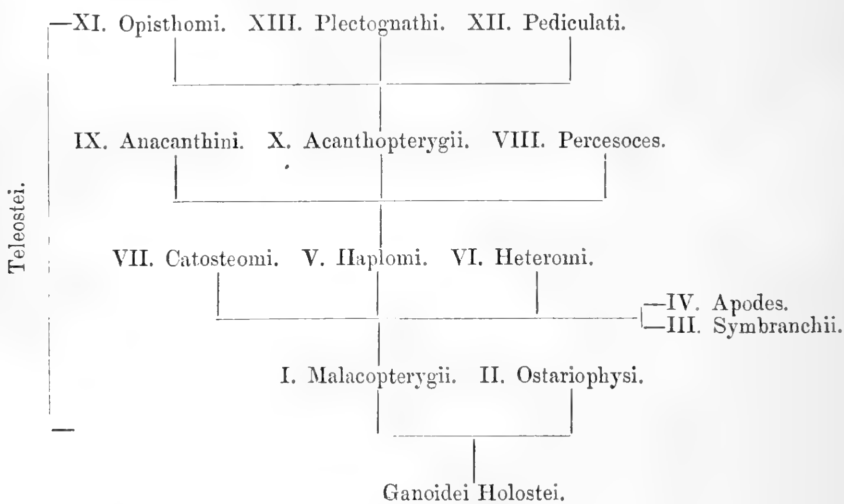
XIX.—*A Synopsis of the Suborders and Families of Teleostean Fishes.* By G. A. Boulenger, F.R.S.

For several years I have been endeavouring to improve the classification of Teleostean Fishes, chiefly through a study of their skeletons, of which a large series has been prepared in the British Museum; and Dr. A. Smith Woodward has recently published his views on the arrangement of the fossil types of this order. The time has come to gather together the information thus obtained. The synopsis here offered was prepared two years ago for the fish-volume of the 'Cambridge Natural History,' but owing to circumstances over which I have had no control its publication in that work is still further delayed. Several important changes to my original scheme have been made during this lapse of time, owing to the work carried on in America by Drs. Gill, Jordan, and Starks, and in this country by my young colleague Mr. C. Tate Regan, whose criticisms on many points I gratefully acknowledge.

I need hardly say that I regard this new arrangement of an enormous and most difficult group, including close upon 12,000 species, as merely provisional, and I am fully aware that not a few groupings are nothing but card castles, which future investigations are likely to upset. But my aim has been to build up on phylogenetic lines, and as such I sincerely trust my attempt will be found a considerable improvement on the previous systems and serve as a basis for criticism.

The arrangement here proposed has been used in the 'Zoological Record' for 1902, which has just appeared.

The precise definition of the order Teleostei, as compared with the Holostean Ganoids, is a matter of some difficulty. The most important character appears to be the presence of an ossified supraoccipital bone. Remnants of primitive characters, such as Ganoid scales, fulcra, rudiments of a splenial bone, spiral valve to the intestine, multivalvular bulbus arteriosus, are still found in some lower Teleosteans, but no longer in that combination which characterizes the preceding Order. Although *Albula* is exceptional among all Teleosteans in having two transverse series of valves to the bulbus arteriosus instead of one, no Ganoid has fewer than three. The order Teleostei, thus defined, is divided into thirteen suborders, the probable relations of which are expressed in the following diagram:—



In the classification of Günther, which has been generally in use in this country for the last thirty-five years, the Teleosts were divided into six principal groups, regarded as of ordinal rank:—1. Acanthopterygii; 2. Acanthopterygii Pharyngognathi; 3. Anacanthini; 4. Physostomi; 5. Lophobranchii; 6. Plectognathi. Group 1 corresponds to Suborders VI. (part.), VII. (part.), VIII. (part.), X., XI., and XII. of the present classification; Group 2 to Suborder X. (part.); Group 3 to Suborders IX. and X. (part.); Group 4 to Suborders I., II., III., IV., V., VI. (part.), and VIII. (part.);

Group 5 to Suborder VII. (part.); and Group 6 to Suborder XIII.

Fuller definitions of the families, with an indication of the principal genera contained in each, will be given in the forthcoming seventh volume of the 'Cambridge Natural History.'

Suborder I. Malacopterygii.

Air-bladder, if present, communicating with the digestive tract by a duct. Opercle well developed. Pectoral arch suspended from the skull; mesocoracoid arch present. Fins without spines, the ventrals abdominal, if present. Anterior vertebræ distinct, without Weberian ossicles.

This suborder, which corresponds to the Isospondyli and Scyphophori of Cope and to a part of the Isospondyli of A. S. Woodward, embraces the most generalized of the Teleosts, and is intimately connected with the Holostean Ganoids by the fossil forms which are placed at the base of the series of families. The physostomous condition of the air-bladder, the connexion of the pectoral arch with the skull, the presence of a mesocoracoid arch, the backward position of the many-rayed ventral fins, the normal condition of the anterior vertebræ, the absence of true spines to the fins, and the separation of the supraoccipital bone from the frontals by the parietals are primitive characters which occur combined in some families of this suborder only. The mesocoracoid arch is retained by the Ostariophysi, which differ in the remarkably modified condition of the anterior vertebræ, but it disappears in all other Teleosts, which gradually acquire a more forward position of the ventral fins and a reduction in the number of their rays, develop spines in the vertical fins, and lose the communication of the air-bladder with the outside.

The Malacopterygii may be divided into twenty-one families:—

I. Fins fringed with fulcra, or scales coated with ganoine; notochord usually continuous through the vertebræ (connecting forms between Ganoids and Teleosts).

Vertebral centra not more than rings; fins with fulcra; scales rhombic, united by peg-and-socket	1. *Pholidophoridæ* †.
Vertebral centra not more than rings; fins with fulcra; scales cycloid	2. *Archæomænidæ* †.
Vertebral centra complete or with minute perforation; fins with fulcra; scales cycloid ..	3. *Oligopleuridæ* †.
Vertebral centra nearly complete, but with perforation; no fulcra; scales cycloid........	4. *Leptolepididæ* †.

† This sign indicates that the family is represented by fossil forms only.

II. Fins without fulcra; scales without ganoine; vertebral centra usually complete.

A. Supraoccipital separated from the frontals by the parietals.

1. Ventral fins with 10 to 16 rays.

An intergular bone; parasphenoid narrow .... 5. *Elopidæ.*
No intergular bone; parasphenoid very broad .. 6. *Albulidæ.*

2. Ventrals with not more than 7 rays.

a. Supratemporal very large, plate-like, covering the greater part of the parietal bone.

Præmaxillary single, its posterior extremity free from the maxillary; symplectic absent; basis cranii simple...................... 7. *Mormyridæ.*
Præmaxillary paired, its posterior extremity firmly attached to the maxillary; symplectic present; basis cranii double ...... 8. *Hyodontidæ.*

b. Supratemporal small; maxillary firmly attached to posterior extremity of præmaxillary.

Præmaxillary paired; a large hole on each side of the skull, between the postfrontal and the squamosal; basis cranii double; suboperculum absent; ribs sessile .... 9. *Notopteridæ.*
Præmaxillary paired; basis cranii simple; suboperculum reduced; ribs inserted on parapophyses............................ 10. *Osteoglossidæ.*
Præmaxillary single; basis cranii simple; suboperculum and interoperculum absent; ribs inserted on parapophyses .... 11. *Pantodontidæ.*

c. Supratemporal small; maxillary movable; ribs sessile; ventral fins below the pectorals .... 12. *Ctenothrissidæ* †.

B. Supraoccipital in contact with frontals.

1. Interoperculum enormous; symplectic absent; basis cranii simple.......................... 13. *Phractolæmidæ.*

2. Interoperculum normal; symplectic present; basis cranii double.

a. Teeth in sockets; maxillary firmly attached to præmaxillary.

Symplectic exposed, fitting into a notch of the quadrate............................ 14. *Saurodontidæ* †.
Symplectic hidden between the quadrate and the hyomandibular .... 15. *Chirocentridæ.*

b. Teeth not in sockets.

Postclavicle on outer side of clavicle; no adipose dorsal fin .... 16. *Clupeidæ.*
Postclavicle on inner side of clavicle; an adipose dorsal fin .... 17. *Salmonidæ.*
Postclavicle absent; no adipose dorsal fin...... 18. *Alepocephalidæ.*

3. Interoperculum normal; basis cranii simple.

Maxillary large, toothed; præcaudal vertebræ without well-marked parapophyses; scales cycloid or absent; adipose dorsal fin present or absent .... 19. *Stomiatidæ.*

Mouth small, toothless; vertebræ with strong parapophyses; head and body covered with spiny scales .... 20. *Gonorhynchidæ.*
Mouth small, toothless; no symplectic; head and body naked .... 21. *Cromeriidæ.*

Suborder II. OSTARIOPHYSI.

Air-bladder, if well developed, communicating with the digestive tract by a duct. Pectoral arch suspended from the skull; mesocoracoid arch present. Fins without spines, or dorsal and pectoral with a single spine formed by the co-ossification of the segments of an articulated ray. The anterior four vertebræ strongly modified, often co-ossified and bearing a chain of small bones (Weberian ossicles) connecting the air-bladder with the ear.

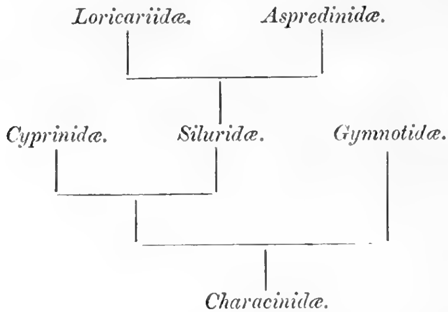
This is one of the most natural groups of the class Pisces, although its members are so diversified in outward appearance as to have been widely separated in the systems of older authors. It is to Sagemehl * that is due the credit of having first grouped, under the above name, the Characines, the Carps, the Catfishes, and the Gymnotids, the relations of which had been realized to a certain extent by Cope. But it was not until the homology throughout the group of the ossicula auditus, first described by E. H. Weber in 1820, had been demonstrated by Sagemehl that the justification for the course here followed appeared in its full strength, as such an agreement in the structure of so complicated and specialized an apparatus can only be the result of a community of descent of the families which are possessed of it. It is invariably the anterior four vertebræ that take part in the support of the Weberian apparatus. The first vertebra is much reduced; its upper arch is absent and replaced by the ossicles termed *claustrum* and *scaphium* †, the former being perhaps nothing but the modified neural arch, which fill in the space between the exoccipital and the neural arch of the second vertebra; the principal piece of the apparatus, the *tripus*, variable in form, is related to the third vertebra, of which it is regarded as a modified rib; a fibrous ligament extends from the anterior extremity or the *tripus* to the *scaphium*, and in this ligament is inserted the fourth piece, the *intercalarium*. The various forms of this suborder also show a complete agreement in the spinal nerves which pass through these ossicles.

* Morphol. Jahrb. x. 1885, p. 22.

† For the nomenclature of these ossicles, *cf.* Bridge and Haddon, Proc. Roy. Soc. xlvi. 1889, p. 310.

The parietal bones either separate the frontals from the supraoccipital or are fused with the latter.

This suborder is divided into six families. The Characinids are the most generalized, and the others are probably derived from them in the manner expressed by the following diagram :—



I. Parietal bones distinct from the supraoccipital; symplectic present; ribs mostly sessile, all or the greater number of the præcaudal vertebræ without parapophyses.

Mouth not protractile, usually toothed; pharyngeal bones normal; body scaly; an adipose dorsal fin often present	1. *Characinidæ.*
Mouth not protractile, usually toothed; pharyngeal bones normal; body eel-shaped, naked or scaly; vent under the head or on the throat	2. *Gymnotidæ.*
Mouth usually more or less protractile, toothless; lower pharyngeal bones large, falciform; body naked or scaly; no adipose dorsal fin	3. *Cyprinidæ.*

II. Parietal bones usually fused with the supraoccipital; symplectic absent; body naked or with bony scutes; mouth usually toothed, with barbels; adipose dorsal fin often present.

Ribs attached to strong parapophyses; operculum well developed	4. *Siluridæ.*
Ribs sessile; parapophyses absent; operculum more or less developed; mouth inferior..............	5. *Loricariidæ.*
Ribs sessile; strong parapophyses to the vertebræ; operculum absent	6. *Aspredinidæ.*

Suborder III. Symbranchii.

Eel-shaped fishes without paired fins, with the pectoral arch free or suspended from the skull and with the anterior vertebræ distinct, without Weberian ossicles. Gill-openings confluent into a single ventral slit. Air-bladder absent.

The structure of the skull conforms to that of typical Malacopterygians. The præmaxillary and maxillary are both well developed, the latter placed behind the former, and forming but a very small part of the oral border; the symplectic is present; the parietals form a long sagittal suture and separate the frontals from the supraoccipital. The vertebræ are very numerous, the præcaudals bearing very strong parapophyses, to which short slender ribs are attached. The skin is naked (Symbranchidæ) or covered with minute scales (Amphipnoidæ), and the vertical fins are rudimentary, reduced to mere dermal folds.

Like the Apodes, these fishes are no doubt derived from some low type with abdominal ventral fins, but whether from the Malacopterygii or the Haplomi we have as yet no data from which to conclude.

Only two families:—

Post-temporal well developed, forked, attached to the skull .... 1. *Symbranchidæ.*
Post-temporal absent, the shoulder-girdle free from the skull .... 2. *Amphipnoidæ.*

Suboder IV. Apodes.

Air-bladder, if present, communicating with the digestive tract by a duct. Præmaxillaries absent; the maxillaries, if present, separated on the median line by the coalesced ethmoid and vomer. Pectoral arch, if present, not connected with and remote from the skull; mesocoracoid arch absent. Fins without spines, the ventrals absent. Anterior vertebræ distinct, without Weberian ossicles.

The Apodes, or Eels, are elongate serpentiform fishes with naked skin or with minute scales imbedded in the skin, the opercular bones small and completely hidden under the integument, narrow or minute gill-openings, the vertical fins, if present, confluent behind or separated by the projecting tip of the tail. The pterygo-palatine arch is often reduced or absent, and there is no distinct symplectic; the supraoccipital bone is small, separated from the frontals by the parietals, which meet on the middle line. The vertebræ are very numerous (up to 225) and the præcaudals bear strong parapophyses, to which short slender ribs may be attached; epineurals are sometimes present.

The five families into which this suborder is divided show remarkable degrees of simplification in the structure of the skull, through reduction or loss of either the maxillary or the pterygo-palatine arches.

Five families:—

Maxillaries present, separated on the median line by the ethmo-vomer; palato-pterygoid present, connected with the hyomandibular and quadrate; gill-clefts separate, opening into the pharynx by wide slits; tongue present; vent far removed from the head . .	1. *Anguillidæ.*
Distinguished from the preceding by the position of the vent, which is close to, or at no great distance from, the gill-openings	2. *Nemichthyidæ.*
Maxillaries narrowly separated on the median line, their extremity strongly attached by ligament to the mandible; pterygo-palatine arch absent; gill-openings externally confluent into a single ventral slit	3. *Synaphobranchidæ.*
Maxillaries narrowly separated on the median line, extremely elongate; mouth enormous; pterygo-palatine arch absent; hyomandibular arch slender and movably articulated to the cranium; branchial arches far behind the skull	4. *Saccopharyngidæ.*
Maxillaries absent, replaced by the palato-pterygoid, the mouth bordered by the latter and the ethmo-vomer; palato-pterygoid bone separated from hyomandibular arch; branchial openings into the pharynx narrow slits; no tongue	5. *Murænidæ.*

Suborder V. Haplomi.

Air-bladder, if present, communicating with the digestive tract by a duct. Opercle well developed. Pectoral arch suspended from the skull; no mesocoracoid arch. Fins usually without, rarely with a few spines; ventrals abdominal, if present. Anterior vertebræ distinct, without Weberian ossicles.

The absence of the mesocoracoid arch distinguishes the Haplomi from the Malacopterygii, with which they are united by various authors. They lead to the Percesoces through the Cyprinodontids, and to the Lower Acanthopterygians, such as the Berycids, through the Scopelids, Stephanoberycids, and Percopsids, as is evidenced by the structure of the mouth and the forward position in some of the genera of the ventral fins, which, however, are never attached to the pectoral girdle. Most of the forms which are here included inhabit either fresh waters or the deep sea.

Fourteen families :—

I. Parietals separating the frontals from the supraoccipital; post-temporal simple; præcaudal vertebræ with autogenous parapophyses.

Margin of the upper jaw formed by the præmaxillaries and the maxillaries; basis cranii simple; no adipose dorsal fin .... 1. *Galaxiidæ.*
Margin of the upper jaw formed by the præmaxillaries only; basis cranii double; adipose dorsal fin present .... 2. *Haplochitonidæ.*

II. Frontals in contact with the supraoccipital.
A. Præcaudal vertebræ without parapophyses.
1. Margin of the upper jaw formed by the præmaxillaries and the maxillaries.

Body without or with minute scales, usually with rows of scutes; adipose dorsal fin usually present .... 3. *Enchodontidæ* †.
Body scaly; post-temporal forked; no adipose dorsal fin; ventrals with 6 to 11 rays .... 4. *Esocidæ.*
Body scaly; post-temporal incompletely ossified; pectoral fin without pterygials; no adipose dorsal fin; ventrals with 3 rays only...... 5. *Dalliidæ.*

2. Maxillaries excluded from the oral border.
a. Adipose dorsal fin usually present; ventral fin with 7 to 10 rays.

Post-temporal forked; dorsal fin formed of articulated rays .... 6. *Scopelidæ.*
Post-temporal simple; dorsal fin very long, formed of slender, non-articulated, simple or bifid rays .... 7. *Alepidosauridæ.*

b. No adipose dorsal fin; head and mouth enormous, dentition feeble; body naked; ventral fins, if present, with 5 rays. 8. *Cetomimidæ.*

B. Præcaudal vertebræ with well-developed parapophyses; maxillaries excluded from the oral border.
1. Dorsal and anal fins without spines; scales cycloid, or with erect spines; no adipose dorsal fin.

Mouth not protractile; ventral fins far forward, with 7 to 17 rays .... 9. *Chirothricidæ* †.
Mouth not protractile; ventral fins remote from the pectorals, with 9 rays............... 10. *Kneriidæ.*
Mouth protractile; ventral fins, if present, with 5 to 7 rays............................ 11. *Cyprinodontidæ.*
Mouth scarcely protractile; ventral fins rudimentary or absent; vent close to the gills.. 12. *Amblyopsidæ.*
Mouth slightly protractile; ventral fins with 5 or 6 rays .... 13. *Stephanoberycidæ.*

2. Dorsal and anal fins with true spines; scales ctenoid; an adipose dorsal fin; ventral fins with 9 rays.. 14. *Percopsidæ.*

Suborder VI. Heteromi.

Air-bladder without open duct. Opercle well developed; parietal bones separating the frontals from the supraoccipital. Pectoral arch suspended from the supraoccipital or the epiotic, the post-temporal small and simple or replaced by a ligament; no mesocoracoid. Ventral fins abdominal, if present.

The Halosauridæ and Notacanthidæ are deep-sea fishes of obscure affinities. In the abdominal position of the many-rayed ventral fins and in the absence of the mesocoracoid arch they agree with the Haplomi; but if, as the investigations of Günther lead us to believe *, there is really no open communication between the air-bladder and the digestive tract, they should be removed from this physostomous suborder. The two families have many characters in common, such as the attachment and structure of the pectoral arch, which is devoid of a postclavicle, the position of the pectoral fins high up the sides, the strong parapophysis inserted very low down on the centre of the vertebræ, the extent of the parietal bones, which meet in a sagittal suture and separate the frontals from the supraoccipital. The recent discovery of a third family, the Lipogenyidæ, which in the structure of the dorsal fin is so exactly intermediate between the two others, has lessened the gap between the Lyomeri (Halosauridæ) and Heteromi (Notacanthidæ) of Gill, which I propose to unite in a suborder under the latter name. These fishes are no doubt derived from forms in which a separate caudal fin existed; such a type must have been near the Dercetidæ, as defined by A. S. Woodward, which may provisionally be placed here.

There is a fifth family which may be placed in this suborder, the Fierasferidæ, the structure of which has been exquisitely described and figured by Emery. Hitherto placed with or near the Ophidiidæ, they differ widely from them, as well as from all other Acanthopterygians, in the conformation of the skull, the supraoccipital being separated

* Vaillant was inclined to take a different view, but with considerable diffidence, owing to his inability actually to trace an open duct. I believe Günther to be right on this point, as well as in his account of the suspension of the pectoral arch in *Notacanthus*, which I have been able to verify. Besides, Mr. W. S. Rowntree, who has great experience in these matters, has kindly examined at my request a well-preserved example of *Halosauropsis macrochir*, and informs me that "the air-bladder passes anteriorly into a tapering band of tissue which ends in a thread-like ligament attached to the stomach near its posterior end and in the mid-dorsal line —not to the œsophagus; no trace of an open communication could be found."

from the frontals by the parietals, which form a long median suture. This is a feature which has only been observed in fishes with abdominal ventral fins; and although the total absence of these fins in *Fierasfer* deprives us of an important criterion in deciding on its affinities, I am inclined to regard this family as derived from an abdominal type. The conformation of the pectoral arch has much in common with that of the Halosaurs, and, notwithstanding the interpretation that has been given to the bones at the back of the cranium in the latter type, the same may be said in a general way of the skull.

As pointed out by Emery, the very anterior position of the vent in the Fierasferidæ is directly related to the curious mode of life of these fishes, and the analogous condition obtained in various families, such as the Gymnarchidæ, Nemichthyidæ, Amblyopsidæ, and Aphredoderidæ, shows it to be of relatively small importance.

Five families :—

Ordinary scales small or wanting, but two or more continuous series of enlarged scutes along each side; mouth large, præmaxillaries apparently forming the greater part of the upper border of the mouth, which is toothed; opercular apparatus complete; dorsal fin more or less extended, without spines; anal short; caudal separate; ventrals with not less than 7 or 8 rays .... 1. *Dercetidæ* †.

Body covered with cycloid scales, the tail tapering to a point, without caudal fin; head with scales; mouth moderate, bordered by the præmaxillaries and the maxillaries, both toothed; suborbitals large; præopercle rudimentary; dorsal fin short, without spines; ventrals formed of 9 or 10 soft rays; anal very long, without spines, extending to the end of the tail .... 2. *Halosauridæ*.

Similar to the preceding, but with a toothless, roundish inferior mouth and with the short dorsal and the long anal formed partly of spines and partly of soft rays; ventrals with 3 spines and 7 soft rays.................................... 3. *Lipogenyidæ*.

Body covered with cycloid scales, the tail tapering to a point, without caudal fin; head with scales; mouth small, inferior, bordered by the præmaxillaries only; jaws toothed; no suborbitals; præoperculum small; post-temporal replaced by ligament; dorsal fin formed of a series of short disconnected spines; anal very long, formed partly of spines and partly of soft rays; ventrals with 1 to 5 spines and 7 to 10 soft rays ...... 4. *Notacanthidæ*.

Body extremely attenuate, naked; no caudal fin; mouth small, inferior, bordered by the præmaxillaries; jaws toothed; no suborbitals; præoperculum well developed; dorsal and anal very long, formed of soft rays; ventrals absent; vent immediately behind the gill-opening .... 5. *Fierasferidæ.*

Suborder VII. Catosteomi.

Air-bladder, if present, without open duct. Parietal bones, if present, separated by the supraoccipital. Pectoral arch suspended from the skull; no mesocoracoid arch; coracoid usually very large, or produced posteriorly. Ventral fins, if present, abdominal, or pelvis attached to the coracoid bones.

The mouth is bordered by the præmaxillaries, or by the præmaxillaries and a small portion of the maxillaries. Air-bladder present, except in the Solenostomidæ and Pegasidæ.

Following the suggestions of Kner and Steindachner and Cope to their logical conclusion, A. S. Woodward has united the Lophobranchs of Cuvier with the Hemibranchs of Cope, a course which seems fully justified, and has received further support from the recent investigations of Swinnerton *, who has proposed to unite the two groups under the new name of Thoracostei. The structure of the Lophobranchs (Solenostomidæ and Syngnathidæ) shows that these fishes are only extremely specialized forms of the group of which the Sticklebacks are the well-known type, and the character of the "tufted" gills alone is surely not of sufficiently great importance to warrant the retention of the Lophobranchii as a division equivalent to the suborders adopted in the present classification. Besides, as recently pointed out by A. Huot †, there is no fundamental difference, only one of degree, between the so-called tufted gill and the normal type; each "tuft" corresponds to one branchial lamella, and at a certain stage of development the disposition of the branchial lamellæ is the same in a *Syngnathus* and an ordinary Teleostean. I have recently attempted to show ‡ that the Lamprididæ are related to the Hemibranchii, although sufficiently distinct to warrant the establishment of a division, named Selenichthyes §.

The affinities of the Lamprididæ are very doubtful. *Lampris* has usually been placed with the Acanthopterygians, a

* Quart. Journ. Micr. Sci. xlv. 1902, p. 503.

† Ann. Sci. Nat. (8) xiv. 1902, p. 197.

‡ Ann. & Mag. Nat. Hist. (7) x. 1902, p. 147.

§ E. C. Starks, in an important paper (P. U.S. Nat. Mus. xxv. 1902, p. 619), has shown that the so-called "infraclavicle" of sticklebacks and allies does not exist as a distinct element. The definition of the Catosteomi as I had originally drawn it up has accordingly been modified.

view which is still upheld by Gill *. I now agree with this high authority in regarding the bone which I took for an infraclavicle as a much developed coracoid, and the bone termed by me the coracoid as a pterygial. But it has also been shown, by Starks, that such a thing as an infraclavicle does not exist even in the stickleback, the bone so-called being only a part of the coracoid; and as, in most of the sticklebacks, the pelvic bones join the latter, the resemblance between them and *Lampris* remains. As I have previously pointed out, the absence of spines in the fins and the position of the ventral fins, together with the great number of rays in the latter, which is only met with in the lower Teleosteans, are characters which necessitate the removal of *Lampris* from the Acanthopterygians, and I cannot find a better place for them than near the Gastrosteidæ.

The whole question of the arrangement of the Physoclists with abdominal ventrals (Catosteomi and Percesoces) is, I feel, much in need of revision, and it may be found advisable to break up this group into a greater number of suborders, in which case the Selenichthyes would stand by themselves; the Hemibranchii and Lophobranchii would be united under the former name, as proposed by Woodward, or under that of Thoracostei (Swinnerton) or Phthinobranchii (Hay).

Eleven families :—

I. Præoperculum and symplectic distinct; branchial apparatus fully developed, gills pectinate; mouth terminal, toothless; post-temporal forked, free; pelvic bones connected with scapular arch, vertical fins with 15 to 17 rays; ribs long, sessile; fins without spines. (SELENICHTHYES.) .... 1. *Lamprididæ.*

II. Præoperculum and symplectic distinct, latter much elongate; branchial apparatus more or less reduced, gills pectinated; post-temporal simple, immovable; mouth terminal. (HEMIBRANCHII.)

A. Mouth toothed.

1. Pelvic bones close to or connected with scapular arch; spinous dorsal represented by isolated spines.

Snout conical or but slightly tubiform; ventral fins with one spine and one or two soft rays; ribs slender, free; anterior vertebræ not enlarged.......................... 2. *Gastrosteidæ.*

Snout tubiform; ventral fins with one spine and four soft rays; ribs flattened, fused with the lateral bony shields; anterior vertebræ not enlarged.......................... 3. *Aulorhynchidæ.*

Snout tubiform; ribs slender, free; first vertebra enlarged.......................... 4. *Protosyngnathidæ* †.

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* Proc. U.S. Nat. Mus. xxvi. 1903, p. 915.

2. Pelvic bones not connected with scapular arch; ventrals without spine, with 5 or 6 rays; snout tubiform; first vertebra very elongate, formed by the fusion of several.

Isolated dorsal spines; body scaly .... 5. *Aulostomatidæ.*
No dorsal spines; body naked .... 6. *Fistulariidæ.*

B. Mouth toothless; snout tubiform; two short dorsal fins, the first with a few spines; ventral fins with 3 to 5 rays; anterior vertebræ elongate.

Body covered with bony shields and small rough scales.......................... 7. *Centriscidæ.*
Body completely cuirassed by bony shields, which are fused with the endoskeleton .. 8. *Amphisilidæ.*

III. Præoperculum absent; symplectic much elongate; branchial apparatus more or less reduced; gill-lamellæ reduced in number and enlarged, forming rounded lobes; post-temporal simple, immovably attached to the skull; mouth toothless, at the end of a tubiform snout; body covered with bony plates. (Lophobranchii.)

Two dorsal fins; ventral fins present, with 7 rays; gill-openings wide; exoskeleton of large star-like plates .... 9. *Solenostomidæ.*
A single dorsal fin; no ventral fins; gill-openings very small; exoskeleton in the form of rings .... 10. *Syngnathidæ.*

IV. Præoperculum and symplectic absent; gills pectinated; mouth inferior, toothless; body entirely covered with bony plates; ventral fin with 2 or 3 rays. (Hypostomides.) 11. *Pegasidæ.*

Suborder VIII. Percesoces.

Air-bladder, if present, without open duct. Parietal bones separated by the supraoccipital. Pectoral arch suspended from the skull; no mesocoracoid arch. Ventral fins, if present, abdominal, or at least with the pelvic bones not solidly attached to the clavicular arch.

This group connects the Haplomi with the Acanthopterygii, the Scombresocidæ being somewhat related to the Cyprinodontidæ *, whilst the Anabantidæ show distinct affinity to the

* Swinnerton (Quart. Journ. Micr. Sci. xlv. 1902, p. 554) has pointed out that the skull of the Scombresoces belongs to what he terms the Acrartete type (*e. g.* in which the attachment of the palatine cartilage or its derivates is confined to the pre-ethmoid cornua), whilst the other Percesoces examined by him, as well as the Cyprinodonts, are Disartete (the attachment being at the par-ethmoid and pre-ethmoid cornua); but the character is so indistinctly defined in some adult Cyprinodonts, that I feel some diffidence in making use of this character for systematic purposes in the present state of our knowledge.

Osphromenidæ in the following suborder. Other families, previously included among the Scombriform Acanthopterygians, are placed here on the assumption that the loose attachment of the pelvic bones to the clavicles is a primitive character, and not the result of degeneration, such as occurs in some cases among the Acanthopterygians. Although this suborder is perhaps only an artificial association, it must be borne in mind that, notwithstanding the very wide divergence which exists between the first and last families, however dissimilar their members appear to be at first sight, a gradual passage may be traced connecting the most aberrant types.

Twelve families:—

I. Ventral fins, if present, inserted far behind the pectorals; no spines to the fins.

Ribs attached to the extremity of much-developed parapophyses; lower pharyngeal bones completely united; pectoral fins inserted very high up .... 1. *Scombresocidæ.*

Ribs mostly sessile; lower pharyngeal bones distinct; pectoral fins nearer the ventral than the dorsal line .... 2. *Ammodytidæ.*

II. Ventral fins, if present, more or less approximated to the pectorals.

A. Two well-developed dorsal fins, the anterior small and formed, at least in part, of spinous rays.

1. Ribs attached to strong parapophyses.

Pelvic bones free or connected with the clavicles by ligament; pectoral fins inserted high up .... 3. *Atherinidæ.*

Pelvic bones suspended from the postclavicles; pectoral fins inserted very high up; teeth very feeble or absent .... 4. *Mugilidæ.*

Pelvic bones suspended from the postclavicles; pectoral fins nearer the ventral than the dorsal line, with detached lower rays .... 5. *Polynemidæ.*

Pelvic bones connected with the clavicles by ligament; pectoral fins nearer the ventral than the dorsal line; dentition powerful, cardiform; scales minute or absent .... 6. *Chiasmodontidæ.*

2. Anterior ribs sessile; pelvic bones not connected with the scapular arch; pectoral fins nearer the ventral than the dorsal line .... 7. *Sphyrænidæ.*

B. Spinous dorsal, if present, connected with the soft.

1. Anterior vertebræ without parapophyses; scales on head, if present, small.

Œsophagus with lateral sacs which are beset with papillæ internally; spinous dorsal long; scales rhomboidal, in oblique transverse series; pelvic bones free .... 8. *Tetragonuridæ.*

Œsophagus with lateral sacs which are beset with toothed papillæ internally; spinous dorsal, if distinct, shorter than the soft dorsal; scales moderate or small, cycloid, often deciduous	9. *Stromateidæ.*
No sacs in the œsophagus; fins without spines; scales very small or absent	10. *Icosteidæ.*

2. All or all but the two anterior vertebræ with parapophyses; scales on head large; a suprabranchial cavity.

No spines to the fins	11. *Ophiocephalidæ.*
Strong spines to the dorsal, anal, and ventral fins.	12. *Anabantidæ.*

Suborder IX. Anacanthini.

Air-bladder without open duct. Parietal bones separated by the supraoccipital; prootic and exoccipital separated by the enlarged opisthotic. Pectoral arch suspended from the skull; no mesocoracoid arch. Ventral fins below or in front of the pectorals, the pelvic bones posterior to the clavicular symphysis and only loosely attached to it by ligament.

Fins without spines; caudal, if present, without expanded hypural, perfectly symmetrical, and supported by the neural and hæmal spines of the posterior vertebræ and by basal bones similar to those supporting the dorsal and anal rays. This type of caudal fin must be regarded, as I have pointed out *, as secondary, the Gadidæ being no doubt derived from fishes like the Macruridæ, in which the homocercal fin had been lost. The scapular foramen or fenestra is nearly always between the scapular and coracoid bones, as in the Trachinidæ and several allied families, not in the coracoid, as in the other Acanthopterygians. The first two vertebræ have no epipleurals.

Mr. C. Tate Regan †, who has recently given a good definition of the Anacanthini, divides them into three families, which are here adopted:—

Ventral fins below the pectorals, with 7 to 12 rays; no caudal fin	1. *Macruridæ.*
Ventral fins jugular, with 1 to 9 rays; caudal fin more or less distinct (diphycercal or isocercal)	2. *Gadidæ.*
Ventral fins jugular, with 5 rays; no caudal fin; pectoral pterygials in increased number (10); scales as in the Anguillidæ	3. *Murænolepididæ.*

* Ann. & Mag. Nat. Hist. (7) x. 1902, p. 295.
† *Op. cit.* xi. 1903, p. 460.

Suborder X. Acanthopterygii.

Air-bladder usually without open duct. Opercle well developed; supraoccipital in contact with the frontals. Pectoral arch suspended from the skull; no mesocoracoid. Ventral fins thoracic or jugular, the pelvic bones more or less firmly attached to the clavicular arch. Gill-opening usually large; if small, in front of or above the base of the pectoral fin.

The character from which this suborder, the most comprehensive of the whole class, derives its name, viz. the presence of non-articulated, more or less pungent rays in the dorsal and anal fins, is by no means universal, exceptions to the rule being numerous. The mouth is usually bordered by the premaxillaries to the exclusion of the maxillaries, and if these should, by exception, enter the oral edge, they are always toothless. The ventral fins are sometimes inserted at some distance behind the base of the pectorals (Haplodactylidæ, Platycephalidæ), in which case, however, this is merely due to the elongation of the pelvic bones, which are solidly attached to the clavicular arch. The suborder is broken up into 9 divisions, which follow in somewhat arbitrary order, the natural affinities being opposed to a linear arrangement.

I. No suborbital stay, or process extending from the suborbital bones towards the præoperculum; basis cranii double in the symmetrical forms. Primary shoulder-girdle composed of a perforate scapula and a coracoid; of the four or five pterygials, or basal bones of the pectoral fins, only one or two are in contact with the coracoid; ventral fins thoracic.

Rays of the caudal fin not strongly forked at the base; hypural usually with a basal spine or knob-like process on each side; epipleural bones usually inserted on the parapophyses or on the ribs; dorsal fin usually with strong spines; caudal peduncle rarely much constricted .... I. Perciformes.

Rays of the caudal fin strongly forked at the base, embracing a considerable portion of the hypural, which always bears a basal spine; epipleural bones usually inserted on the centra or on the parapophyses, rarely on the ribs; dorsal spines feeble or detached; caudal peduncle much constricted; scales usually very small or absent .... II. Scombriformes.

Rays of the caudal fin not strongly forked at the base, no hypural spine, and ventral fins with one spine and six to eight soft rays, *or* cranium asymmetrical .... III. Zeorhombi.

II. No suborbital stay; basis cranii double; scapula absent, the pterygials inserted on the coracoid; ventral fins thoracic. IV. Kurtiformes.

III. No suborbital stay; basis cranii simple; scapula and coracoid more or less reduced, sometimes vestigial; pterygials large, only one or two in contact with the coracoid; ventral fins thoracic. V. GOBIIFORMES.

IV. No suborbital stay; basis cranii simple; a perforate scapula; three pterygials in contact with the coracoid; ventral fins thoracic; a suctorial transversely laminated disk on the upper surface of the head .... VI. DISCOCEPHALI.

V. A suborbital stay, the second suborbital bone being more or less produced on the cheek or joining the præoperculum; ventral fins thoracic .... VII. SCLEROPAREI.

VI. No suborbital stay; ventral fins usually jugular or mental, or, if thoracic, structure of the pectoral arch differing from that ascribed to the first five divisions of this Synopsis.

Pectoral fin with vertical or subvertical base; anal fin usually elongate, rarely small .... VIII. JUGULARES.

Pectoral fin with horizontal or subhorizontal base; body exceedingly compressed; dorsal fin with all the rays simple; anal fin absent or very small .... IX. TÆNIOSOMI.

Division I. PERCIFORMES.

No bony stay for the præoperculum. Basis cranii double. Spinous dorsal usually well developed. None of the epipleural bones attached to the centra of the vertebræ in the præcaudal region. Pectoral arch with well-developed scapula and coracoid, the former pierced by a foramen or fenestra; pterygials longer than broad, more or less regularly hourglass-shaped, 4 or 5 in number, one or two of which are in contact with the coracoid. Ventral fins thoracic.

This large group, consisting chiefly of marine forms, has members in all parts of the world, with the exception of the Arctic and Antarctic regions, and was already represented by numerous Berycidæ and a few Serranidæ and Scorpididæ in the Upper Cretaceous. The division into families, capable of rigid definition, is a task of considerable difficulty, and the necessities of a linear arrangement result in the breaking up of some natural sequences. Thus it appears highly probable that the Scorpididæ, themselves derived, together with the Serranidæ, from the Berycidæ, lead to the Carangidæ in the division Scombriformes, whilst a nearly perfect passage can be traced between the Acanthuridæ of this division and the Balistidæ among the Plectognaths.

Thirty-six families:—

I. Gills four, a slit behind the fourth.
 A. Two nostrils on each side.
  1. Ventrals with one spine and 6 to 13 soft rays.
   1. *Berycidæ.*

2. Ventrals with not more than 5 soft rays.
   a. Lower pharyngeal bones not completely united, showing at least a median suture.
      a. Gill-membranes free from isthmus.
         * Ventrals little if at all behind the pectorals.
            † Third vertebra without transverse processes *or* with sessile ribs.
               ‡ A more or less developed subocular shelf, or inner lamina of the suborbitals supporting the eyeball, sometimes reduced to a mere process of the second suborbital.
                  § Ribs inserted on the transverse processes, when these are developed.

Body covered with very large bony scales; ventrals with a very strong spine and 2 or 3 very short soft rays	2. *Monocentridæ.*
Dorsal very short, with few graduated, adnate spines; anal very long	3. *Pempheridæ.*
Spinous dorsal usually well developed, soft dorsal usually not much more developed than the anal; palate usually toothed....	11. *Serranidæ.*
Dorsal and anal fins elongate and formed mostly of articulated soft rays, the spines feeble and few........................	12. *Pseudochromididæ.*
Dorsal and anal fins much elongate, without distinct spines; body band-like	13. *Cepolidæ.*
Teeth in the jaws fused to form a beak	14. *Hoplegnathidæ.*
Soft dorsal and anal much elongate; a separate spinous dorsal	15. *Sillaginidæ.*
Soft dorsal much longer than the anal; a separate spinous dorsal	16. *Sciænidæ.*

§§ Ribs mostly sessile, behind the parapophyses; body deep; mouth moderately large and protractile.

Supratemporal forked, distinct from skull	25. *Scorpididæ.*
Supratemporal completely ankylosed to the skull; mouth very protractile	26. *Caproidæ.*

‡‡ No subocular shelf.
   § Ribs mostly sessile, behind the parapophyses; anal spines 3 to 14.

Teeth conical; palate toothed; mouth freely protractile	4. *Centrarchidæ.*
Teeth incisor-like; fins densely scaled	5. *Cyphosidæ.*
Teeth conical; palate toothless..............	6. *Lobotidæ.*
Maxillary very slender, mouth very protractile.	7. *Toxotidæ.*
No entopterygoid; mouth very protractile	8. *Nandidæ.*

§§ Ribs inserted on the transverse processes when these are developed; not more than 3 anal spines.

Mouth not or but feebly protractile; palate toothed; spinous dorsal usually longer than the soft; anal with 1 or 2 spines....	9. *Percidæ.*
Mouth moderately protractile; palate toothed; spinous dorsal not longer than the soft; anal with 2 or 3 spines	10. *Acropomatidæ.*

Mouth very protractile, præmaxillary with an upward lateral process; palate toothless.. 17. *Gerridæ.*
Mouth moderately protractile; palate toothless; anal longer than soft dorsal; body scaly .. 18. *Lactariidæ.*
Mouth moderately protractile; palate toothless; anal much longer than soft dorsal; body naked .... 19. *Trichodontidæ.*

†† Transverse processes developed on the third vertebra and bearing the rib; palate usually toothless.

No subocular shelf; teeth small .... 22. *Pristipomatidæ.*
A subocular shelf; teeth often either cutting in front or molar-like on the sides ...... 23. *Sparidæ.*
A subocular shelf; teeth very small or absent; a pair of barbels on the throat .... 24. *Mullidæ.*

** Ventrals rather far behind the base of the pectorals; lower pectoral rays unbranched, often thickened; no subocular shelf.

Anal fin nearly as long as the soft dorsal .... 20. *Latrididæ.*
Anal fin much shorter than the soft dorsal .... 21. *Haplodactylidæ.*

β. Gill-membranes attached to the isthmus.

* Scales well developed; vertebræ 24 or more.

A subocular shelf; mouth small; palate toothless .... 27. *Chætodontidæ.*
No subocular shelf; mouth small; palate toothless .... 28. *Drepanidæ.*
Subocular shelf more or less developed; a superbranchial respiratory organ .... 31. *Osphromenidæ.*

** Scales minute; mouth small; vertebræ 22 or 23.

Post-temporal not distinctly forked; vertebræ with strong transverse processes; ventrals with 1 spine and 2 to 5 soft rays .... 29. *Acanthuridæ.*
Post-temporal forked; vertebræ without transverse processes; ventrals with 2 spines and 3 soft rays between them .... 30. *Teuthididæ.*

b. Lower pharyngeals completely united into one bone, without median suture .... 32. *Embiotocidæ.*

B. A single nostril on each side; lower pharyngeal bones more or less completely united, but with persistent suture; no subocular shelf; palate toothless ...... 33. *Cichlidæ.*

II. Gills three and a half; lower pharyngeals completely united into one bone, without median suture; palate toothless.

A single nostril on each side; teeth conical or incisor-like; a subocular shelf .... 34. *Pomacentridæ.*
Two nostrils on each side; anterior teeth usually strong and canine-like; teeth on pharyngeal bones conical or tubercular; no subocular shelf .... 35. *Labridæ.*
Two nostrils on each side; anterior teeth more or less coalesced into a beak; teeth on pharyngeal bones flat, tessellated; no subocular shelf......................... 36. *Scaridæ.*

Division II. Scombriformes.

No bony stay for the præopercle. Spinous dorsal, if distinct, formed of short or feeble, slender spines. Epipleurals usually attached to the centra when ribs are sessile, or to the parapophyses of the vertebræ, rarely to the ribs. Pectoral arch similar to that of the Perciformes, but pterygials sometimes more abbreviated. Ventral fins thoracic. Caudal fin, if well developed, with very numerous rays deeply forked at the base.

Although bound by natural ties, the series of families that cluster round the mackerel offer so many modifications of structure that it is almost impossible to draw up a diagnosis differentiating every one of its members from the Perciformes, with which they are closely connected, and from which they hardly deserve to be separated. Even after removing many genera which have been united with them by my predecessors, and which will now be found scattered among various groups of the system, no better definition of the Scombriformes can be given than that the mackerel and horse-mackerel are taken as the pattern-forms around which more or less aberrant types are located, types yet not so aberrant as to be traced back to these familiar forms through a number of intermediate grades. As regards external features, it may be stated that the dorsal and anal spines, if present, are weak and slender, or, if strong, short and detached, the caudal peduncle is constricted, and the caudal fin, if well developed, is usually deeply forked and with the forked bases of the very numerous rays much longer than in most of the Perciformes, embracing at least a considerable portion of the expanded ural bones, a character by which the Chætodontidæ, Acanthuridæ, and several extinct types which have been placed with the Carangidæ are at once excluded. All are marine and many are pelagic and of very wide distribution. No prætertiary members of this division, as here defined, have yet been found.

Nine families :—

I. Præmaxillaries more or less protractile, not beak-like ; scales small or absent, sometimes with enlarged lateral scutes ; spinous dorsal short or replaced by a series of isolated spines ; anal usually with one or two spines detached from the rest of the fin.

Præcaudal vertebræ with transverse processes, behind which the ribs are attached .... 1. *Carangidæ.*

Præcaudal vertebræ without well-developed parapophyses ; ribs and epipleurals inserted close together on the centra .... 2. *Rhachicentridæ.*

II. Præmaxillaries not protractile; scales usually small or absent; body more or less elongate; dorsal fin elongate, single or divided, without free spines; no free anal spines.

A. Pseudobranchiæ present.

Vertebræ without transverse processes; soft dorsal fin longer than the spinous; pectoral fins high up the sides	3. *Scombridæ.*
Vertebræ without transverse processes; soft dorsal fin shorter than the spinous, if the latter be distinct; pectoral fin low down the sides......	4. *Trichiuridæ.*
Vertebræ without transverse processes; snout produced into a spear	5. *Histiophoridæ.*
Vertebræ with transverse processes bearing the ribs; snout produced into a sword; no ventrals................................	6. *Xiphiidæ.*
Vertebræ without transverse processes; gill-membranes attached to isthmus; dorsal and anal fins formed of unarticulated, widely set rays; dentition very feeble	7. *Luvaridæ.*

B. Pseudobranchiæ absent; no well-developed transverse processes to the præcaudal vertebræ, the ribs and the epipleurals inserted close together on the centra; snout short and very deep. 8. *Coryphænidæ.*

III. Præmaxillaries not protractile, or, if slightly protractile, scales large; dorsal and anal fins elongate, without distinct spinous division; most of the præcaudal vertebræ with strong hæmapophyses, to which the ribs are attached.... 9. *Bramidæ.*

Division III. Zeorhombi.

Aberrant, strongly compressed Perciformes, with very short præcaudal region, modified in the direction of the flat-fishes, culminating in asymmetrical forms, and characterized by the combination of an increased number (7 to 9) of ventral rays, with absence of hypural spine (by which the Berycidæ are excluded), *or* by asymmetry of the skull in the forms in which the spine of the ventral fin has been lost.

Among the symmetrical forms, the existing Zeidæ agree with the Berycidæ in having more than five soft rays to the ventral fins, and are probably derived, together with the Eocene Amphistiidæ, from some common ancestral group still to be discovered in Cretaceous beds. These Zeidæ have much in common with the Pleuronectidæ * and might be regarded as forming part of the family out of which the latter have sprung, were it not that they have lost the last half-gill. *Amphistium* is probably more nearly related to the Pleuronectidæ, which may have been directly derived from the family of which it is as yet the only known representative †.

* *Cf.* Thilo, Zool. Anz. 1902, p. 305.

† *Cf.* Boulenger, Ann. & Mag. Nat. Hist. (7) x. 1902, p. 295.

This division embraces three families only :—

A spinous dorsal fin; anal spines detached from the soft portion; a ventral spine; gills three and a half, three slits between them..........	1. *Zeidæ.*
Dorsal and anal spines few, continuous with the soft rays; a ventral spine	2. *Amphistiidæ* †.
No spines; cranium twisted in front, with the two orbits on one side; gills four, a slit behind the fourth	3. *Pleuronectidæ.*

Division IV. Kurtiformes.

No bony stay for the præopercle. Dorsal spines feeble, few. Scapula absent, the coracoid supporting four small pterygials. Ventral fins thoracic.

A single family, *Kurtidæ.*

Division V. Gobiiformes.

No bony stay for the præoperculum. Basis cranii simple. Spinous dorsal, if present, formed of few, flexible rays. None of the epipleural bones attached to the centra of the vertebræ in the præcaudal region. Scapula and coracoid more or less reduced or even vestigial; pterygials large, 4 or 5 in number, forming together a thin plate which is in contact with or narrowly separated from the clavicle; one or two of the pterygials in contact with the coracoid. Ventral fins thoracic.

The *Gobiidæ,* which alone constitute this division, are not very remote from the Perciformes and may have evolved out of a type not very different from the Percidæ.

Division VI. Discocephali.

Highly aberrant Acanthopterygians with the anterior dorsal fin modified into a suctorial, transversely laminated oval disk on the head, the skull being very much flattened and with simple basis cranii. The pectoral rays are inserted on the small, perforate, scapula and on four hourglass-shaped pterygials, three of which are in contact with the coracoid. Ventral fins thoracic.

A single family, *Echeneididæ.*

In spite of a superficial external resemblance to the genus *Elacate,* the sucking-fish, as first observed by Gill, bear certainly no affinity to that genus nor to other Scombriformes. They are probably derived from Perciformes, but from which family it is impossible to suggest.

Division VII. Scleroparei.

Second suborbital bone more or less produced towards or ankylosed with the præoperculum ("suborbital stay") *. Ventral fins thoracic.

The "Cheek-armoured Acanthopterygians," "Joues cuirassées" of Cuvier, after the exclusion of the sticklebacks, form a perfectly natural association, evidently derived from the Serranidæ, with which the more generalized forms have much in common. From the perch-like genus *Sebastes* a continuous series can be traced towards the Triglidæ, especially through such forms as *Apistus*, *Minous*, and *Choridactylus*, in which one or more of the lower pectoral rays are detached from the rest of the fin. Through the Comephoridæ the Scorpænidæ are connected with the Cottidæ, whilst the latter merge insensibly into the still more aberrant Cyclopteridæ. These conclusions, which are apparent enough from a mere comparison of the external characters, become fortified by a study of the skeletons. The passage between the various groups here accepted as families is so complete that no serious objection could be raised to their union in one great family with a number of minor divisions.

The character from which the Scleroparei derive their name is subject to many modifications. The second suborbital (the third, if the præorbital be regarded as the first) may be merely enlarged and prolonged over the cheek towards the præoperculum (*Sebastes*, *Anhoplopoma*), or firmly ankylosed to the latter (*Scorpæna*, *Platycephalus*), or form part of the external armature of the head (*Trigla*, *Dactylopterus*). The structure of the base of the pectoral fin appears to afford important characters for the definition of the families, as first pointed out by Gill.

Eleven families :—

I. Head not completely cuirassed.

A. Ventral fins not widely separated; none of the pterygials in contact with the clavicle.

Two nostrils on each side; basis cranii double; gill-membranes free from isthmus	1. *Scorpænidæ*.
A single nostril on each side; basis cranii double; gill-membranes free from isthmus	2. *Hexagrammidæ*.
Two nostrils on each side; basis cranii simple; gill-membranes free or narrowly attached to isthmus..................................	3. *Comephoridæ*.
Two nostrils on each side; basis cranii simple; gill-opening narrow, above base of pectoral..	4. *Rhamphocottidæ*.

* This character suffers one exception, to be found in *Comephorus*, a degraded form otherwise closely related to *Cottocomephorus*, in which the skeleton is typical of the present division.

B. Ventral fins, if present, not widely separated; one or several of the pterygials in contact with the clavicle.

Ventral fins distinct; gill-clefts wide	5. *Cottidæ.*
Ventral fins united into a sucking-disk; gill-opening narrow, above base of pectoral	6. *Cyclopteridæ.*

C. Ventral fins widely separated; none of the pterygials in contact with the clavicle.

Ventral fins behind base of pectorals; præcaudal vertebræ without transverse processes	7. *Platycephalidæ.*
Ventral fins a little in front of base of pectorals; præcaudal vertebræ with transverse processes..............................	8. *Hoplichthyidæ.*

II. Head completely cuirassed.

Ventral fins narrowly separated; no pectoral appendages; pterygials short and broad	9. *Agonidæ.*
Ventral fins widely separated; 2 or 3 lowermost rays of pectoral fin detached as feelers; pterygials short and broad	10. *Triglidæ.*
Ventral fins narrowly separated; pectoral fin divided into two portions; pterygials elongate	11. *Dactylopteridæ.*

Division VIII. Jugulares.

No bony stay for the præoperculum. Ventral fins jugular or mental. Gill-openings in front of the pectoral fin, the base of which is vertical or subvertical.

In a recently published note * I have alluded to the group of physoclistous fishes for which I propose to revive the old name Jugulares, pointing out that some of the forms previously grouped together as Trachinidæ agree with the Gadidæ, not only in the jugular position of the ventral fins, but also in the condition of the scapula and coracoid.

Mr. Regan † has since been able to show that the Gadidæ and Macruridæ possess certain characters in common by which they may be separated, not only from the other Jugulares, but even from the Acanthopterygians, and, as mentioned above (p. 176), the Müllerian suborder Anacanthini may be maintained, after excluding the Pleuronectidæ. That the Blenniidæ are akin to *Lycodes* and allies has long been admitted, and authors who have placed them in different divisions of their systems have had to confess the difficulty of referring certain genera to the one family rather than to the other. The fact that *Lycodes* and many forms previously associated with the Ophidiidæ agree with the Macruridæ and Gadidæ in the diphycercal vertebral column, and in the

* Ann. & Mag. Nat. Hist. (7) viii. 1901, p. 261.
† *Op. cit.* xi. 1903, p. 459.

absence of spines to the fins, is merely, it seems to me, the result of degradation; they probably form the terminal group of a series in which the vertebral column was originally homocercal and fin-spines were present, as is the case in most of the Blenniidæ and Trachinidæ and their near allies. All these families may be assumed to have evolved in several series, often on parallel lines, from some group closely related to the Berycidæ; the resemblance which their terminal forms bear to the Anacanthini is, as recognized by Regan, probably to be ascribed to convergence, not to any close genetic affinity.

Fifteen families:—

I. Pectoral rays attached to the scapula and to a series of pterygials, of which only one or two are in contact with the scapula; ventral fins jugular, with 1 spine and 4 or 5 soft rays; anterior dorsal rays usually spinous or not articulated, often forming a detached fin.

A. Epipleurals present.

1. Second suborbital produced inwards to support the eyeball.

Ventrals close together; scales very small, cycloid, forming oblique bands	1. *Trachinidæ.*
Ventrals widely separated	2. *Percophiidæ.*

2. No subocular shelf.

Ventrals widely separated; two nostrils on each side	3. *Leptoscopidæ.*
Ventrals widely separated; a single nostril on each side	4. *Nototheniidæ.*
Ventrals close together; scales very small, forming oblique bands; head partly covered with bony plates	5. *Uranoscopidæ.*

B. No epipleurals.

Post-temporal forked, articulated to the skull; soft dorsal and anal much elongate	6. *Trichonotidæ.*
Post-temporal closely adnate to the skull; soft dorsal and anal short (with only 7 to 10 rays)..	7. *Callionymidæ.*
Post-temporal simple, articulated to the skull; soft dorsal and anal short; a ventral sucker	8. *Gobiesocidæ.*

II. Pectoral rays all attached to the pterygials, of which two or three are in contact with the scapula; ventral fins, if present, jugular or mental, composed of 1 to 4 rays.

A. Ventrals jugular or absent.

Post-temporal distinctly forked; præcaudal vertebræ with transverse processes; some or all of the dorsal rays spinous or not articulated; caudal fin usually distinct	9. *Blenniidæ.*
Post-temporal small and ankylosed to the skull; præcaudal vertebræ without well-developed transverse processes; a very short spinous dorsal; caudal fin distinct	10. *Batrachidæ.*

Post-temporal distinctly forked; præcaudal vertebræ with hæmal arches; dorsal rays all spinous; caudal fin distinct .... 11. *Pholididæ.*

Post-temporal distinctly forked; præcaudal vertebræ with transverse processes; dorsal rays all articulated, or a few of the posterior spinous; no distinct caudal .... 12. *Zoarcidæ.*

Post-temporal forked, ankylosed to the skull; præcaudal vertebræ with transverse processes; no spines; no distinct caudal .... 13. *Congrogadidæ.*

B. Ventrals mental (just behind the chin); no spines. 14. *Ophidiidæ.*

III. Pectoral rays attached to an undivided cartilaginous plate representing the pterygials; ventral fins jugular, reduced to a filament formed of two adnate rays; fins without spines. 15. *Podatelidæ.*

Division IX. Tæniosomi.

Exceedingly compressed, more or less elongate, often ribbon-like fishes of doubtful affinities, probably related to the earlier Acanthopterygians, the ventral fins, when well developed, comprising as many as 7 to 9 rays. Dorsal fin extending from the head to the end of the tail, its rays simple (separable into lateral halves), the anterior often prolonged; anal fin very short or absent. Pectoral fin with horizontal, or nearly horizontal, base, the rays supported by the scapula and by three short pterygials, all three, or two at least, of which are related to the coracoid. Ribs small and slender, or absent. Post-temporal simple and solidly attached to the skull. Scales minute or absent.

Deep-sea or pelagic fishes from the Atlantic and Mediterranean and from the Pacific; specimens are rare in collections and the life-histories are still very imperfectly known, although it has been ascertained that great changes of form take place with growth.

Only two families :—

Mouth very protractile; ventral fins more or less developed, with 6 to 9 rays, or reduced to a single long ray; no anal fin; vent about the middle of the body; caudal rays, if present, divided into two fascicles, the upper sometimes much prolonged and directed upwards........ 1. *Trachypteridæ.*

Mouth moderately protractile; ventrals very small, if distinct, with 4 or 5 rays; body-cavity extending nearly the whole length of the much elongate body, the vent very far back and followed by a short anal fin; caudal fin small, not divided .... 2. *Lophotidæ.*

Suborder XI. Opisthomi.

Air-bladder without open duct. Opercle well developed, hidden under the skin; supraoccipital in contact with the frontals, separating the parietals. Pectoral arch suspended from the vertebral column, far behind the skull; no mesocoracoid; no clavicle distinct from the cleithrum. Vertical fins with spines. Ventral fins absent.

This division stands in the same relation to the Acanthopterygii as the Apodes to the Malacopterygii. The single family, *Mastacembelidæ*, inhabiting the fresh waters of Southern Asia and Africa, is possibly derived from the Blenniidæ.

Suborder XII. Pediculati.

Air-bladder without open duct. Opercle large, hidden under the skin; supraoccipital in contact with the frontals, separating the parietals. Pectoral arch suspended from the skull; no mesocoracoid. No ribs, no epipleurals. Ventral fins jugular. Gill-opening reduced to a foramen situated in or near the axil, more or less posterior to the base of the pectoral. Body naked or covered with spines or bony tubercles.

A small natural group, connected with the Acanthopterygii Jugulares through the Batrachidæ, in which the elongate pterygials of the pectoral fin foreshadow the kind of arm ("pseudobrachium") which is more or less characteristic of these highly aberrant fishes. As in the Batrachidæ, the post-temporal is flat and ankylosed to the cranium, and the suprascapula is much elongate. The pterygials, two or three in number, are separated from the small scapula and coracoid by a broad ligament, the arm-like pectorals being more or less distinctly geniculated and inserted far back behind the cranium. The head is large, the basis cranii simple. The gills are reduced to 2, 2½, or 3. The spinous dorsal, if present, consists of a few rays, which may be modified into tentacles inserted on the head.

Five families:—

I. Gill-opening in or behind lower axil of pectoral; mouth large, terminal or directed upwards.

Pectoral fin scarcely geniculated; ventrals present . 1. *Lophiidæ.*
Pectoral fin scarcely geniculated; ventrals absent. . 2. *Ceratiidæ.*
Pectoral fin strongly geniculated; ventrals present . 3. *Antennariidæ.*

II. Gill-opening behind lower axil of pectoral; mouth inferior; ventrals absent .... 4. *Gigantactinidæ.*

III. Gill-opening above axil of pectoral; mouth rather small, subterminal or inferior; pectoral fin strongly geniculated; ventrals present; spinous dorsal absent or reduced to a small tentacle lodged in a cavity under the snout .... 5. *Malthidæ.*

Suborder XIII. PLECTOGNATHI.

Air-bladder without open duct. Opercular bones more or less reduced; supraoccipital in contact with the frontals, separating the parietals; maxillary and præmaxillary bones often firmly united. Pectoral arch suspended from the skull; no mesocoracoid. No ribs. Ventral fins thoracic and much reduced if present; the pelvic bones, if present, more or less completely co-ossified. Gill-opening much reduced. Body covered with more or less osseous scales, bony scutes, or spines, or naked.

A highly aberrant group, closely connected with the Acanthopterygii through the Acanthuridæ, as pointed out long ago by Dareste *. The skeleton is often feebly ossified and the vertebræ much reduced in number, but the jaws, although short, are very strong, usually with large sectorial teeth which may be confluent into a beak; the post-temporal is short and simple, suturally united to the squamosal. These fishes have usually been arranged in three divisions: Sclerodermi, Ostracodermi, and Gymnodontes; but Regan †, whose classification is here followed, has shown that the latter include a type (*Triodon*) which, in spite of its beak-like teeth, is more nearly related to the Sclerodermi, whilst the Ostracodermi have much more in common with the latter than with the Gymnodontes. It therefore appears best to admit only two divisions, the first with four, the second with three families:—

I. SCLERODERMI. Supraclavicle vertical; pectoral arch of the Perciform type; all the vertebræ with a single neural spine.

A. Body covered with hard or spinous scales; epipleurals present; pelvis present.

Teeth separate; spinous dorsal present; ventrals paired; pelvis immovable .... 1. *Triacanthidæ.*

A beak; spinous dorsal and ventrals absent; pelvis movable .... 2. *Triodontidæ.*

Teeth separate; spinous dorsal present; ventrals absent or represented by a single short spine; pelvis movable.......................... 3. *Balistidæ.*

B. Body encased in a carapace; no epipleurals; spinous dorsal, pelvis, and ventrals absent .... 4. *Ostraciontidæ.*

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* Ann. Sci. Nat., Zool. (3) xiv. 1850, p. 105, and C. R. Ac. Sci. lxxiv. 1872, p. 1527.

† P. Z. S. 1902, ii. p. 284.

II. Gymnodontes. Supraclavicle oblique or nearly horizontal; lower three pterygials enlarged and immovably united to the coraco-scapular cartilage; anterior vertebræ with bifid divergent neural spines; pelvis absent.

Beak with a median suture; interoperculum not connected with suboperculum; three gills; caudal fin present; body inflatable	5. *Tetrodontidæ.*
Beak without median suture; interoperculum attached posteriorly to suboperculum; three gills; caudal fin present; body inflatable	6. *Diodontidæ.*
Beak without median suture; interoperculum attached posteriorly to suboperculum; four gills; caudal fin absent, the body non-inflatable, truncate posteriorly, with the dorsal and anal fins confluent	7. *Molidæ.*

XX.—*On a Collection of Fishes made by Mr. John Graham at Yunnan Fu.* By C. Tate Regan, B.A.

The British Museum has received from Mr. John Graham a small collection of fishes from the large lake "Sea of Tien," on the north shore of which the city of Yunnan Fu is situated. This lake is at an altitude of about 6000 feet above the sea-level, and its overflow runs northwards by the Pulu-shing to the Yang-tse-kiang. Of thirteen species represented, eight are described below as new to science. The complete list is as follows:—

1. *Cyprinus carpio*, L.

The two specimens received both lack the anterior barbel *, and should perhaps be referred to a distinct subspecies on this account. Six examples in the British Museum Collection, from the Southern Shan States, with large scales, 26–29 $\frac{4\text{-}5}{6\text{-}7}$, may also be regarded as belonging to a geographical race or subspecies.

2. *Barbus Grahami*, sp. n.

Depth of body $3\frac{1}{2}$ times in the total length, length of head $3\frac{3}{4}$ times. Snout nearly twice as long as the eye, the diameter of which is $5\frac{2}{3}$ times in the length of head and $1\frac{1}{3}$ times in the interorbital width. Mouth subterminal, maxillary not extending to below the eye. Two barbels on each side, the anterior $\frac{3}{8}$, the posterior nearly $\frac{1}{2}$ the length of head.

* Some of the specimens figured in Reeve's drawings of Chinese fishes have apparently no anterior barbel.

Sc. 110 $\frac{23}{20}$, 14 between lateral line and root of ventral; l. lat. 70. D. III 7, the third simple ray a strong spine, with finely serrated posterior edges, the first branched ray the longest, $\frac{2}{3}$ the length of head; origin of dorsal equidistant from anterior nostril and base of caudal. A. III 5. Pectoral not reaching ventral. Caudal forked, the upper lobe slightly the longer, a little less than the length of head. Caudal peduncle $1\frac{3}{4}$ times as long as deep. Brownish, with silvery reflections, lighter below.

A single specimen, 170 mm. in total length.

3. *Barbus yunnanensis*, sp. n.

Depth of body $3\frac{3}{4}$ times in the total length, length of head $4\frac{2}{5}$ times. Snout $1\frac{2}{3}$ times as long as eye, the diameter of which is 5 times in the length of head and $1\frac{3}{4}$ times in the interorbital width. Mouth subterminal; maxillary not extending to below the eye. Two barbels on each side, the anterior $\frac{1}{5}$, the posterior $\frac{2}{7}$ the length of head. Sc. 46 $\frac{6\frac{1}{2}}{7\frac{1}{2}}$, 4 between lateral line and root of ventral. D. III 8, the third simple ray a strong spine with serrated posterior edges, the first branched ray the longest, $\frac{4}{5}$ the length of head; origin of dorsal equidistant from tip of snout and base of caudal. A. III 5. Pectoral not reaching ventral. Caudal forked, the lobes as long as the head. Caudal peduncle $1\frac{2}{3}$ times as long as deep. Brownish, with silvery reflections, lighter below; membrane of outer half of dorsal and anal blackish.

A single specimen, 210 mm. in total length.

4. *Achilognathus barbatulus*, Gthr.

5. *Barilius polylepis*, sp. n.

Depth of body $4\frac{2}{3}$ times in the total length, length of head $4\frac{2}{5}$ times. Snout nearly as long as the eye, the diameter of which is $3\frac{2}{3}$ times in the length of head and is nearly equal to the interorbital width. Mouth small, oblique, the maxillary not extending to below the eye; no barbels. Sc. 70 $\frac{11\frac{1}{2}}{5\frac{1}{2}}$, 3 between lateral line and root of ventral. D. III 7, its origin a little behind that of the ventral and nearly equidistant from tip of snout and base of caudal. A. III 13. Pectoral extending $\frac{2}{3}$ of the distance from its base to the origin of ventral. Caudal forked. Caudal peduncle twice as long as deep. Brownish above, silvery on the sides and below.

A single specimen, 130 mm. in total length.

Allied to *B. hainanensis*, Blgr., from which it is distinguished especially by the much smaller scales.

6. *Misgurnus anguillicaudatus*, Cantor.

7. *Nemachilus pleurotænia*, sp. n.

Depth of body 5 times in the total length, length of head 4 times. Snout nearly as long as the postorbital part of head. Diameter of eye $4\frac{1}{4}$ times in the length of head and nearly equal to the interorbital width. Nostrils well separated, the anterior tubular. Rostral barbels shorter than the one at the angle of the mouth, which is $\frac{1}{2}$ the length of head. Scales minute; thorax naked; lateral line present anteriorly, disappearing before origin of dorsal. D. III 8, its origin equidistant from anterior nostril and base of caudal, above or slightly in advance of the origin of ventral. A. III 5. Pectoral extending $\frac{2}{3}$ of the distance from its base to origin of ventral. Ventral with 9 rays. Caudal bilobed. Caudal peduncle $1\frac{1}{5}$–$1\frac{1}{3}$ times as long as deep. Back with some dark spots or markings; a blackish longitudinal stripe along the middle of the side; fins immaculate.

Two specimens, 46 and 51 mm. in total length.

8. *Nemachilus nigromaculatus*, sp. n.

Depth of body 4–$4\frac{1}{4}$ times in the total length, length of head $3\frac{2}{5}$ times. Snout shorter than the postorbital part of head. Diameter of eye $4\frac{3}{4}$–$5\frac{1}{5}$ times in the length of head, interorbital width 3–$3\frac{1}{4}$ times. Nostrils well separated, the anterior tubular. Rostral barbels shorter than the one at the angle of the mouth, which is less than $\frac{1}{3}$ the length of head. Scales very small, not imbricated; thorax and abdomen naked; lateral line absent. D. III 8, its origin equidistant from middle of eye and base of caudal, a little in advance of the origin of ventral. A. III 5. Pectoral extending $\frac{1}{2}$–$\frac{3}{5}$ of the distance from its base to origin of ventral. Ventral with 8 rays. Caudal truncate. Caudal peduncle as deep as or deeper than long. Back and sides spotted or marbled with blackish; fins immaculate.

Two specimens, 61 and 77 mm. in total length.

9. *Silurus mento*, sp. n.

Depth of body $5\frac{1}{4}$–$5\frac{1}{2}$ times in the total length, length of head 4–$4\frac{2}{3}$ times. Breadth of head $1\frac{4}{7}$–$1\frac{2}{3}$ times in its length, diameter of eye $7\frac{1}{2}$–$9\frac{1}{2}$ times, interorbital width 3-$3\frac{1}{2}$ times, length of snout $3\frac{2}{3}$–4 times. Lower jaw projecting, the mouth superior; vomerine teeth in two separate patches; 4 barbels, the maxillary ones extending to the base of pectoral or beyond, the mental ones nearly $\frac{2}{5}$ as long. D. 4, its distance from the tip of snout $\frac{1}{2}$ its distance from the caudal. A. 71–73, continued on to the caudal. P. I 12, the spine stout, anteriorly somewhat roughened or slightly serrated, posteriorly with a series of 6–9 fairly strong teeth, its length a little more than $\frac{1}{2}$ that of the soft part of the fin, which extends nearly to the origin of ventral. Ventrals with 10 rays, originating just in front of the vent and extending to the third or fourth ray of anal. Caudal truncate rounded. Greyish, clouded with blackish.

Two specimens, 115 and 215 mm. in total length.

10. *Liobagrus nigricauda*, sp. n.

Depth of body about 6 times in the total length, length of head $3\frac{2}{3}$–$3\frac{3}{4}$ times. Breadth of head $1\frac{1}{8}$–$1\frac{1}{4}$ times in its length, interocular width $2\frac{3}{4}$–3 times, length of snout about $3\frac{1}{2}$ times. Eyes very small. Jaws equal anteriorly; mouth wide. Post-mental barbel the longest, extending to base of pectoral or a little beyond. D. I 5, the spine concealed in a fold of skin which also extends over the soft rays, about $\frac{2}{5}$ the length of head; adipose fin low, originating above or a little in advance of the anal and extending on to the procurrent rays of the caudal. A. 15. P. I 7, the spine concealed like that of the dorsal, a little more than $\frac{1}{2}$ the length of the fin, which is rounded and nearly equal in length to $\frac{2}{3}$ the length of head, extending $\frac{1}{2}$ the distance from its base to the origin of ventral. V. 6. Caudal rounded. Greyish, spotted or marbled with darker; dorsal and pectoral in great part blackish; ventrals and anal with or without blackish spots; caudal, in the smaller specimen, with a large median blackish blotch confluent with a semioval blackish basal band, in the larger specimen almost entirely blackish except for two small light areas on the upper and lower margins respectively.

Two specimens, 64 and 96 mm. in total length.

The genus *Liobagrus*, established in 1878 by Hilgendorf for *L. Reinii* from Southern Japan, is allied to *Akysis* and *Acrochordonichthys*, but is distinguished by the truncate or rounded caudal and by the wide gill-openings, which are not restricted from above, whilst the gill-membranes are entirely separate from each other and from the isthmus. *Amblyceps marginatus*, Gthr. (Pratt's 'Snows of Thibet,' Appendix, p. 245, pl. ii. fig. A, 1892), is another species of this genus, differing from the one described above in the coloration, projecting lower jaw, longer barbels, and truncate caudal. *Amblyceps* is distinguished from *Liobagrus* by the nostrils, which are close together instead of well separated, and by the forked caudal. In *Liobagrus*, as in *Akysis* and *Acrochordonichthys*, and also in *Amblyceps*, the air-bladder is reduced to two small lateral portions enclosed in bone.

11. *Macrones medianalis*, sp. n.

Depth of body $5\frac{1}{4}$–$5\frac{1}{2}$ times in the total length, length of head $3\frac{4}{5}$–$4\frac{1}{6}$ times. Diameter of eye 5–$6\frac{2}{3}$ times in the length of head, interorbital width $3\frac{3}{5}$ times, length of snout $3\frac{1}{4}$ times. Nasal barbel extending beyond posterior border of eye, maxillary barbel to base of pectoral or beyond, post-mental barbel to the edge of the gill-membrane at a point directly posterior to its origin or a little beyond. Upper jaw slightly the longer; width of mouth $\frac{1}{2}$ the length of head. Upper surface of head covered by skin; supraoccipital process more than twice as long as broad, its length $\frac{1}{4}$ that of the head; basal bone of the anterior dorsal ray hidden beneath the skin, separated by a short interspace from, or in contact with the supraoccipital process. D. I 7, the spine smooth, equal to $\frac{2}{3}$–$\frac{3}{4}$ the length of head; length of adipose fin equal to its distance from the base of middle rays of caudal. A. 17–18. P. I 7, the spine with a series of 5–8 teeth posteriorly, equal in length to that of the dorsal. V. 6. Caudal bilobed. Caudal peduncle twice as long as deep. Greyish, with a few large dark spots or blotches.

Three specimens, 65–128 mm. in total length.

Although with less than 20 anal rays, the relations of this species are with the section *Pseudobagrus*.

12. *Monopterus javanensis*, Lacep.

13. *Ophiocephalus argus*, Cant.

XXI.—*Rhynchotal Notes.*—XXI. By W. L. Distant.

HETEROPTERA.

Fam. **Capsidæ**. (Part II.)

This paper concludes the examination of the Capsidæ contained in the British Museum, including Walker's types;

of some of these the condition is so imperfect as to make their generic identification a matter of no little difficulty, but they will be all found in the "summarized disposition" here appended.

Division MIRARIA.

NYMANNUS, gen. nov.

Elongately subovate; head as long as pronotum, subconical, narrowed anteriorly, with a narrow central linear sulcation; eyes of moderate size, almost touching the anterior margin of the pronotum; antennæ about as long as the body, first joint strongly incrassated, narrowed at base, about as long as head, second joint slender, about twice as long as first and almost equal in length to remaining joints together; rostrum almost reaching the posterior coxæ; pronotum nearly twice as broad posteriorly as anteriorly, very faintly transversely impressed on anterior area, posterior margin truncate, oblique beyond the scutellar angles, mesonotum exposed; scutellum subtriangular; hemelytra a little convexly ampliated, cuneus longer than broad, membrane short; posterior femora incrassated, posterior tibiæ finely setose; first joint of posterior tarsi as long as second and third joints together.

Nymannus typicus, sp. n.

Pale reddish-testaceous, basal lateral areas of corium stramineous, clavus somewhat piceous; antennæ with the basal joint castaneous, second joint pale ochraceous, remaining joints fuscous; femora castaneous; tibiæ pale ochraceous; tarsi, excluding base, fuscous; membrane dark fuscous; body above finely shortly pilose; narrow central sulcation to head appearing as a fuscous line; basal angles to scutellum linearly foveate and fuscous.

Long. 6 mm.

Hab. Cape Colony: Grahamstown (Albany and Brit. Muss.).

Genus MEGACÆLUM *.

Megacœlum, Fieb. Wien. ent. Monats. Bd. ii. p. 305. n. 21 (1858).
Creontiades, Dist. Biol. Centr.-Amer., Rhynch. i. p. 237 (1883).

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* I have here substituted the generic term *Megacœlum* for *Creontiades* (*ante*, p. 105). I had already sank as a synonym the proposed genus

Pantiliodes, Noualh. Ann. Soc. Ent. Fr. 1893, p. 15.
Umslopogas, Kirk. Tr. Ent. Soc. 1902, p. 254.
Kangra, Kirk. Tr. Ent. Soc. 1902, p. 257.

Megacœlum transvaalensis, sp. n.

Pale luteous; apex of head, eyes, subanterior and subposterior transverse fasciæ to pronotum, broken at centres and sometimes united along lateral margins, inner and outer margins of clavus, an elongate spot on posterior disk of corium which is angulated and connected with the membranal margin, membrane, basal joint of antennæ (remaining joints mutilated), extreme apices of tibiæ, and the apices of tarsi black; abdomen beneath with central and sublateral fuscous fasciæ; apices of femora and bases of tibiæ testaceous; pronotum finely transversely granulate; scutellum shining, almost glabrous; hemelytra finely and obscurely punctate; posterior tarsi mutilated.

Long. 6 mm.

Hab. Transvaal: Zoutpansberg (*Junod*, Brit. Mus.); Pretoria (*Distant*).

Megacœlum nigroquadristriatus.

Umslopogas nigroquadristriatus, Kirk. Trans. Ent. Soc. 1902, p. 254, pl. v. fig. 11.

Head, pronotum, and scutellum pale shining greenish yellow, pronotum usually more greenish; a central longitudinal fascia to head, four longitudinal fasciæ to pronotum (two central and one at each lateral margin, and sometimes more or less fused anteriorly), and two basal spots and lateral margins of scutellum, black; antennæ fuscous; hemelytra pale opaque greenish yellow, the clavus, inner area, and a longitudinal apical spot to corium fuscous; membrane pale fuscous; body beneath and legs pale dull ochraceous, legs speckled with fuscous, apices of tarsi piceous; a narrow sublateral fascia and sometimes apical segment to abdomen piceous; rostrum reaching posterior coxæ; second joint of

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Kangra, and since then have seen the species on which *Umslopogas* is founded. It now becomes clear that to keep these genera distinct the only reliable character is the proportional length of the joints in the posterior tarsi (frequently mutilated in specimens received); and as this seems to be but a sectional character of a large and well-marked genus, I have thought it best to now include all under *Megacœlum*.

antennæ about twice the length of first; corium finely pilose.

Long. 7 mm.

Hab. Natal: Howick (*Cregoe*, Brit. Mus.). Transvaal: Pretoria (*Distant*); Johannesburg (*Ross*).

The British Museum possesses a long series of this species from Howick, Natal, whence Kirkaldy's type is recorded, and I have also a considerable number of specimens from the Transvaal. They are all moderately uniform in markings and coloration, and the figure given by Kirkaldy appears to be much too highly coloured.

I found this the most abundant species in the Transvaal, frequenting grasses, and readily obtained by sweeping.

Division Cylaparia.

Chamus, gen. nov.

Elongately subovate; head broad, anteriorly broadly channelled, with three long, frontal, slightly upwardly curved spines, one central and one before base of each antenna, two discal callosities on posterior area; eyes prominent, inserted near base of antennæ, which are very robust and longly and strongly pilose, first joint very strongly incrassate, moderately petiolate at base, second joint almost twice as long as first, third much shorter than second, twice as long as fourth; rostrum reaching the anterior coxæ; pronotum with the posterior margin about three times broader than anterior, constricted before middle, the anterior area with two obscure callosities; scutellum in typical specimen destroyed by pin; lateral margins of corium sinuate and ampliate posteriorly; cuneus somewhat large, a little longer than broad; membrane with a single elongate quadrangular cell; legs moderately short, strongly and longly pilose; posterior legs mutilated; pronotum, corium, and cuneus somewhat thickly minutely tuberculate, lateral margins longly and strongly pilose.

Chamus Wealei, sp. n.

Reddish testaceous; second and third joints of antennæ, extreme lateral margins of corium, rostrum, body beneath, and legs stramineous; pronotum and corium with numerous small sanguineous tuberculations; cuneus and membrane pale dull ochraceous, the first with the small tuberculations sanguineous near inner angle, the membranal venation also sanguineous; lateral margins of body beneath sanguineous.

Long. 6½ mm.

Hab. Cape Colony (*Mansell Weale*).

Division —— ?

ARCULANUS, gen. nov.

Subelongate; head broad, subglobose, shortly obtusely conically produced in front of eyes, a little narrowed posteriorly and anteriorly; eyes of moderate size, situate at about centre of lateral margins; antennæ moderately robust, very finely pilose, first joint distinctly thickened from beyond base and very slightly longer than head, second more than twice as long as first, third much shorter than second, more than half as long again as fourth; rostrum short, robust, about reaching the anterior coxæ; pronotum somewhat long, with a broad anterior collar, narrowed anteriorly, strongly constricted before middle, where there are two strong subconical tuberculations, posterior area convexly tumid, foveate near lateral angles, which thus appear subprominent, posterior margin almost five times as broad as anterior margin; scutellum subtriangular, its lateral margins very slightly convex; corium somewhat long, its lateral margins a little sinuate; cuneus longer than broad and passing abdominal apex; membrane with a single elongate quadrangular cell; legs moderately short, femora a little thickened.

A genus which may be placed near *Disphinctus*.

Arculanus Marshalli, sp. n.

Pale sanguineous; anterior margin of head, tuberculations and lateral margins to pronotum, scutellum, outer claval area to corium, basal area of cuneus, sternum, coxæ, rostrum, bases of femora, tibiæ (excluding bases), and the tarsi more or less pale ochraceous; above shining, finely and obscurely pilose; outer margin of clavus, inner margin of cuneus, and two longitudinal discal lines on apical half of membrane fuscous; membrane pale bronzy, the venation sanguineous.

Long. 7½ mm.

Hab. Mashonaland: Umfili River (*G. A. K. Marshall*).

Division PHYTOCORARIA.

Genus PARACALOCORIS.

Paracalocoris Barretti, sp. n.

Purplish brown; head, antennæ (excluding basal joint), lateral margins and a broad central fascia (attenuated posteriorly) to pronotum, basal angles of scutellum, a very small marginal spot near apex of corium, a marginal spot to cuneus, body beneath, rostrum, and legs pale ochraceous; apices of second and third joints of antennæ and apices of tibiæ purplish red; pronotum with two discal black spots; first joint of antennæ incrassate and pilose, second joint distinctly incrassate towards apex, about half as long again as first; pronotum transversely rugulose; membrane very pale fuscous with the veins darker.

Long. $5\frac{1}{2}$ mm.

Hab. Cape Colony: King William's Town (*Miss Barrett*, Brit. Mus.).

Division CAPSARIA.

Genus LYGUS.

Lygus Schonlandi, sp. n.

Ochraceous; hemelytra somewhat longly pilose; apex of second joint of antennæ black (remaining joints mutilated); basal area of pronotum, two central longitudinal fasciæ to scutellum, inner area and two lateral spots (one before middle, the other at apex) to corium, and a spot at apex of cuneus piceous; basal and inner margins of cuneus generally distinctly narrowly sanguineous; membrane fuscous with paler mottlings; body beneath and legs pale ochraceous; mesosternum, a lateral spot to metasternum, base of posterior tibiæ, and apices of tarsi black; apical halves of posterior femora castaneous with broad fuscous annulations; rostrum reaching the intermediate coxæ; pronotum finely and obscurely punctate; first joint of antennæ slightly thickened, second joint a little more than twice the length of first.

Long. 4 to $4\frac{1}{3}$ mm.

Hab. Cape Colony: Grahamstown (Albany and Brit. Muss.). Natal: Durban (*Marshall*).

Genus Horcias.

Horcias Signoreti.

Capsus Signoreti, Stål, Freg. Eug. Resa, Hem. p. 257 (1859).
Capsus cinctipes, Walk. Cat. Het. vi. p. 109. n. 247 (1873).
Resthenia cinctipes, Atkins. Cat. Capsidæ, p. 57 (1890).

Horcias obumbratus.

Capsus obumbratus, Walk. Cat. Het. vi. p. 111. n. 251 (1873).
Resthenia obumbratus, Atkins. Cat. Capsidæ, p. 60 (1890).

Horcias ? squalidus.

Capsus squalidus, Walk. Cat. Het. vi. p. 110. n. 249 (1873).
Resthenia squalidus, Atkins. Cat. Capsidæ, p. 61 (1890).

A single specimen represents the type, in bad condition and imperfectly described. The "piceous band on the hind border" of the pronotum does not extend on each side beyond the basal angles of the scutellum; the corium is piceous red, with a broad sublateral stramineous fascia; cuneus carmine-red.

Horcias lacteiclavus, sp. n.

Black; pronotum (excluding basal margin), prosternum, rostrum, segmental incisures, and legs pale ochraceous; clavus, margins of mesosternum, and three narrow marginal lines to abdomen lacteous white; antennæ black, annulation to first joint, base of second, and third (excluding apex) lacteous; posterior femora with a small lacteous spot on upper surface near apex, posterior tibiæ with two lacteous annulations; membrane pale fuscous; shining, glabrous, scutellum distinctly tumid; head elongately subconical.

Long. 5 mm.

Hab. Ecuador: Cachabé (*Rosenberg*, Brit. Mus.).

Horcias albiventris, sp. n.

Black; head and pronotum (excluding basal margin) pale ochraceous; head beneath, sternum, coxæ, and abdomen lacteous white; intermediate legs ochraceous, tibiæ with a broad, subapical, lacteous annulation, tarsi black; anterior and posterior legs mutilated; apical joint of antennæ lacteous; membrane pale fuscous; apex of head piceous; scutellum distinctly tumid; body above shining, glabrous.

Long. 6 mm.

Hab. Ecuador: Chimbo (*Rosenberg*, Brit. Mus.).

Horcias signatus, sp. n.

Black; head, pronotum, scutellum, a sublateral streak and apical angle to corium, base and apex of cuneus, body beneath, and legs ochraceous; a central, discal, longitudinal spot and lateral angles of pronotum, lateral margins of abdomen beneath, spots to tibiæ, and the tarsi (excluding base) black; apical halves of femora testaceous, speckled with black; basal joint of antennæ (excluding apex), central annulation to second joint, and base of third joint ochraceous; membrane pale fuscous, with a lacteous spot near margin of cuneus; scutellum not prominently tumid; body above shining, glabrous.

Long. 5 mm.

Hab. Colombia: Cali (Brit. Mus.).

Genus Cyphodema.

Cyphodema? Junodi, sp. n.

Head ochraceous, eyes and antennæ black; pronotum ochraceous, somewhat coarsely punctate, with a very large transverse, subbasal, black spot, which is angulately sinuate anteriorly; scutellum pale stramineous, with a central longitudinal ochraceous fascia; corium and clavus black, the first with a large central, marginal, pale stramineous spot; inner and apical margins of clavus, extreme lateral margin and apex of corium and the cuneus dark ochraceous; membrane fuscous, black at basal angle; body beneath black, legs ochraceous, bases of femora and apices of tibiæ black; hemelytra very finely and obscurely pilose; second joint of antennæ about three times the length of first; eyes large and transverse.

Long. $4\frac{1}{2}$ mm.

Hab. Transvaal: Zoutpansberg (*Junod*, Brit. Mus.).

A single specimen, agreeing generally with the characters and appearance of the genus *Cyphodema*.

Genus Camptobrochis.

Camptobrochis Esau, sp. n.

Shining black, somewhat longly greyishly pilose; head opaque, piceous, with a large testaceous spot at inner margin of each eye; anterior and posterior margins of pronotum, a broad central fascia to scutellum (not reaching base), corium (excluding inner area and a submarginal punctate line), body beneath, antennæ, rostrum, and legs pale dull ochraceous; basal joint of antennæ, apical halves of posterior femora, and bases of posterior tibiæ dull testaceous; extreme base of first joint and apices of second and third joints of antennæ and apices of the tarsi piceous; antennæ finely pilose, first and second joints moderately thickened, second a little more than twice as long as first; pronotum distinctly punctate, scutellum and corium a little more finely and obscurely punctate; cuneus sanguineous, its outer area and apex black.

Long. 5 mm.

Hab. Transvaal: Zoutpansberg (*Junod,* Brit. Mus.).

Camptobrochis capensis, sp. n.

Reddish ochraceous; head and scutellum black, the last with a central reddish-ochraceous fascia, which does not reach the base; antennæ, lateral margins of corium, tibiæ, and tarsi pale ochraceous; apices of tarsi black; antennæ somewhat slender, second joint more than twice the length of first; pronotum distinctly punctate, anterior and posterior margins narrowly ochraceous, the last linearly transversely black near lateral angles; scutellum and corium more finely and obscurely punctate than pronotum; corium and clavus somewhat longly pilose; membrane fuscous, with paler mottlings.

Long. 4 mm.

Hab. Cape Colony: Grahamstown (Albany and Brit. Muss.).

Division Bryocoraria.

Genus Tenthecoris.

Tenthecoris, Scott, Ent. Month. Mag. xxxiii. p. 65 (1886).

Type, *T. bicolor,* Scott (Brit. Mus.).

This genus is very closely allied to *Eccritotarsus*, Stål. It is described as an orchid pest, as is also *Eccritotarsus exitiosus*, Dist., and *E. orchidearum,* Reut. *T. bicolor* is very closely allied by description to Reuter's species; Scott describes the first and second joints of the antennæ as red, but in one of his typical specimens the apex of the first joint and the whole of the second joint are distinctly black.

Division —— ?

Genus Fundanius.

Fundanius alternus.

Capsus alternus, Walk. Cat. Het. vi. p. 111. n. 252 (1873).
Resthenia alternus, Atkins. Cat. Capsidæ, p. 57 (1890).

Division —— ?

Genus Armachanus.

Armachanus spicatus, sp. n.

Uniform pale cinnamon-brown; a discal, transverse, pale greyish line across apex of clavus, and an oblique line of the same colour crossing corium near middle; a prominent black marginal spot near middle of corium and a larger black spot to cuneus; head with a long, porrect, anterior, central spine; first joint of antennæ a little more than half the length of second; pronotum strongly constricted and depressed before middle; scutellum carinately tumid; hemelytra obliquely depressed on each side, the sutures forming a central longitudinal carinate ridge; posterior area of the corium before cuneus semiglobose.

Long. 5 mm.

Hab. N.W. Australia: Adelaide River (*J. J. Walker*, Brit. Mus.).

The genus *Armachanus* is described and its type figured in my second volume on the Rhynchota of British India, which will shortly be published. The typical species was from Ceylon.

Division PLAGIOGNATHARIA.

DAGBERTUS, gen. nov.

Head somewhat large and subtriangular above, deflected anteriorly, where it is conically produced, and a little laterally compressed; eyes of moderate size, almost touching, but projecting a little beyond the anterior angles of the pronotum; antennæ slender, first joint about as long as head and stouter than the other joints, second about or a little more than twice the length of first, third and fourth slender, tomentose, third longer than fourth; rostrum long, passing the posterior coxæ; pronotum trapezoidal, the posterior lateral angles slightly subacutely produced, posterior margin slightly convex and about twice as broad as anterior margin, lateral margins nearly straight; scutellum subtriangular, about as long as the pronotum; hemelytra subhyaline, lateral margins almost parallel, a little rounded; posterior femora moderately incrassate, remaining legs mutilated in the types of the three representative species.

This genus may be placed near *Episcopus*, Reut.

Dagbertus Darwini.

Capsus Darwini, Butl. Proc. Zool. Soc. 1877, p. 89.

Hab. Galapagos; Charles Island (*C. Darwin*, Brit. Mus.).

Dagbertus quadrinotatus.

Capsus quadrinotatus, Walk. Cat. Het. vi. p. 113. n. 256 (1873).
Resthenia quadrinotatus, Atkins. Cat. Capsidæ, p. 61 (1890).

Rostrum passing the posterior coxæ; not "reaching" same, as described by Walker.

Dagbertus? spoliatus.

Capsus spoliatus, Walk. Cat. Het. vi. p. 112. n. 254 (1873).
Resthenia spoliatus, Atkins. Cat. Capsidæ, p. 61 (1890).

This species is represented in the National Collection by six very imperfect specimens. Exact generic identification is out of the question.

Capsus obscurellus, Walk. Cat. Het. vi. p. 93. n. 154 (1873).

Type in such a mutilated condition as to be undeterminable.

Monalonion divisum, Walk. Cat. Het. vi. p. 163. n. 9 (1873).

The type is headless. Probably represents an undescribed genus with affinities to the Neotropical *Resthenia*.

Capsus intaminatus, Walk. Cat. Het. vi. p. 127. n. 304 (1873).

In the four specimens representing this species there are contained three distinct genera; but the specimens are all mutilated, the type cannot be fixed, and the species must be regarded as non-existent.

Summarized Disposition of Walker's Genera and Species.

Capsidæ.

Species considered valid and described under correct Genera.

Monalonion braconoides, Walk. Cat. Het. vi. p. 162 (1873).
Eucerocoris braconoides, Walk. *loc. cit.* p. 164.
—— *basifer*, Walk. *loc. cit.*
Helopeltis niger, Walk. *loc. cit.* p. 165.

Species considered valid, but requiring generic revision.

Lopus partilus, Walk. Cat. Het. vi. p. 56 (1873), belongs to gen. *Araspus*, g. n.

—— *australis*, Walk. *loc. cit.* p. 57,	belongs to gen.	*Pantilius*, Curtis.
—— *sordidus*, Walk. *loc. cit.*,	,,	*Sabellicus*, g. n.
Capsus incisus, Walk. *loc. cit.* p. 92,	,,	*Resthenia*, Spin.
—— *coccineus*, Walk. *loc. cit.* p. 93,	,,	*Lomatopleura*, Reut.
—— *limbatellus*, Walk. *loc. cit.*,	,,	*Pœcilocapsus*, Reut.
—— *strigulatus*, Walk. *loc. cit.* p. 94,	,,	*Camptobrochis*, Fieb.
—— *filicornis*, Walk. *loc. cit.* p. 96,	,,	*Megacœlum*, Fieb.
—— *marginatus*, Walk. *loc. cit.*,	,,	*Pœcilocapsus*, Reut.
—— *floridanus*, Walk. *loc. cit.* p. 97,	,,	*Lopidea*, Uhler.
—— *scitulus*, Walk. *loc. cit.* p. 99,	,,	*Lopidea*, Uhler.
—— *opacus*, Walk. *loc. cit.* p. 100,	,,	*Calocoris*, Fieb.
—— *jamaicensis*, Walk. *loc. cit.* p. 101,	,,	*Resthenia*, Spin.

Capsus basalis, Walk. Cat. Het. vi. p. 108 (1873), belongs to gen. *Resthenia*, Spin.
—— *tibialis*, Walk. *loc. cit.* p. 109, belongs to gen. *Sysinas*, Dist.
—— *atroluteus*, Walk. *loc. cit.*, „ *Resthenia*, Spin.
—— *xanthophilus*, Walk. *loc. cit.* p. 110, „ *Monalonion*, Herr.-Schäff.
—— *squalidus*, Walk. *loc. cit.*, „ *Horcias*, Dist. ?
—— *incertus*, Walk. *loc. cit.* p. 111, „ *Megacœlum*, Fieb.
—— *obumbratus*, Walk. *loc. cit.*, „ *Horcias*, Dist.
—— *alternus*, Walk. *loc. cit.*, „ *Fundanius*, Dist.
—— *leprosus*, Walk. *loc. cit.*, „ *Paracalocoris*, Dist.
—— *spoliatus*, Walk. *loc. cit.* p. 112, „ *Dagbertus*, g. n.
—— *quadrinotatus*, Walk. *loc. cit.* p. 113, „ *Dagbertus*, g. n.
—— *sobrius*, Walk. *loc. cit.* p. 115, „ *Paracalocoris*, Dist.
—— *illepidus*, Walk. *loc. cit.*, „ *Lygus*, Hahn.
—— *solitus*, Walk. *loc. cit.* p. 116, „ *Pœciloscytus*, Fieb.
—— *pallidulus*, Walk. *loc. cit.*, „ *Lygus*, Hahn.
—— *conspersus*, Walk. *loc. cit.*, „ *Lygus*, Hahn ?
—— *suffusus*, Walk. *loc. cit.* p. 117, „ *Lygus*, Hahn.
—— *sericeus*, Walk. *loc. cit.*, „ *Paracalocoris*, Dist.
—— *partitus*, Walk. *loc. cit.* p. 119, „ *Liocoris*, Fieb.
—— *stramineus*, Walk. *loc. cit.* p. 120, „ *Megacœlum*, Fieb.
—— *patulus*, Walk. *loc. cit.*, „ *Deræocoris*, Kirschb.
—— *sinicus*, Walk. *loc. cit.*, „ *Megacœlum*, Fieb.
—— *vicarius*, Walk. *loc. cit.* p. 121, „ *Rhinomiris*, Kirk.
—— *incisuratus*, Walk. *loc. cit.*, „ *Argenis*, g. n.
—— *fasciatus*, Walk. *loc. cit.* p. 122, „ *Disphinctus*, Stål.
—— *discoidalis*, Walk. *loc. cit.*, „ *Malacopeplus*, Kirk.
—— *apicifer*, Walk. *loc. cit.* p. 124, „ *Sabellicus*, g. n.
—— *lucidus*, Walk. *loc. cit.*, „ *Kosmiomiris*, Kirk.
—— *simulans*, Walk. *loc. cit.* p. 125, „ *Bothriomiris*, Kirk.
—— *tristis*, Walk. *loc. cit.*, „ *Saturniomiris*, Kirk.
—— *angulifer*, Walk. *loc. cit.* p. 126, „ *Megacœlum*, Fieb.
—— *pictulifer*, Walk. *loc. cit.*, „ *Zanessa*, Kirk.
—— *laticinctus*, Walk. *loc. cit.* p. 127, „ *Calocoris*, Fieb.
Leptomerocoris maoricus, Walk. *loc. cit.* p. 146, belongs to gen. *Lygus*, Hahn.
Monalonion politum, Walk. *loc. cit.* p. 163, belongs to gen. *Disphinctus*, Stål.
—— *divisum*, Walk. *loc. cit.*, belongs to gen. ? (type headless).

Species treated as synonymic.

Capsus xanthomelas, Walk. Cat. Het. vi. p. 92 (1873), = *Resthenia insitiva*, Say.
—— *hirsutulus*, Walk. *loc. cit.* p. 95, = *Neurocolpus nubilus*, Say.
—— *contiguus*, Walk. *loc. cit.*, = *Calocoris norvegicus*, Gmel.
—— *stramineus*, Walk. *loc. cit.* p. 96, = *Calocoris norvegicus*, Gmel.
—— *decoratus*, Walk. *loc. cit.* p. 100, = *Pœcilocapsus ornatulus*, Stål.
—— *bicinctus*, Walk. *loc. cit.*, = *Resthenia ornaticollis*, Stål.
—— *cinctipes*, Walk. *loc. cit.* p. 109, = *Horcias Signoreti*, Stål.
—— *innotatus*, Walk. *loc. cit.* p. 116, = *Lygus australis*, Dist., nom. n.
—— *limbatus*, Walk. *loc. cit.* p. 117, = *Lygus æthiops*, Dist., nom. n.
—— *canescens*, Walk. *loc. cit.* p. 121, = *Rhinomiris vicarius*, Walk.
—— *lineifer*, Walk. *loc. cit.* p. 122, = *Hyalopeplus vitripennis*, Stål.
—— *ustulatus*, Walk. *loc. cit.* p. 128, = *Calocoris laticinctus*, Walk.

Leptomerocoris antennatus, Walk. *loc. cit.* p. 145, = *Sabellicus sordidus*, Walk.
Helopeltis braconiformis, Walk. *loc. cit.* p. 165, = *Helopeltis* (*Dulichius*) *clavifer*, Walk.

To be treated as non-existent.

Types broken, undeterminable.

Capsus obscurellus, Walk. Cat. Het. vi. p. 93 (1873).
—— *intaminatus*, Walk. *loc. cit.* p. 127.

Species the types of which are not now to be found in the British Museum.

Capsus frontifer, Walk. Cat. Het. vi. p. 94 (1873).
—— *pallescens*, Walk. *loc. cit.*
—— *nigritulus*, Walk. *loc. cit.* p. 112.
—— *semiclusus*, Walk. *loc. cit.* p. 118.
—— *subirroratus*, Walk. *loc. cit.* p. 119.
—— *marginicollis*, Walk. *loc. cit.* p. 128.
Leptomerocoris simplex, Walk. *loc. cit.* p. 145.
Monalocoris bipunctipennis, Walk. *loc. cit.* p. 159.
Monalonion ichneumonoides, Walk. *loc. cit.* p. 162.

XXII.—*New Bats from British East Africa collected by Mrs. Hinde, and from the Cameroons by Mr. G. L. Bates.* By Oldfield Thomas.

The British Museum owes to the kindness of Mrs. Hinde, wife of Dr. S. L. Hinde, of Fort Hall, British East Africa, a further collection of bats, and these include three well-marked new forms, which I have described below, in conjunction with two others obtained by Mr. G. L. Bates in West Africa.

The new *Myotis* from Fort Hall, which I have named in honour of its captor, is an especially noticeable discovery.

Pipistrellus crassulus, sp. n.

A medium-sized species with disproportionally short fore-arms.

General build thick and heavy. Muzzle broad, swollen. Ears short, laid forward they do not nearly reach to the tip of the muzzle; inner margin straight below, convex above; tip evenly and broadly rounded; outer margin straight above, slightly convex below; basal lobe small, rounded. Tragus of medium length, its greatest breadth opposite its inner base; inner margin straight, tip rounded, outer margin gently convex, ending below in a small basal lobule. Thumbs short, with thickened but not enlarged basal pad. Wings from the base of the toes. Calcars about equal in length to the free border of the uropatagium; postcalcareal lobules distinct but narrow. Tail involved in membrane almost to the tip. Penis very long, slender.

Fur 3·5–4·0 mm. long on back. Uniformly dusky brown above, scarcely paler below. Membranes blackish brown throughout, without any trace of white margins.

Skull broad, stout and flattened, conspicuously broader and heavier, especially anteriorly, than in *P. pipistrellus*, which has a much longer forearm. Upper profile straight, the frontal region not inflated.

Inner upper incisors very thick, bifid; the postero-external cusp nearly as long as the main one; outer incisor slender, unicuspid, reaching about halfway from the cingulum to the tip of the inner tooth. Small upper premolar in the inner angle between the canine and large premolar, which touch one another outside it; not visible from without. Lower incisors broad, bifid. First lower premolar about three fourths the height of the second.

Dimensions of the type (measured in spirit):—

Forearm 28 mm.

Head and body 47; tail 27; ear 10; tragus on inner edge 3·5; thumb, free of membrane (c. u.) 4; third finger, metacarpus 26, 1st phalanx 9, 2nd phalanx 8·8; fifth finger 37; lower leg 12; hind foot, from back of calcar (c. u.) 7; penis 11.

Skull: greatest length 12·7; mastoid breadth 7·7.

Hab. Efulen, Cameroons.

Type. Adult male. Collected by G. L. Bates. One specimen.

This bat, with the short forearm of such pigmy species as *Pipistrellus Stampflii* and *minusculus*, has a very much larger body and head. The breadth and flatness of the skull are particularly noticeable.

Scotophilus nigrita colias, subsp. n.

A richly yellow (almost orange) bellied race of *S. nigrita*.

General characters as in this species, which is Dobson's "*S. borbonicus*." Fur long, rather shaggy; hairs of back 8–9 mm. in length. General colour above (of the tips of the hairs) olivaceous, but the bases of the hairs are a dull sulphur-yellow, which shows through on the upper surface. Below, the central line is a rich chrome-yellow, deepening laterally on the sides of the belly to a golden yellow, which is especially bright on the broad band of fur extending on the wing-membrane between the elbows and knees.

Dimensions of the type:—

Forearm 55 mm. (57 in a second specimen).

Skull: greatest length 20·5; zygomatic breadth 14·5; cheek-tooth series 5·7.

Hab. Fort Hall, Kenya District, British East Africa.

Type. Male. B.M. no. 2. 7. 6. 11. Original number 107. Collected 25th Jan., 1902, and presented by Mrs. Hinde.

The bats referable to *S. nigrita* seem divisible by colour into several geographical subspecies, of which *S. n. Dingani*, Smith, would be the Cape one, and *S. n. leucogaster*, Cretzschm., the Abyssinian. Specimens representing the true Senegalese *S. nigrita* and the Mozambique forms described by Peters are still wanting to the Museum Collection.

From any member of the group as yet described *S. n. colias* seems readily distinguishable by its brilliantly yellow under surface.

Scotophilus nigrita nux, subsp. n.

A chestnut-brown subspecies of *S. nigrita*.

General characters of the smaller forms of the widely distributed *S. nigrita*. Fur short, close and fine; hairs of back about 5 mm. in length. Colour above uniform chestnut-brown, or "burnt umber" (Ridgway), the bases of the hairs slightly paler than the tips; very different therefore from the other pale brown or olivaceous representatives of the species. Under surface a rather lighter brown, approaching "russet" (Ridgway), the other forms being all yellowish or whitish below. Fur of body scarcely extending on the wing-membranes below.

Dimensions of the type (measured in spirit before skinning):—

Forearm 55 mm.

Head and body 70; tail 47; ear 15.

Skull: greatest length 20·5; zygomatic breadth 14·7; upper cheek-tooth series 5·8.

Hab. Efulen, Cameroons.

Type. Adult male. B.M. no. 3. 2. 4. 5. Collected by Mr. G. L. Bates.

Although conspicuously different in colour from any of the known forms of *S. nigrita*, this bat so clearly represents that species in the West-African forest country that for the present I prefer to give it only subspecific rank.

Myotis Hildegardeæ, sp. n.

A beautiful and brightly coloured species allied to *M. Bocagei.*

Size medium. Ears small, narrow; inner margin evenly convex, tip very narrowly rounded, outer margin concave above, convex below, a marked angular antitragal lobule at the outer base thickly covered with fur. Tragus rather short, its inner margin slightly but evenly convex, its greatest breadth opposite the lower third of its inner margin, whence it slopes evenly to the narrow but not sharply pointed tip; basal lobe large, rounded. Feet large; wings to the metatarsi; calcars long, reaching nearly three-fourths towards the tip of the tail and ending in a distinct lobule.

Fur soft, thick and fine; hairs of back about 5–6 mm. in length. Wing-membranes naked, except for a few hairs on the under surface between the humeri and the flanks. Interfemoral furry above at the base, a narrow band passing outwards behind the legs nearly halfway down the tibiæ. Top of toes hairy.

General colour of upper surface bright "tawny-ochraceous," the head rather paler than the back. Individually the hairs are blackish brown for about 2 mm. at their bases, then pale tawny, darkening to their tips. Below the general colour is "pinkish-buff," the hairs blackish at their bases. Membranes dark throughout, contrasting strikingly with the bright colour of the body.

Skull considerably larger than in *M. Bocagei,* broader and lower than in *M. Goudoti.* Small upper premolars in the tooth-row, subequal in horizontal section, and less unequal in height than usual.

Dimensions of the type (measured in skin):—

Forearm 37 mm.

Head and body (c.) 53; tail 37; ear (dry) 13; tragus on inner edge (dry) 4·6; thumb clear of membrane 5; third finger, metacarpus 35, 1st phalanx 15·5, 2nd phalanx 10·7; fifth finger 53; tibia 17; foot from back of calcar (c. u.) 9·8; calcar 17.

Skull: greatest length 15·2; basal length 11·3; breadth of brain-case 8; front of canine to back of m^3 5·7.

Hab. Fort Hall, Kenya District. Alt. 4000 feet.

Type. Male. B.M. no. 3. 3. 2. 2. Original number 115. Collected 17th Oct., 1902, by Mrs. Hinde. Two specimens.

This very beautiful bat I have much pleasure in naming in honour of its discoverer Mrs. Hildegarde Hinde, to whom the British Museum is indebted for so many interesting Chiroptera and Rodentia.

M. Hildegardeæ is readily distinguishable from any of its allies by its striking coloration, as it is far brighter in tone than either *M. Bocagei* or *M. Goudoti*, the species most similar to it.

Nyctinomus Hindei, sp. n.

A whitish-winged member of the *N. pumilus* group.

Essential characters of ears, tragus, skull, &c., apparently as in *N. limbatus*, Peters. A marked tuft of brown hairs behind the joining membrane of the ears.

Colour of upper surface chocolate-brown, finely flecked with white; the bases of the hairs (which attain about 4–4·5 mm. in length) rather lighter. Under surface brown, more or less washed superficially with whitish, especially along the middle line of the belly; a creamy white line edging the junction of the wings with the flanks. Ears, forearms, hind limbs, and interfemoral membrane dark brown. Wing-membranes near the body whitish brown, paling to white on the middle part of the wing, and darkening again at the tips to brown.

Skull about as in *N. Emini*, though with less marked pre-orbital processes. Small upper premolar outside the middle line of tooth-row, less crushed than in *limbatus*, more so than in *Emini*. Middle lower incisors deeply bifid.

Dimensions of the type (measured in skin):—

Forearm 40 mm.

Head and body (c.) 61; tail 35; thumb close to membrane 6; third finger, metacarpal 39, 1st phalanx 15·5; fifth finger 39.

Skull: greatest length 17·6; basal length 14·6; zygomatic breadth 11·4; front of canine to back of m^3 6·7.

Hab. Fort Hall, Mt. Kenya district, British East Africa. Alt. 4000 feet.

Type. Adult male. B.M. no. 3. 3. 2. 4. Original number 134. Collected 1st Jan., 1903, and presented by Mrs. Hinde. Two specimens.

This *Nyctinomus* is most closely related to *N. Emini*, de Wint., of Usambiro, German E. Africa *, but differs by its whitish wings and more closely crushed upper premolars.

* Not Mosambiro, as accidentally printed in the original description, Ann. & Mag. Nat. Hist. (7) vii. p. 41 (1901).

XXIII.—*Descriptions of new Species of Aculeate and Parasitic Hymenoptera from Northern India.* By P. Cameron.

Apidæ.

Nomia pilosella, sp. n.

Black; the head, thorax, base of abdomen, and legs densely covered with longish white pubescence; the second, third, fourth, and fifth segments with emerald-coloured smooth bands; postscutellum with two stout longish black spines; metanotal area stoutly closely striated. Wings hyaline, the apex infuscated; tegulæ black, pale round the outer border. Face and clypeus not very strongly keeled down the middle. Hind femora roundly dilated above, the basal slope longer and not so long as the apical; the hind tibiæ become gradually wider towards the apex and rounded on the outer side; on the inner side the basal two thirds is straight, only slightly roundly dilated; the apex is broadly bluntly roundly dilated, somewhat as in *N. Westwoodi*, but the femora are much thicker, more dilated in the centre above, the basal and apical slopes are straight, oblique, whereas in *Westwoodi* the femora above have a gradually rounded curve from the base to the apex; in the present species they are shaped more as in *N. Elliotii* as figured by Smith (Trans. Ent. Soc. 1875, pl. i. fig. 7), but not by Bingham ('Fauna of Brit. India,' i. p. 449). The pubescence on the present species is much longer and denser than in *Elliotii*, which has the base of the metanotum "finely punctured," and there is a green band on the first abdominal segment; the present species has no band on it and the base of the metanotum is stoutly reticulated; also it is much more densely pilose.

Hab. Khasia Hills. Coll. Rothney.

Habropoda fulvipes, sp. n.

Black; the basal two segments of the abdomen rufo-fulvous, the lower inner orbits, a dagger-shaped mark (the "handle" above) on the centre of the face and clypeus, apex of clypeus, labrum, and basal half of mandibles pale yellow; the hair on the front of the head darker, behind paler coloured than it is on the thorax; antennæ dark brownish; legs fulvous, with paler hair. Wings hyaline, slightly tinged with fulvous; the nervures and stigma black. ♀.

Length 14 mm.

Hab. Khasia Hills. Coll. Rothney.

Clypeus punctured; in its centre a stout keel which reaches near to the apex; the face tuberculate in the middle, its apex and that of the labrum margined; on the centre of the face at the apex is a broadly triangular yellow-fulvous mark; on either side of the top of the labrum is a brownish mark, with two projections, the inner of which is raised. There is a dark brownish plate on the outer side of the base of the hind tibiæ, which is longer than broad, shield-shaped, roundly narrowed towards the apex, and with the outer edges raised. Basal four abdominal segments fringed with pale fulvous hair, the apical with longer black hair all over; the pygidium bare, with the sides broadly depressed on the apical half. Vertex smooth and shining, the front punctured, with a narrow keel down the centre.

What I suppose is the male has the head black, except the clypeus, which is pale yellowish testaceous; the lower part of the front and the sides of the clypeus thickly covered with depressed fulvous pubescence, as is also the greater part of the thorax; the abdomen above is black except the base and apices of the basal two segments broadly, and the ventral surface, which are honey-coloured; the legs are similarly coloured, except that the coxæ, trochanters, femora, and hind tibiæ are black above; the hind femora become gradually roundly dilated from the base to the apex; the hind tibiæ curved, not swollen. Clypeus margined laterally, not very convex, its apex transverse, margined narrowly on the inner edge. Antennæ entirely black. The wings are more clear hyaline than in the female, and the nervures and stigma are lighter coloured.

Compared with Bingham's figure of *H. Magrettii* the male of the present species has the thorax only very slightly haired and the hind femora are not at all so strongly dilated; its abdomen, too, is longer and narrower. It (the male) appears to be much more slenderly built than any species of *Habropoda* I have seen, is much less hairy, and has a much longer malar space, the eyes being widely distant from the base of the mandibles. The third joint of the antennæ is swollen, not narrowed at the base, and is hardly so long as the fourth, whereas in what I take to be the male of *H. Radoszkowskii* it is clearly longer and distinctly narrowed at the base. In neither the female nor the male of my species is the second recurrent nervure interstitial. The Indian species of *Habropoda* can hardly be looked upon as typical of the genus. Possibly my male represents a distinct species. It certainly appears to be too slender for the female, comparing it with the males of other species of the genus and their females.

Cœlioxys cariniscutis, sp. n.

This species is very similar to *C. khasiana*, with which it agrees in size, form, and coloration, including the fulvous pubescence on the underside of the tarsi, but it differs in the clypeus being keeled down the centre, in the sides of the scutellum being deeply furrowed, with the outer edge raised; the lateral teeth are stouter, depressed in the centre, become narrowed gradually to the apex, which is rounded and not depressed; the pronotum at the base projects into a large plate, which becomes gradually narrowed outwardly, forming a triangle of which the upper side is longer than the lower. There are eight teeth on the apical segment, two basal and six apical; the upper central pair are the shorter; the space behind them is depressed, the base of the depression with an oblique slope and shallower than it is at the apex; the apical lower pair of teeth are much longer and stouter than the others; the apices of the third, fourth, and fifth segments are less closely punctured than the rest; there is an oblique furrow on the sides of the second near the base and an oblique depression on the sides of the fifth near the base; the ocellar region has some smooth spaces at the sides and behind the ocelli; the lateral teeth of the scutellum are not bent downwards as in *khasiana* and *basalis*; the wings are fuscous violaceous to the transverse basal nervure. ♂.

Length 11–12 mm.

Hab. Khasia Hills. Coll. Rothney.

Cœlioxys khasiana, sp. n.

Black; clypeus, face, lower part of the vertex broadly on the sides, pleuræ, metanotum, and the apices of the abdominal segments narrowly covered with white pubescence, the rest of the head and thorax with short white pubescence; wings bright dark fuscous violaceous, highly iridescent, the nervures and stigma black. ♀.

Length 11–12 mm.

Hab. Khasia Hills. Coll. Rothney.

Vertex covered with large, deep, round punctures, which are much more widely separated at the sides of the ocelli; the raised central part of the front more coarsely punctured, almost reticulated; its sides more closely and less coarsely punctured; face and clypeus closely irregularly punctured; the hair fringing the apex of the clypeus has a fulvous tinge. Mandibles to near the apex coarsely punctured, the punctures longish. Pro- and mesothorax closely covered with large deep punctures, which are small on the base of the mesonotum. Apex of scutellum broadly rounded; the lateral teeth large, almost smooth, curved down slightly at the apex. Median segment and apex of mesopleuræ smooth. Abdomen sparsely but distinctly punctured; the apex of the last segment closely rugosely punctured, the centre raised, smooth, the sides obliquely depressed; the apex becomes gradually narrowed to a point; the apical ventral segment becomes gradually narrowed and projects largely beyond the upper. Legs covered with white pubescence; the tarsi below with longish stiff fulvous hair.

Comes near to *C. basalis*, Sm.

Nomia Rothneyi, sp. n.

Black; an interrupted band of white pubescence on the apex of the first abdominal segment; a broad smooth white band on the apices of the second, third, and fourth segments; flagellum of antennæ brownish beneath; wings hyaline, the stigma testaceous, the nervures darker coloured. ♀.

Length 7 mm.

Hab. Mussoorie (*Rothney*).

Face broadly roundly raised in the middle; clypeus opaque, with clearly separated scattered punctures, its apex transverse; front and vertex closely punctured; an impressed line on the centre of the upper three fourths of the front; the sides of face, of the front, and the outer orbits thickly covered with white pubescence. Thorax closely punctured; the sides and apex of the mesonotum and the postscutellum thickly covered with grey pubescence. Basal area of metanotum large, clearly defined, strongly transversely striated; the striæ distinctly separated; the narrowed basal inner edges obliquely striated. Pleuræ, sternum, and legs densely covered with long cinereous pubescence. Abdomen smooth and shining; there is a transverse, curved, impressed line behind the white band on the third and fourth segments; the apical two segments are brown.

This species cannot well be confounded with any of the described white-banded species of *Paranomia*.

Nomia interrupta, sp. n.

Black; a narrow line of pale green on either side of the apex of the second abdominal segment, the tibiæ rufous; the pleuræ densely covered with long fulvous pubescence, the mesonotum more sparsely with shorter black, the cheeks with pale fulvous, the face and clypeus with fulvous pubescence. Flagellum of antennæ for the greater part rufo-testaceous. Wings hyaline, slightly tinged with fulvous. Face and clypeus stoutly keeled down the centre. ♀.

Length 13 mm.

Hab. Khasia Hills. Coll. Rothney.

Face distinctly projecting in the middle, the projection with an oblique slope, almost smooth; the clypeus distinctly sparsely punctured; the central keel on the two is continuous. Clypeus roundly convex, its apex broadly roundly. Front and vertex sparsely indistinctly punctured. Mesonotum closely and distinctly punctured, the scutellum as closely but not so strongly. Basal area of metanotum closely, strongly, irregularly transversely striated. Tegulæ rufo-testaceous. Back of abdomen minutely punctured, except at the apex of the segments; the scopa bright rufous. Hair on legs long, fulvous, glistening on the tibiæ and tarsi.

A distinct species, easily known by the single, interrupted, smooth, greenish band on the second abdominal segment, strongly keeled face and clypeus, and the four rufous front tibiæ.

Nomia tuberculata, sp. n.

Black; the pubescence on the head, thorax, and underside of the abdomen pale fulvous; the base of the first abdominal segment thickly covered with fulvous pubescence, the rest of the pubescence on the back short, sparse; the apices of the basal three segments broadly smooth and shining. Face roundly dilated in the centre, almost smooth; the clypeus broadly depressed in the middle, the sides roundly dilated, smooth and shining, bearing some large punctures; the top in the centre keeled, the apex is transverse, clearly separated. Wings hyaline, the apex with a fuscous cloud; stigma and nervures testaceous. ♀.

Length 13 mm.

Hab. Khasia Hills. Coll. Rothney.

Face, front, and vertex sparsely punctured, the face in the centre smooth. Postscutellum thickly covered with fulvous pubescence. Median segment smooth and shining, its basal area not defined, its sides with a few keels. Tegulæ testaceous. The hair on the legs is long, dense, and fulvous, the spurs dark rufous.

Characteristic of this species is the fact that the raised centre of the face and the sides of the clypeus form three large tubercles. In Bingham's arrangement ('Fauna of Brit. India,' Hym. i. p. 459) it comes near *N. terminata*, Sm.

Megachile khasiana, sp. n.

The pubescence on the head, thorax, and base of abdomen dense, fulvous, on the rest of the back of abdomen and on the apex of ventral surface black; on the base the ventral scopa black; legs covered with cinereous pubescence; the pubescence on the underside of the base of four front tarsi rufous, on the hinder black; wings fuscous violaceous, the base more hyaline, paler. ♀.

Length 13 mm.

Hab. Khasia Hills. Coll. Rothney.

Face and clypeus strongly but not closely punctured, the pubescence on them paler and sparser than on the front. Mandibles widely furrowed along the outer edge; the apical part bordered by a narrow curved furrow, the central with some irregular furrows, of which the apical is the wider and deeper; the apical tooth is long and stout, rounded at the apex, the second is broader and shorter and becomes gradually narrowed to the apex, which is rounded; the rest is broadly bluntly rounded and toothless. Abdomen opaque, closely punctured; the basal three segments have transverse furrows near the middle, the apex of the third is more widely depressed. Calcaria testaceous; metatarsus nearly as wide as the tibiæ; apex of clypeus transverse.

Of the Indian species this comes nearest to *M. umbripennis*, Sm., recorded by Smith from Borneo and Nepaul and by Bingham from Sikhim and Tenasserim. The number of mandibular teeth is not given by Bingham, but Smith states (Cat. Hym. Brit. Mus. i. p. 175) that they have four stout teeth, so his species is readily separated from *M. khasiana*.

Fossores.

Trypoxylon placidum, sp. n.

Black; the antennal scape, face, and clypeus thickly covered with silvery pubescence, the pleuræ, sternum, and median segment with longish white hair, the pro- and mesonotum thickly with long fuscous hair, the legs sparsely with white pubescence. Wings hyaline, the apex smoky, nervures and stigma black. Apical joint of antennæ thickened, nearly twice the length of the preceding two joints united. Front alutaceous, indistinctly furrowed in the centre; vertex opaque, finely, not very distinctly punctured. Clypeus not carinate in the middle, its apex broadly rounded, raised, smooth. Palpi pallid testaceous, black at the base. The apex of metanotum has an oblique slope; the basal furrow extends from the base to the apex, becomes gradually wider, is shallow and finely transversely striated; the furrow on apical slope wide, deep on the basal half, V-shaped; the apical third of the segment is somewhat coarsely transversely striated. Abdominal petiole narrow, with only the apex dilated; it is as long as the succeeding three segments united, its apex distinctly clavate. ♀ ♂.

Length 13 mm.

Hab. Khasia Hills. Coll. Rothney.

Trypoxylon fulvocollare, sp. n.

Black; the basal five or six joints of the antennæ fulvous, the scape thickly covered with white hair, the flagellum with shorter blackish pubescence; clypeus and mandibles rufous, palpi pale testaceous; the apex of pronotum and tubercles fulvous; the base and sides of the first abdominal segment and the base of the second and third segments broadly rufo-testaceous. Apex of fore coxæ, trochanters, femora, tibiæ, and tarsi fulvous, the femora of a deeper hue, the apex of the middle femora, the middle tibiæ and base of tarsi, and the base of the hinder tibiæ pale testaceous. Wings hyaline, with a slight fulvous tinge, the costa and stigma fulvous, the latter lighter in tint; the radius and cubitus testaceous. Face, eye-incision, outer orbits and the base, sides and apex of mesonotum thickly covered with golden pubescence; the scutellum with short fuscous, the postscutellum with longer fulvous hair; the pleuræ and sternum with short pale fulvous pubescence. Front and vertex sparsely punctured, the former above with a wide and shallow furrow; the lower half triangularly keeled. On the apex of the basal half of the median segment is an elongated fovea; the apical half deeply furrowed in the middle. The apical third of the petiole dilated.

Comes nearest to *T. coloratum*, Sm.; that species has only a small tubercle above the base of the antennæ, while in the present species there is not a tubercle, but a long stout keel. There is no lateral furrow on the base of the median segment. ♀.

Length 17–18 mm.

Hab. Khasia Hills. Coll. Rothney.

Trypoxylon khasiæ, sp. n.

One of the larger species. In size comes near to *T. coloratum*, which differs in having the pubescence golden. In Bingham's table ('Fauna of Brit. India,' Hym. i. p. 224) it comes into B, except as regards the size and b^3. "Abdomen red, basal segment only black."

Black; apex of clypeus testaceous; mandibles yellow, their teeth black; palpi yellow; scape and base of flagellum of antennæ pale yellow, the rest black, brownish beneath; the base and sides of mesonotum with a distinct fulvous-yellow band; tubercles yellow, except at the base, and fringed with silvery hair; abdomen rufo-testaceous, the petiole black, except at the apex, the black there being triangularly incised in the middle. Four front legs yellowish, the femora of a more testaceous hue, the base of all the coxæ black; the hind femora black, running into testaceous towards the middle; the hinder tibiæ yellowish beneath, flavo-testaceous above, blackish towards the apex, the tarsi blackish, the apices of all the joints testaceous. Wings hyaline, the stigma testaceous. The clypeus, orbits, and eye-incision densely covered with silvery pubescence; the front obscurely punctured; a narrow furrow runs from the ocelli. Thorax densely pilose, the pile fuscous on the mesonotum, longer and more silvery on the sides; the sides and apex of median segment thickly covered with pale hair; at its base in the middle is an elongated somewhat pear-shaped depression; the apex is deeply and widely furrowed and densely covered with long white hair. The greater part of the pleuræ covered with silvery pubescence.

Length 20 mm.

Hab. Khasia Hills. Coll. Rothney.

Trypoxylon orientale, sp. n.

Antennæ black, distinctly thickened towards the apex, the scape thickly covered with long white hair; flagellum bare. Face, lower part of eye-incision, and clypeus thickly covered with silvery pubescence; front and vertex opaque, covered with long fuscous hair. Palpi pale testaceous. Thorax thickly covered with pale hair. Median segment short, its apex with an oblique slope; on the base is a striated depression, which becomes gradually wider towards the apex and is moderately deep; there is a smooth, narrower, oblique furrow on the sides. Legs black, pilose, the hair on the femora longer. Wings clear hyaline, the sides of the dilated apex of the petiole and the base and sides of the second segment rufous; the petiole long and slender, as long as the following three segments united. ♀.

Length 22 mm.

Hab. Khasia Hills. Coll. Rothney.

Psen rufo-balteata, sp. n.

Black; the apex of the second abdominal segment and the whole of the third rufous; the fifth and following joints of the antennæ testaceous beneath. Legs thickly covered with white hair; the spurs pale rufous. Wings clear hyaline; the first cubital cellule in front is half the length of the second, the first recurrent nervure is received very near the first transverse cubital, the second at twice the distance from the second transverse cubital. ♀.

Length 5 mm.

Hab. Khasia Hills. Coll. Rothney.

Antennæ stout, thickened towards the apex; the scape beneath sparsely covered with long black hair. Face and clypeus thickly covered with silvery pubescence; the front and vertex almost bare, sparsely punctured; the eyes almost parallel; the ocelli in pits; the front with a shallow central furrow; antennal tubercle large, the apex triangular, its sides distinctly margined, the middle depressed; below this is a larger broader one, roundly incised at the apex, the sides rounded. Pro- and mesothorax shining, sparsely covered with white hair; the mesonotum distinctly but not closely punctured; the scutellums with a few fine punctures. Area on the base of metanotum narrow, elongate, and marked with stout striæ; the central furrow is wide and deep, becoming slightly wider towards the apex, and marked with a few stout striæ; on either side of it at the apex is a large leaf-like expansion, its apex transverse, on the outer side covered with long hair; at its base is a small rounded projection. Pro- and mesopleuræ finely and sparsely punctured; below the mesopleural tubercles is a wide, deep, slightly oblique furrow, marked with some transverse keels; there is a smooth furrow near the base of the metapleuræ; the apex of the latter is rugose and is marked with some transverse keels.

Comes near to *P. rufiventris*, but is quite distinct therefrom.

Ichneumonidæ.

Suvalta annulipes, sp. n.

Agrees with *S. lævifrons* in having the front and vertex smooth, but is smaller, has two yellow marks on the mesonotum, the scutellum yellow from base to apex, not yellow on the basal half only; the mark on the mesopleuræ is smaller, and there is none on the metapleuræ; the black on hind femora broader, reaching to the middle; the hind coxæ are yellow at the base, not broadly in the middle, and the hind trochanters yellow, not black.

The ninth to twenty-second joints of antennæ yellowish white below; the flagellum thickly covered with black short hair; scape shining, sparsely pilose. Face, clypeus (except at apex), labrum, mandibles, palpi, apical two thirds of scutellum, a large somewhat triangular mark on the sides of the first abdominal segment at the apex, the other segments broadly at the sides, and the apical almost entirely, yellow. Four front legs fulvous, yellow at the base, the end joint of tarsi black; hind coxæ black, with a large yellow band on the base above; the trochanters and basal half of femora fulvous, the apical half of femora and of the tibiæ black, the basal half of the tibiæ and of the tarsi yellowish. ♀.

Length 12 mm.

Hab. Khasia Hills. Coll. Rothney.

Face strongly punctured above, in the middle transversely striated; apex of clypeus smooth, the base punctured; mandibles punctured at the base. Front and vertex smooth and shining, sparsely covered with long black hair; the space between the hind ocelli with large deep punctures. Mesonotum rugosely punctured, reticulated in parts. Scutellum covered with long fuscous hair, its yellow mark is rounded before and behind, its sides coarsely punctured, the depressions stoutly striated behind. In the centre of the metanotum at the base is an area wider than long and having inside a few stout oblique keels; the rest of the basal region reticulated, the reticulations wider on the inner side; the rest is strongly closely reticulated; the teeth large, broad, rounded at the top, looked at from behind. Propleuræ sharply margined at the base above, above strongly punctured; the rest stoutly striated. Mesopleuræ stoutly longitudinally striated, except in the middle behind; immediately under the tubercles the striæ are vertical or oblique; near the base under the tubercles is a keel. Metapleuræ coarsely rugosely punctured, the punctures running into reticulations.

Areolet almost square, the recurrent nervure received near the apical third. Abdomen short; petiole shining, strongly punctured; between the apex and the middle are scattered punctures; the second and third segments are closely punctured, the others smooth; gastrocœli smooth, hardly depressed in the middle.

Suvalta pallidinerva, sp. n.

Agrees closely in coloration with *S. annulipes*, but may be known from it by the longer, more slender petiole, which is not so much dilated at the apex nor so strongly punctured; the head is wider compared with the mesothorax, and the pronotum is much more dilated at the base, it being there distinctly tuberculate.

Length to apex of petiole 7 mm.

Hab. Khasia Hills. Coll. Rothney.

Black; clypeus (except at apex), palpi, the inner orbits to near the end of the vertex, the outer more broadly from near the top, edge of pronotum (broadly in front, more narrowly behind), scutellum broadly in the middle, a broad line on the sides of median segment from shortly above the spines, a large mark on the base of propleuræ (broad above, gradually narrowed towards the apex), the tubercles, a large mark on the lower side of the base of mesopleuræ (curved and narrowed above), the base and lower side straight, a mark under the hind wings, the greater part of the lateral scutellar keels, and the sides of the abdominal segments broadly, yellow. Four front legs fulvous, their coxæ and trochanters pallid yellow; the fore femora lined with black above; the hinder legs are of a deeper fulvous tint; the coxæ, trochanters, slightly more than the apical third of the femora, apical fourth of tibiæ, the spurs, and base of metatarsus black; the tarsi are of a more yellowish tint than the tibiæ. Wings hyaline, the nervures, stigma, and costa pale testaceous; the areolet is of equal width throughout, a little longer than broad, the recurrent nervure is received in its apical third.

Mesonotum rugosely punctured, the punctures running into striations in the middle. Scutellum covered with long fuscous hair, smooth; postscutellum very smooth and shining. The depression in the middle of median segment is smooth, at its sides it is finely punctured, the outer part coarsely punctured. The segment outside the keel is coarsely rugosely punctured; the teeth broadly rounded at the top, oblique at the sides; behind them are some curved keels. The upperside of the pronotum is roundly incised in the centre, the sides of the propleuræ above are strongly punctured, the middle strongly obliquely striated. Mesopleuræ longitudinally striated (except on the lower side at the base, which is punctured, and a small smooth space in the middle behind); the tubercles are punctured. Metapleuræ closely rugosely punctured, above more closely punctured. Mesosternum punctured, its furrow triangularly widened at the apex. Petiole shining; before its apex is a punctured band, surrounding a smooth space; the second and third segments are closely punctured; gastrocœli shallow, coarsely aciculated, the part behind them is raised on the outer side and is very smooth and shining.

The antennæ and the apical abdominal segments are broken off.

Algathia rufopetiolata, sp. n.

Black; the scape of antennæ rufous below, the base of flagellum brownish, joints 11–14 white below; a triangular yellowish mark in the centre of the face above; apex of mandibles testaceous; palpi pale yellow; scutellums, the sides of the apex of median segment, the apices of the second, third, fifth, and the whole of the apical abdominal segments pale yellow; the petiole rufous, its apex yellow. Legs red; the four front coxæ and trochanters pale yellow; the femora and tibiæ fulvous, the tibiæ paler, the fore tarsi fuscous except at the base, the middle blackish; the hinder coxæ, trochanters, and femora rufous; a large mark on the coxæ below at the apex, the apex of femora, and tibiæ (except a small dull rufous band at the base) black; the calcaria pale; tarsi black, with rufous spines. Wings hyaline, with a slight fuscous tinge, the nervures and stigma black; areolet narrowed in front; transverse median nervure received shortly in front of the transverse basal. ♂.

Length 8–9 mm.

Hab. Khasia Hills. Coll. Rothney.

Face sparsely punctured laterally, more thickly in the centre; clypeus punctured, more sparsely below; labrum fringed with long fulvous hair; the face thickly covered with fuscous pubescence. Front sparsely punctured, the inner orbits above sharply margined. Mesonotum closely punctured, the apex in the middle broadly longitudinally striated, almost reticulated; middle lobe raised at the base. Scutellum roundly raised, smooth, covered with long pale hair. Postscutellum bifoveate at the base. Metanotum at the base with large deep punctures; the areola longer than broad, rounded at the base, gradually narrowed to the apex; the rounded basal part has a stout central keel and a less distinct one at the apex; the lateral areæ stoutly obliquely striated; the posterior median strongly, closely, transversely striated, the sides more sparsely and strongly. Base of propleuræ aciculated, the upper half strongly punctured, the lower with some stout striations; meso- and metapleuræ closely and strongly punctured, the latter more strongly and rugosely above the keel. The postpetiole has a depression in the middle, which is wide at the apex, narrowed towards the base; the second and third segments closely punctured, the base of the second closely and strongly longitudinally striated, the striæ going on to the gastrocœli, which are shallow, brownish, and aciculated at the apex.

Algathia tibialis, sp. n.

Black; a mark in the middle of the face above and the base of the mandibles rufous; palpi lemon-yellow, the apical lateral areæ of the mesonotum except at the base yellow; first abdominal segment blood-coloured, the sides in the middle blackish, the apex yellow, the apex of the second, the sides of the third broadly at the apex, and the sixth and seventh entirely, pale yellow; the basal three joints of the antennæ rufous beneath, the tenth to sixteenth white, fuscous above; four front legs rufo-fulvous, the coxæ and trochanters yellow; the middle tarsi fuscous; the hind legs rufous, the apex of the femora, tibiæ (except at the base), and the tarsi black. Wings hyaline, with a slight fulvous tinge, the stigma fuscous. ♀.

Length 8–9 mm.

Hab. Khasia Hills. Coll. Rothney.

Face closely punctured, thickly covered with fuscous hair, the clypeus more strongly and sparsely punctured, the front and vertex shining, sparsely punctured, the former indistinctly keeled. Mesonotum strongly punctured, longitudinally striated in the middle towards the apex. Scutellum shining, thickly covered with long fuscous hair. Areola obliquely narrowed towards the base and to a less extent towards the apex, which is transverse; its base has a central and a less distinct and more irregular longitudinal keel on the sides, the middle irregularly transversely striated; the posterior median area is (except at the base) transversely striated; the outer basal area coarsely punctured, smooth at the base; the apical stoutly transversely striated, more stoutly on the apical than on the basal half; spiracular area finely rugose at the base, more coarsely transversely rugose before the spiracles, the middle with some stout curved keels, the apex much more closely but not quite so sharply obliquely striated. Mesopleuræ closely punctured, strongly irregularly striated under the tubercles; the metapleuræ uniformly, somewhat strongly punctured and deeply depressed at the base above. Postpetiole obscurely punctured laterally and furrowed in the middle. Scutellum thickly covered with long fuscous hair; postpetiole striated at the base.

Agrees closely in coloration with *A. rufopetiolata*, including the rufous petiole; may be known from it by the narrower areola, which receives the keel in the middle, while in *rufopetiolata* it is received clearly above the middle.

Algathia latibalteata, sp. n.

Agrees closely in coloration with *A. zonata*; may be known from it by the black hind coxæ, by the base of metanotum being rugosely punctured, by the areola being rounded at the base and stoutly transversely striated, &c.

Black; a small mark on the face below the antennæ (broad at base, gradually narrowed to the apex, as long as it is wide at the base), palpi, tegulæ, scutellums (except the scutellum at the base), the apex of the first abdominal segment, of the second and third more broadly, the apical two thirds of the penultimate, and the whole of the last, pale yellow. Mandibles black, the apical third rufous. Palpi pale yellow. Four front legs fulvous, the tarsi infuscated, the coxæ and trochanters pale yellow; the hind coxæ black, the top and more or less of the inner side rufous; basal joint of trochanters rufous, apical yellowish; the femora with the apex broadly black, the black more extended above; tibiæ and tarsi black, the former broadly rufous at the base; calcaria pale. Wings hyaline, with a fulvous tinge; nervures fuscous, darker at the base; areolet much narrowed in front; the second transverse cubital nervure faint.

Length 11 mm.

Hab. Khasia Hills. Coll. Rothney.

Scape of antennæ testaceous in the middle below; the flagellum at the base obscure brownish, thickly covered with black hair. Face and clypeus with widely separated punctures and covered with long fuscous hair. Front and vertex shining, sparsely haired and punctured; the front ocellus surrounded by a furrow. Mesonotum shining, punctured in the middle, at the base of the basal lobe almost striated.

The basal lateral areæ of metanotum strongly punctured and with a curved furrow on the inner side; areola twice longer than wide, bulging out obliquely in the middle and with the apex wider than the base and transverse; its basal half is furrowed deeply down the middle, the sides irregularly transversely striated; the base of the posterior median area with a stout longitudinal keel in the middle, the rest transversely irregularly striated, the striæ weaker and closer towards the apex; the outer areæ strongly punctured, the punctures large and deep, the spiracular area irregularly reticulated at the base, the rest strongly transversely striated. Propleuræ above with large deep punctures, the depressed middle stoutly, obliquely, irregularly striated. Mesopleuræ strongly punctured, rugosely near the tubercles; the metapleuræ between the keels strongly and uniformly punctured. The first abdominal segment smooth, the sides of postpetiole depressed and punctured; the middle with a large deep depression; the second and third segments closely punctured, the base of the second closely longitudinally striated; the gastrocœli shallow, closely striated (except at the apex); the apical segments thickly covered with white hair.

Algathia rufipes, sp. n.

Black; the tenth to fifteenth joints of antennæ white below; face, clypeus, inner orbits and the outer from near the top, mandibles at the base, palpi, edge of pronotum (except at the base) narrowly, an irregular squarish mark behind the middle of the mesonotum, scutellums, sides of metanotum broadly, the lower edge of propleuræ, tubercles, an irregular mark (narrowed in the middle) on the lower part of mesopleuræ, a short line below the hind wings, a small mark over the hind coxæ, the centre and apex of scutellum, the apices of the first, second, third, and fourth abdominal segments, of the sixth, and the whole of the apical segment, yellow. Legs rufous, the four front coxæ and trochanters yellow; the hind coxæ and base of trochanters black; the hind tarsi white, the basal and apical joints black. Wings hyaline, the stigma testaceous, the nervures blackish; areolet narrowed above, the nervures almost touching there; transverse median postfurcal. ♀.

Length 10, terebra 1 mm.

Hab. Khasia Hills. Coll. Rothney.

Face closely punctured and covered with silvery pubescence; there is an irregular diamond-shaped mark in its centre and a less distinct black line above the clypeal foveæ.

Clypeus punctured, but not strongly or closely, its apex slightly bent inwardly. Scutellum opaque, closely and uniformly punctured, more strongly than the mesonotum. Metanotum closely punctured (except in the centre at the base); areola longer than broad and of nearly equal width; the teeth broad, large, rounded, and narrowed at the apex. Propleuræ have a plumbeous hue and are irregularly striated at the apex; the meso- closely, the metapleuræ if anything still more closely, punctured, the punctuation running into striæ at the apex. The second to fifth abdominal segments are closely punctured; the gastrocœli striated at the base; the petiole is aciculated in the middle towards the apex.

Algathia erythropoda, sp. n.

Black; the face, clypeus in the centre above, the mark rounded at the apex, the basal half of the mandibles, palpi, the inner orbits, the line dilated in front of the ocelli, a line on the pronotum (broad at the base, gradually narrowed to the apex), basal half of tegulæ, tubercles, scutellum (except at the base), postscutellum, the fifth abdominal segment (narrowly in the middle), the apical two thirds of the sixth and seventh entirely, yellow. Scape of antennæ yellow below, thickly covered with white hair; the joints of flagellum dilated below (especially near the apex) and brownish. Legs rufous, the front coxæ and trochanters yellow, the middle coxæ yellow, broadly black at the base behind; the hinder black, with the apical half yellow above; the basal joint of the trochanters, apex of hinder tibiæ, and the hind tarsi black; the spurs pale fulvous. Wings not very clear hyaline, the stigma and nervures black; areolet narrowed in front, being there less in length than the space bounded by the recurrent and second transverse cubital nervures. ♂.

Length 11 mm.

Hab. Khasia Hills. Coll. Rothney.

Face coarsely punctured, thickly covered with short white hair; the clypeus less strongly punctured, almost smooth at the apex; the vertex strongly punctured, the front smooth. Mesonotum closely strongly punctured. Scutellum shining, covered with long fuscous hair. Areola broader than long, the sides at the base obliquely truncated, the apex slightly bent inwardly, the sides distinctly depressed, with two or three keels at the apex; the centre raised, rugosely punctured; the posterior median area widened at the base, closely, strongly, transversely striated; the lateral basal areæ coarsely aciculated on the inner side, the rest strongly irregularly striated; the spiracular area behind strongly aciculated, the rest coarsely transversely striated; the other basal areæ strongly but not closely punctured; the apical areæ smooth at the base, the rest with stout, clearly separated, transverse keels. Upper part of propleuræ strongly punctured, the base aciculated, the middle below stoutly striated; mesopleuræ strongly punctured, the base above and the apex below striated; metapleuræ punctured strongly all over. Postpetiole strongly and closely punctured, raised in the middle and obliquely narrowed at the apex; the second and third abdominal segments closely punctured, the apical thickly covered with fulvous hair; the gastrocœli large, the base on the inner side with a stout keel, the outer with two keels.

Comes near to *A. parvimaculata*; it is larger, wants the white bands on the postpetiole, the hinder trochanters are yellow, not black; the black mark on the face and clypeus is much smaller and the middle coxæ are yellow.

Algathia varipes, sp. n.

Black; the face, clypeus, labrum, the inner orbits from the middle of the ocelli to the white face, an oblique somewhat triangular mark near the eyes opposite the hinder ocelli, the lower three fourths of the outer orbits (the mark narrow above, broader below), palpi, mandibles (except their teeth), a line on the pronotum (curved at the base), scutellums, the posterior intermedian, the apex of spiracular end of the tooth-bearing areæ of median segment, a mark above the hind coxæ, the apices of the first and second abdominal segments broadly (the lines dilated in the middle), the sixth slightly in the middle, and the whole of the last segment pale yellow; the four front legs fulvous, the coxæ and trochanters pale yellow; the hinder coxæ black, broadly yellow in the middle above; the basal joint of the trochanters yellow, the apical joint and the base of femora rufous, the rest of the femora, almost the apical half of the tibiæ, and the base of metatarsus black; the rest of tarsi white, the hinder spurs dark rufous. Wings hyaline, the costa, stigma, and nervures black. ♂.

Length 9 mm.

Hab. Khasia Hills. Coll. Rothney.

Antennal scape beneath and the fourteenth to twenty-fifth joints white; scape thickly covered with long fuscous hair, the flagellum with short black pubescence. Face, clypeus, and vertex closely and strongly punctured, thickly covered with short fuscous hair. Mesonotum closely punctured, opaque; scutellums shining, smooth, sparsely covered with short fuscous hair; the basal scutellar keel stout, sharp, white at the apex, and extending to the middle. Base of median segment depressed at the base, the furrow smooth, slightly curved, petiolar area open at the base, areola longer than broad, rounded at the base, rounded inwardly at the apex; posterior median area slightly widened at the base, almost smooth, only obscurely transversely striated; the supra-external area has some scattered punctures, the tooth-bearing coarsely punctured, the spiracular finely punctured at the base, the rest obliquely striated; the posterior inter-median coarsely obliquely striated; the teeth indistinct. Propleuræ punctured above, below smooth, the apex in the middle with some stout punctures; mesopleuræ closely punctured, the metapleuræ more strongly, with the punctures somewhat more widely separated.

Algathia Rothneyi, sp. n.

Agrees closely in coloration with *A. varipes*, except that it has a yellow mark on the mesopleura; otherwise differing in having the base of the metanotum opaque and aciculated, the keels bordering the petiolar area are longer, the areola is not smooth, the teeth are more distinct, the hinder femora have only the apical third black, and the scutellar keels reach to the apex.

Black; the head below the antennæ, mandibles (except the teeth), palpi, the inner orbits above, the line narrowed below, the apical three fourths of outer orbits, edge of pronotum (the basal half of the line dilated and acute at the base), the tubercles, a mark on the hinder edge of mesopleuræ (longer than wide and obliquely truncated at the apex), scutellums, the sides of the median segment (broadly at the apex), a narrow band on the first abdominal segment (roundly dilated in the middle), the apex of second broadly, and the apical two entirely, pale yellow. Four front legs rufous, their coxæ and trochanters pallid yellow; hinder legs of a deeper red; coxæ black, yellow above and within, the basal joint of trochanters yellow; the apical third of femora and of the tibiæ and the basal two thirds of metatarsus black; the rest of the tarsi pale yellow, except the apex of the last joint. Wings clear hyaline, the stigma testaceous, nervures fuscous. ♀.

Length 8 mm.

Hab. Khasia Hills. Coll. Rothney.

Scape below and joints 9–16 of antennæ white, the flagellum at base and apex brownish beneath. Face closely, the clypeus more sparsely punctured; palpi pale yellow; labrum fringed with long fuscous hair. Vertex below the ocelli closely transversely punctured; front smooth and shining. Mesonotum closely punctured. Scutellum not distinctly depressed at base and apex, its keels sharp and extending to the base of the apical third and depressed on the inner side; scutellum bifoveate at the base. Basal area of metanotum large, aciculated, obliquely narrowed towards the apex; areola nearly as long as wide, the sides at the base obliquely narrowed, its apex slightly roundly turned inwardly; posterior median area smooth, of uniform width and rounded at the base; the other areæ closely punctured, opaque; the spiracular and the tooth-bearing areæ more strongly, irregularly, and not so closely striated. Propleuræ above closely punctured, the apex broadly, in the middle longitudinally striated; the base with a broad yellow band, broader than the upper one on the pronotum; mesopleuræ closely punctured, the middle behind coarsely aciculated, the metapleuræ at the base aciculated, the rest closely obliquely aciculated. Gastrocœli shallow, striated; the base rufous, striated.

Algathia robusta, sp. n.

Is very similar in form and coloration to *A. maculiceps*; may be known from it by the yellow scutellum, by the strongly striated front and vertex, by the areola being distinctly defined and the posterior median area not at all, and by the apex of the hind tibiæ and the metatarsus being black.

Black; face (except a small black mark above), clypeus, mandibles, palpi, the inner orbits to beyond the hinder ocelli, the lower outer orbits (narrowly above, broadly below), palpi, a narrow line on the pronotum (not reaching to the base), tegulæ, a line on the base of the propleuræ, the line dilated at the base, two short marks in the centre of the mesonotum, scutellums, two broad lines on the sides of median segment, the tubercles, lower part of mesopleuræ (the yellow dilated upwards at the base), the base of mesosternum, the apices of the first to fourth abdominal segments, and the apical entirely, yellow. Four front legs fulvous, tinged with yellow, the apices of the tarsi black; hinder coxæ and basal joint of trochanters, apex of femora, of the tibiæ and the metatarsus, black; on the apex of the hind coxæ behind is a large yellow mark, narrowed behind. Wings hyaline, the nervures and stigma pale testaceous; the areolet slightly oblique, narrowed in front, the nervures almost uniting there. ♂.

Length 11 mm.

Hab. Khasia Hills. Coll. Rothney.

Face closely and strongly punctured, its middle above almost transversely striated; clypeus less strongly punctured, its apex smooth; it is thickly covered with short white, the labrum fringed with long fulvous, hair. Vertex near the eyes punctured, the centre with three keels, running from the hinder ocelli, which turn outwardly to the central furrow, the front finely transversely striated. Mesonotum closely and strongly punctured. Scutellum at base rugosely punctured, the rounded apex closely longitudinally striated; the keels large, black, and reaching to the apical third. Middle of metanotum at base with an oblique slope, the sides margined, very smooth and shining; areola somewhat wider than long, the base rounded, apex transverse, it is irregularly longitudinally rugose, the middle keeled; the lateral areæ rugose, in the centre almost reticulated; teeth large, wide. Propleuræ obscurely punctured above; the mesopleuræ strongly punctured, the middle slightly, the apex more strongly longitudinally striated; the metapleuræ with the spiracular area closely obliquely striated. Postpetiole closely, finely, irregularly striated, the other abdominal segments closely punctured; gastrocœli deep, finely striated at the base; apex aciculated.

Algathia flavo-balteata, sp. n.

Agrees in size and colour with *A. robusta*; may easily be separated from it by the form of the scutellum, which has a much sharper oblique slope, by the postscutellum being only obscurely, not strongly striated at the base, by the base of metanotum being aciculated, by the areola being longer compared with its breadth, by the black on the hind femora and tibiæ being less extended, by the hind coxæ being almost entirely yellow above, and by the less distinct curve on the apex of clypeus.

Joints 9–15 of antennæ below, the face and clypeus (except for a small oval mark below the antennæ), mandibles, palpi, inner eye-orbits, the outer from near the top more broadly, white. A narrow line on the pronotum, tegulæ, a large mark near the apex of mesonotum, scutellums, two broad curved lines on the sides of median segment at the apex, a broad line on the lower side of the propleuræ, a broader one (curved upwards at the base on the lower side of the mesopleuræ), a narrower one on the hinder edge, a mark below the hind wings, the basal four abdominal segments at the apex, and the apical two entirely, whitish yellow. Four front legs fulvous; the coxæ and trochanters yellow; the hind coxæ black, the middle above broadly yellow, and there is an elongated mark on the side at the base; the hind femora and tibiæ rufous, as are also the trochanters; the hinder knees, apex of tibiæ, and metatarsus black, the rest of the tarsi white. Wings hyaline, with a slight fuscous tint; stigma testaceous. ♀.

Length 11 mm.

Hab. Khasia Hills. Coll. Rothney.

Face closely and strongly punctured; the clypeus sparsely punctured, its apex transverse; the black part of vertex strongly aciculated, the front strongly transversely striated and furrowed down the centre. Propleuræ with a plumbeous hue; the meso- closely, the metapleuræ if anything more strongly, punctured. Scutellum strongly but not closely punctured. Median segment closely punctured; the apex in the centre closely, at the sides much more strongly, transversely striated; the teeth large; areola longer than broad, rounded at the base, slightly narrowed at the apex, which is transverse. Postpetiole shagreened or finely striated in the middle; the gastrocœli large, wide, the base finely striated.

Algathia femorata, sp. n.

Black; a mark (elongated and rounded at the apex) in the centre of the face above, palpi, scutellum, the outer areæ on the apex of the median segment, the middle of the tubercles, the apex of the first and second abdominal segments, a large triangular mark on the sides of the third, the apex of the penultimate, and the whole of the last segment yellow. Scape of antennæ rufous beneath, the middle of flagellum broadly white. Four front legs fulvous, their coxæ and trochanters yellowish white; the middle tarsi and the hind legs black, except the trochanters, which are yellow, and the extreme apex of the femora, which is rufous; the calcaria white. Wings hyaline, the nervures and stigma black. ♀.

Length 10 mm.

Hab. Khasia Hills. Coll. Rothney.

Face strongly, clypeus sparsely punctured. Mesonotum closely and strongly punctured, thickly covered with short thick hair. Scutellum smooth, shining. Areola elongate, the base distinctly, the apex slightly narrowed; the lateral keels received in front of its middle; posterior median area aciculated, shagreened towards the apex; the lateral areæ with some rough transverse keels, the spiracular closely punctured, the apex raised on the inner side, transversely striated; the outer two basal areæ are closely but not strongly punctured, the outer apical have three stout, curved, transverse keels on the apex. The apex of the median segment is thickly covered with long soft white hair. Propleuræ coarsely punctured more finely at the base, the middle below obscurely striated. Mesopleuræ coarsely punctured, below the tubercles obliquely striated; metapleuræ punctured like the mesopleuræ. First segment of abdomen smooth, the depressed sides of the apex punctured; the second and third segments closely punctured, the base of the second striated laterally; gastrocœli not depressed, rufous at the apex. The apical segments of the abdomen are thickly covered with soft white hair.

Algathia cariniscutis, sp. n.

Black; the scape of antennæ and joints 8–12 underneath, the face and clypeus (except for a line in the centre of the former, which gets gradually thicker until it reaches the clypeal foveæ, the clypeus being also black in the centre), and the labrum white; the inner orbits broadly to the end of the eyes, the outer more narrowly on the lower half, maxillary palpi, lower part of propleuræ, the edge of pronotum (except at the base), tegulæ, tubercles, scutellums, the apical half of median segment, a large oblique mark on the mesopleuræ above the coxæ, a smaller one behind the posterior coxæ, one under the hind wings, the apices of the first and second abdominal segments, a mark on either side of the third, and the apical two segments, yellow. Legs rufous, the four front coxæ and trochanters bright lemon-yellow, the apices of the tarsi fuscous; the hinder coxæ black, broadly yellow above and at the sides above on the inner side, their middle behind next to the black part rufous; the trochanters black, the basal joint for the greater part yellow above; the apex of the hind femora and the base of the tibiæ more narrowly black; the hinder tarsi paler, not so rufous in tint as the anterior, their apex black. Wings clear hyaline, the stigma and nervures black. ♀.

Length 8 mm.

Hab. Khasia Hills. Coll. Rothney.

Face and clypeus closely punctured, covered with short white down; the front and vertex almost impunctate. Mesonotum closely and uniformly punctured; scutellum smooth, covered with fuscous pubescence, its sides stoutly keeled. Areola slightly wider than long, rounded at the base, the apex bulging inwardly; the base of posterior median area smooth, the rest transversely striated; the outer apical areæ are more strongly and widely striated. The upper half of propleuræ closely punctured, as are also the mesopleuræ; the metapleuræ are more closely and strongly punctured. First segment of abdomen aciculated, the post-petiole more strongly and raised in the middle; the second and third segments are closely punctured; the gastrocœli wide, striated, the oblique apex aciculated.

XXIV.—*Preliminary Note on certain Points in the Anatomy of* Eryx *and other* Boidæ, *partly indicative of their Basal Position among the Ophidia.* By Frank E. Beddard, M.A., F.R.S.

It is generally believed that the Boidæ occupy phylogenetically a place at or near the base of the Ophidian series; and this view is expressed by Boulenger in a tabular statement of the mutual affinities of the various families of the Order *. This opinion is largely based upon the persistence of considerable vestiges of the pelvic girdle and upon the paired lungs. In studying the anatomy of snakes I have been able to note a few other points to which little or, in some cases, no attention has been paid and which tend to the support of this conclusion. My observations bearing upon this subject were made upon *Python*, *Eryx*, and *Boa*.

The first point to which I would draw attention is the equal size of the right and left aortic arches, which join to form the dorsal aorta. In at least many other snakes (for example, *Zamenis flagelliformis*) the right aortic arch is so much the smaller that it appears almost as an inconspicuous branch of the left. It would appear, however, that in *Python bivittatus* this is not the case †, though Dr. Gadow's drawing ‡ of *Pelophilus madagascariensis* is in accordance with the facts which I have observed.

Secondly, the intercostal branches of the aorta are arranged in a fashion which appears to me to be distinctly archaic. In most snakes the intercostal arteries are very irregular in

* 'Catalogue of the Snakes in the British Museum (Natural History),' London, 1893, vol. i. p. 2.

† Bronn's 'Klassen und Ordnungen des Thierreichs,' Bd. vi. Abth. iii. pl. cxxxiv. fig. 2. This figure is copied from Fritsch.

‡ *Ibid.* pl. cxxxv. fig. 1.

their origins from the dorsal aorta and their points of entrance into the thickness of the dorsal parietes.

They arise at unequal intervals from the aorta and enter the parietes at varying distances from each other. In *Python reticulatus,* Hopkinson and Pancoat * did not figure these arteries at all; but Jacquart † in another python figured them as single arteries arising regularly from the aorta ‡. I do not find this in *Python spilotes.* But as the conditions in *Eryx* are more primitive still, I refer to that snake only for the present. Here the intercostal arteries are practically regular in their arrangement, being metamerically disposed in agreement with the vertebræ. There is a pair to each intervertebral interval. The two arteries of the pair either arise side by side from the aorta, or an artery single in its origin soon bifurcates. I cannot but think that this arrangement of the intercostals is more primitive than that which is more usual among the Ophidia. I may remark that it occurs in the Lacertilia (e. g. *Chamæleon*, *Tiliqua*, &c.).

I am uncertain whether to regard the total absence of a gubernaculum, tying down the ventricle to the pericardium, as indicative of a primitive structural relationship. It may at first appear unnecessary to record the fact of the absence of a gubernaculum. For it is generally stated § that the Ophidia are to be contrasted with the Lacertilia in this very point—the Lacertilia possessing a gubernaculum and the Ophidia being deprived of one. I find, however, considerable vestiges of this "tag" in certain Ophidia, but not in *Eryx* or *Boa.* On the other hand, I think it may be regarded as probable that a conspicuous azygos vein is a primitive feature. Now in *Python spilotes* this vein collects blood from and therefore extends over many more than four intercostal spaces, which is the limit of this vessel in *Coronella getula.* In *Eryx conicus* the azygos vein collects blood from no less than ten intercostal spaces.

As a general rule a considerable number of renal arteries (even as many as eight in *Coluber catenifer*) supply each kidney. This is correlated with the considerable length of the gland in most snakes; I cannot, however, ascertain that there is an exact relationship between the length of the kidney and the number of arteries supplying it. But the

* Trans. Amer. Phil. Soc. v. 1837, p. 121.

† Ann. Sci. Nat. (4) iv. p. 321.

‡ In *Python Sebæ* I find an identical arrangement. The arteries arise singly and bifurcate just before entering the parietes.

§ For instance, in that section of Bronn's 'Klassen und Ordnungen des Thierreichs' which deals with snakes.

existence of only a single renal artery on each side in some Boidæ, though doubtless associated with a small kidney *, is of itself, as it appears to me, a primitive character, inasmuch as there is here an absence of reduplication, so common a feature of the vascular and other systems in the Ophidia.

The same arguments may be used in the case of the gastric arteries, which are two in *Eryx* and three in *Python spilotes*. In the genus *Coluber* there may be as many as ten or eleven gastric arteries.

It is not common in snakes, so far as my experience goes, for the two carotids at their origin to be equal in size: they are, however, in both *Eryx jaculus* and *E. conicus*, but not in *Python spilotes*. Another primitive (?) feature which is found in only one of the two genera mentioned is connected with the dorsal musculature of *Python spilotes*. As a general rule, in snakes a beautiful complex of tendons is seen to occupy the dorsal median region when the animal is opened from below. In *Python* this region is much less converted into tendon; it remains muscular. Now there is evidence elsewhere in the animal kingdom of muscles becoming more tendinous or being converted entirely into ligaments, but not of ligaments and tendons acquiring a muscular character †.

Some features in the circulatory system, other than those briefly referred to above, are not without interest.

It is at least rare among snakes ‡ for the arteries supplying the gonads to arise from the aorta opposite to each other instead of one being in front of the other. Nevertheless, in a female *Eryx conicus* the ovarian arteries form a pair arising side by side. As is usual, these arteries immediately follow the superior mesenteric.

It is a peculiarity of snakes, contrasted with lizards, that the anterior abdominal vein of the latter is single, while it is at least sometimes partly double in the Ophidia. This point of difference from the Lacertilia, and, so far, of resemblance to the Crocodilia, is apt to be slurred over in text-books. In one specimen of *Eryx conicus* the vessel was single throughout; in another it was partly double, as was the case with two specimens of *Eryx jaculus*. In *Boa constrictor* the vessel was single for a distance of six inches behind the gall-bladder and thence to the cloaca double.

* In *Heterodon platyrhinus*, for example, the proportions between the length of the body (to the vent) and the length of the larger kidney are 9 : 1, in *Boa constrictor* 15 : 1.

† For example, one of the glutæal muscles in hornbills.

‡ I have not myself observed a single instance, except in the case mentioned above.

In *Python Sebæ* the fluctuation of this vein between the single and double condition was more plainly seen. Just in front of the gall-bladder the vessel communicates with the gastric portal vein; from this point to two inches behind the gall-bladder it is single. For a distance of $4\frac{1}{2}$ inches it is formed of two tubes lying side by side; these then reunite and finally again separate to form two tubes. This example shows that the double character of the vein is not only due to the elongation of the body, and as a consequence the equivalent of the posterior double region of the same vein in Lacertilia, where it emerges from the two posteriorly situated fat-bodies.

XXV.—*Description of a new Genus of Spatangoids.* By F. Jeffrey Bell, M.A.

Among the Prymnodesmid Spatangoids (or those with a subanal fasciole) the genera known as *Brissus*, *Meoma*, and *Metalia* are ordinarily recognized as forming a compact group. I have lately received from a valued correspondent, Mr. F. W. Townsend, some specimens from the coast of Oman which have a striking resemblance to these three, but are at once distinguished from all of them by the position of the apex, which is hardly, if at all, excentric. This subcentral position of the apex suggests that this new form is phylogenetically older than the three genera to which it seems to be allied; and I suggest for it, therefore, the name of *Eobrissus*.

The genus may be diagnosed in the following terms:—A Prymnodesmid Spatangoid with the apex almost central and the anterior ambulacrum flush with the test; the antero-lateral ambulacra directed forwards and not at right angles to the long axis of the test; an open circumanal fasciole, as in *Metalia*.

The possession of a circumanal fasciole has generally been regarded as a recent acquisition, so that it is of importance to note its coexistence with the archaic position of the apex.

Specific characters and name.—As there is but a single form known, the specific characters must be guessed at. In general appearance like a small *Brissus unicolor*, with light-coloured Brissine spines, none of much greater length than the rest; those on the abactinal side longer and sharper than those on the actinal. Larger tubercles scattered among the smaller on the actinal surface, more regularly larger below; the lateral ambulacra moderately wide and slightly sunken. Four pairs of pores on each side within the subanal fasciole.

Hab. Indian Sea, off Oman.

The species may well be called, after its finder, *Echinobrissus Townsendi*.

The following measurements may be of some service :—

Test.			Length of Ambulacra.		
Length.	Greatest breadth.	Height at apex.	Anterior.	Ant. lat.	Post. lat.
64	49	32	..	..	..
54	44	28	22·5	21·5	21·5
38	30	21	15	14	14

XXVI.—*Description of a new* Barbus *from Cameroon.* By G. A. Boulenger, F.R.S.

The number of recently discovered African Barbels of the group of *Barbus Bynni* is really surprising. Until a year ago the group was unrepresented in West Africa; then I described a species, *B. Batesii* *, allied to the East-African *B. tanensis*, Gthr., discovered in Cameroon by Mr. G. L. Bates, whilst the description of a second closely allied species, likewise from Cameroon, *B. Linnelli*, Lönnberg, appeared in the last number of these 'Annals' †. Thanks to the exertions of Mr. Bates, I am now able to add a third Cameroon species to the list.

Barbus micronema.

Depth of body 3 times in total length, length of head 4 to $4\frac{1}{2}$ times. Snout rounded-subtruncate, $2\frac{2}{3}$ to 3 times in length of head, projecting beyond the mouth, with small pearl-like granules on the sides; diameter of eye $4\frac{2}{3}$ to $5\frac{1}{2}$ times in length of head, interorbital width twice to twice and one third; mouth inferior, forming a broken arch, a feebly curved transverse line in front, its width 3 times in length of head; lips feebly developed, lower restricted to the sides; edge of lower jaw forming a blunt keel; barbels one or two on each side, the anterior, if present, quite minute, the posterior $\frac{1}{2}$ diameter of eye. Dorsal III 10, last simple ray strong, bony, not serrated, its rigid part $\frac{3}{5}$ to $\frac{2}{3}$ length of head, free edge of the fin strongly emarginate; its distance from the occiput a little less than its distance from the caudal fin.

* Proc. Zool. Soc. 1903, i. p. 25, pl. iii. fig. 2.

† P. 138.

Anal III 5, longest ray $\frac{4}{5}$ length of head, reaching root of caudal. Pectoral as long as or a little shorter than head, not reaching ventral; latter below middle of base of dorsal. Caudal fin deeply forked, upper lobe pointed and much longer than lower. Caudal peduncle slightly longer than deep. Scales 27 $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, 2 between lateral line and ventral, 12 round caudal peduncle. Olive-brown above, golden below, the scales darker at the base; fins dark.

Total length 340 mm.

Two specimens from the Kribi River.

This species must be placed near *B. perplexicans*, Blgr., from the Tana River, E. Africa; like that species and the Abyssinian *B. plagiostomus*, Blgr., the shape of the mouth approximates it to the species of *Varicorhinus* or *Capoëta*; whilst in the condition of its barbels it serves to connect the species with two pairs of barbels with those with a single pair.

XXVII.—*Notes on the Structure of the Teeth of some Poisonous Snakes found in Travancore.* By R. SHUNKARA NARAYANA PILLAY.

In offering the following notes on the structure of the teeth of the poisonous Colubrine snakes I do not aspire to lay claim to originality, as my observations have been based on the lines of those already made by eminent men, and refer to a few snakes found in Travancore.

Since April 1901 I have been supplying snake-venom to the Pasteur Institute of India, Kasauli, and to Messrs. Burroughs, Wellcome, & Co.'s Research Laboratory. I had a fancy for the study of snakes, and as Preparator to the Museum I availed myself of the opportunity to make a comparative study of the poisonous and non-poisonous snakes, in the course of which, while examining the skull of a hamadryad (*Naia bungarus*) 14 feet long, the skeleton of which was being articulated for the museum, I noticed a certain peculiarity in the structure of the teeth which, to my mind, appeared to be abnormal—namely, the presence of grooved posterior maxillary teeth.

According to Mr. G. A. Boulenger *, the genus *Naia* is defined as having the poison-fang followed by one or more solid teeth; and in Sir Joseph Fayrer's 'Thanatophidia of India' mention is made of "a second simple tooth at some distance behind the fang." Later on I examined a spirit-specimen of *Naia bungarus*, and in this, too, I found the posterior maxillary teeth were grooved, the grooving being shallow or ill-defined

* 'The Fauna of British India,' Reptilia and Batrachia (1890).

and invisible to the naked eye. I communicated this to Mr. H. S. Ferguson, the Director of the Museum, and he informed Mr. G. A. Boulenger, who, while verifying and confirming the faintly grooved posterior maxillary teeth in the genus *Naia*, a discovery * made by him since the publication of the 'Fauna of British India,' does not seem to have been aware of the more or less grooved palatine series of teeth as well. At his instance I was led to a series of observations on the teeth of various poisonous Colubrine snakes of the subfamily Elapinæ so far as they are represented in Travancore, and, in addition, to the grooved functional and reserve fangs.

	Posterior maxillary.	Palatine.	Pterygoid.
Naia bungarus has	3	17	12
—— *tripudians* has	1	5	14
Bungarus cæruleus has	3	10	13

In the above not only are the posterior maxillary and palatine teeth more or less grooved, but all the pterygoid and mandibular series are likewise marked with faintly depressed lines resembling grooves. Furthermore, in connexion with an examination of two skulls of *Hemibungarus nigrescens*, a small poisonous Colubrine snake fairly common on the hills, I found the palatine teeth indistinctly grooved.

Government Museum, Trevandrum,
October 26, 1903.

Obituary Notice: Dr. William Francis.

Dr. William Francis was born in London on the 16th of February, 1817. He was educated at University College School and St. Omer. He left St. Omer in 1834 and proceeded to Crefelt, but in the autumn of the same year went to Gera, where he remained for about two years. In 1836 he returned to England and spent a year at the London University (University College), afterwards devoting some time to learning the printing business under Mr. Richard Taylor, to whom he had been apprenticed some time previously. He then went to Berlin, and thence to Giessen, where he studied under Liebig, and did much original work, chiefly on the salts of molybdenum. He took his degree of Doctor of Philosophy at Giessen in 1842.

He early developed a taste for Natural History, and during his stay at Gera he devoted much of his time to entomological study and pursuits. While in England, in 1837, "fresh from the teachings of Ehrenberg, and profoundly influenced by the spirit of scientific research which then, as now, prevailed in Germany," he "suggested to Mr. Richard Taylor the establishment of a journal in which, while its pages were freely open to the original contri-

* 'Catalogue of Snakes,' iii. p. 373 (1896).

butions of English naturalists, special attention should be paid to the researches of Continental observers; and the result was the starting of the 'Annals of Natural History,' with which, subsequently, the well-known 'Magazine of Natural History' of Loudon and Charlesworth was amalgamated." His name first appears on the wrapper as co-editor in 1859. As Editor of the 'Annals' he became acquainted with most of the leading naturalists, and made many life-long friends, his indebtedness to whom he warmly acknowledges in the Preface to the Sixth Series.

While in Berlin and Giessen, Dr. Francis, in conjunction with his friend and fellow-student Henry Croft, forwarded every month a series of reports to the 'Philosophical Magazine' on the progress of chemical science on the Continent; but the space available in that Journal being limited, they, on their return to England, started the 'Chemical Gazette' in 1842. Croft was compelled to relinquish the editorship before the fourth number appeared, being appointed Professor of Chemistry at King's College, Toronto; and the 'Gazette' was carried on by Dr. Francis alone until 1859, when the pressure of other work compelled him to relinquish the task, and the 'Gazette' was incorporated with the then newly founded 'Chemical News.'

In addition to furnishing translations of foreign scientific papers to the 'Philosophical Magazine,' he also translated many papers for Taylor's 'Scientific Memoirs,' in the conducting of which, moreover, he had a very large share, although his name did not appear on the titlepage. He also translated Beckmann's 'History of Inventions' for Bohn's Scientific Series.

In 1851 his services to the 'Philosophical Magazine' over many years, both in furnishing translations and in conducting the Journal, were acknowledged by the appearance of his name on the wrapper as co-editor, where it remained until his death. During the whole period of fifty-three years he took an active part in the management of the Magazine. His acquaintance and, in many cases, warm personal friendship with scientific men both in Great Britain and on the Continent, his sound judgment, and tact made his services in this capacity invaluable.

In 1841 he was elected Associate of the Chemical Society, becoming a Fellow in the following year. He was also a Fellow of the Linnean Society (1844), of the Royal Astronomical (1851), of the Geological (1859), and of the Physical (1876).

In 1852 he joined Mr. Richard Taylor as partner in the firm of Taylor and Francis, printers and publishers. He was one of the oldest members of the Stationers' Company, having taken the Livery in 1841.

In 1862 he married Isabella Gray, daughter of Mr. Taunton, M.R.C.S., of Hatton Garden, but became a widower in 1899. For some few years previous to his marriage Dr. Francis had lived at Richmond, and for the rest of his life continued to reside there—for the last thirty-one years at the Manor House, where he died on the 19th of January last.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 76. APRIL 1904.

XXVIII.—*Descriptions of some new Species of Lepidoptera Heterocera from Tropical South America.* By HERBERT DRUCE, F.L.S. &c.

Fam. Syntomidæ.

Ctenucha albolineata, sp. n.

Male.—Head, antennæ, collar, tegulæ, underside of the thorax, and legs black; thorax and abdomen metallic blue, the anal tuft black. Primaries black, a white line from the base through the middle of the cell almost to the outer margin below the apex; above the end of the white line is a small round white spot; the base and inner margin of the wing are streaked with metallic blue: secondaries black, with a wide white band along the costal margin, not quite reaching the apex; the fringes of both wings black.

Expanse $1\frac{3}{4}$ inch.

Hab. N. Peru, Huancabamba, 6000–10,000 feet (*Mus. Druce*).

This species is allied to *Ctenucha clavia*, Druce, from Ecuador.

Fam. Arctiidæ.

Automolis dolens, sp. n.

Female.—Head, antennæ, thorax, abdomen, and legs black; collar, tegulæ, and base of the abdomen yellowish white. Primaries black; a wide yellowish-white band crosses the wing near the base from the costal to the inner margin, the band is slightly widest on the inner margin; a yellowish-white narrow band crosses from the costal margin near the apex to the outer margin, then curves down along the outer margin to the anal angle; the fringe yellowish white: secondaries black, the basal third of the wing yellowish white. The underside the same as above.

Expanse $1\frac{3}{4}$ inch.

Hab. Paraguay (*Mus. Druce*).

This species is allied to *Automolis rectiradia*, Hampson, from the Upper Amazons, also to *Automolis tegyra*, Druce.

Anaxita Lysandra, sp. n.

Male.—Head, antennæ, and legs black, collar brown; tegulæ brown, edged with long black hairs; thorax and abdomen black, the sides bright red, the underside of the abdomen with four yellow spots near the base. Primaries brown, thickly irrorated with yellow scales; three yellow spots edged with black on the costal margin, the first and third small, the second long; veins all black, edged with pale yellowish brown, between each vein a long red line edged with black; fringe black: secondaries dark brown, veins black, with bright red streaks between them; the fringe black. Underside very similar to the upperside; secondaries with more red and with a yellowish streak along the costal margin.

Expanse 3 inches.

Hab. N. Peru, Huancabamba, 6000–10,000 feet (*Mus. Druce*).

A very fine species, very distinct.

Fam. **Ceratocampidæ.**

Adelocephala nisa, sp. n.

Male.—Head and palpi pink, antennæ and tegulæ yellowish brown, the latter edged with pink, the thorax and upperside of the abdomen yellowish brown, the underside of the abdomen and legs bright pink. Primaries pink, crossed by a wide dark yellowish-brown band extending from the apex to the middle of the inner margin; a white dot at the end of the cell, edged with pink; the fringe yellowish brown: secondaries pinkish brown, darkest along the inner margin; the fringe pink. The underside whitish pink, the costal half of the primaries yellowish; a rather faint black line extends from the apex almost to the inner margin; a black spot at the end of the cell; the costal margin of the secondaries slightly blackish.

Expanse $3\frac{1}{2}$ inches.

Hab. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Adelocephala hodeva, sp. n.

Male.—Head and antennæ dark brown; tegulæ pinkish brown; thorax and abdomen above dark brown, the sides of the abdomen banded with white, the underside pinkish grey; legs greyish brown. Primaries dark brown, the outer margin greyish brown, in some lights pinkish brown; a very distinct white spot at the end of the cell; the fringe dark brown: secondaries dark red, shading to brown along the inner margin; the fringe greyish brown. Underside: primaries, the costal half of the wing dark brown, the inner half red, the outer margin greyish; a dark brown line extends from the apex almost to the middle of the wing: secondaries pinkish grey, irrorated with small black spots; a short brown line extending from the anal angle to about the middle of the wing.

Expanse $4\frac{1}{2}$ inches.

Hab. British Guiana (*Mus. Druce*).

Adelocephala Eugenia, sp. n.

Female.—Head, antennæ, collar, and tegulæ brown; thorax and base of the abdomen citron-yellow, the upperside of the abdomen brownish yellow; the anal segment, underside, and legs dark brown. Primaries dark brown, with a greyish shade at the base across the middle of the wing and partly along the outer margin; a small white spot at the end of the cell: secondaries dark brown, with some yellow hairs at the base; the fringe pale brown. The underside of both wings pale greyish brown.

Expanse 4 inches.

Hab. French Guiana (*Mus. Druce*).

Adelocephala Smithi, sp. n.

Male.—Head, antennæ, collar, and tegulæ pale yellowish brown; thorax yellow, speckled with brown; abdomen pale yellow, whitish on the underside. Primaries pale yellow, thickly irrorated with small brown spots, thickest at the base of the wing: secondaries pale yellow, with rather a large tuft of red hairs on the inner margin. Underside: primaries pale greyish brown, irrorated with small brown spots; the base of the wing red; a black spot at the end of the cell: secondaries cream-colour, irrorated with minute brown dots.

Expanse 3 inches.

Hab. Colombia, Cacagualito, 1500 feet (*H. H. Smith, Mus. Druce*).

Adelocephala yucatana, sp. n.

Female.—Head, collar, tegulæ, thorax, and abdomen yellowish brown, antennæ and legs brown. Primaries pale yellowish brown, thickly irrorated with dark brown scales; two faint brown lines cross the wing from the costal to the inner margin, the first nearest to the base, the second beyond the middle; an ill-defined brown spot at the end of the cell: secondaries pink, edged with yellow round the outer margin; the fringe of both wings yellow. Underside very similar to the upperside, but without the lines crossing the primaries and with a large black spot at the end of the cell; the costal margin of the secondaries is also black.

Expanse $3\frac{1}{4}$ inches.

Hab. Yucatan (*Mus. Druce*).

Adelocephala lineata, sp. n.

Male.—Head, antennæ, collar, tegulæ, thorax, and abdomen pale yellow, the underside of the abdomen and legs yellowish white. Primaries pale yellow, the base of the wing greyish brown; a white dot at the end of the cell, beyond which a greyish-brown line crosses the wing from just below the apex to the inner margin close to the base: secondaries pale chrome-yellow; the fringe of both wings yellow. The underside of the primaries and secondaries pale yellowish white.

Expanse $2\frac{1}{4}$ inches.

Hab. Paraguay (*Mus. Druce*).

Fam. **Saturniidæ.**

Attacus vibidia, sp. n.

Male.—Head dark brown; collar white, edged with black; tegulæ and thorax brown; abdomen black, each segment edged with white; underside of the abdomen and legs brown. Primaries pale brown, irrorated with black scales; a curved white line near the base, edged with black on the outer side; a wide hyaline >-shaped mark at the end of the cell, edged with black on both sides; a waved black line extending from the costal margin, beyond which the wing is shaded with white, brown, and yellow; two large black spots edged with white on the inner side close to the apex: secondaries pale brown; an indistinct greyish line close to the base; a large hyaline angular-shaped spot edged with black at end of cell, below which a waved black line, edged with white on the outer side, extends from the costal margin near the apex to the inner margin above the anal angle; beyond the black line the wing is pinkish, then yellowish brown to the outer margin; a submarginal row of small black dots extends from the apex to the inner margin. Underside very similar to the upperside, but paler in colour.

Expanse $3\frac{1}{2}$ inches.

Hab. Argentine Republic, Tucuman (*Mus. Druce*).

A small species, very distinct from any known to me.

Fam. **Lasiocampidæ.**

Ormiscodes radama, sp. n.

Male.—Head and underside of the thorax and legs reddish brown; antennæ, collar, and tegulæ chrome-yellow; thorax reddish brown; abdomen black, each segment edged with white, the anal tuft yellowish brown. Primaries, the costal half of the wing yellow, the inner half clouded with brown, the veins black; a <-shaped white mark at the end of the cell and a white spot beyond; an indistinct slightly waved band crosses the wing from near the apex to the middle of the inner margin; the fringe alternately white and brown: secondaries yellowish brown, palest at the base and along the inner margin; a curved brown line crosses the wing beyond the middle; the veins all black. Underside very similar to the upperside, except that the white markings on the primaries are much smaller and that the costal margin of the secondaries is bordered with white.

Expanse $3\frac{1}{2}$ inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Ormiscodes (?) *choba*, sp. n.

Male.—Head, collar, tegulæ, thorax, abdomen, and legs pale pink; antennæ yellow. Primaries pink, slightly yellowish about the middle of the costal margin, and a yellowish line crossing the wing beyond the cell from the costal to the inner margin; two waved black lines extending from the costal to the inner margin, the first near the base, the second submarginal; a black dot at the end of the cell; the fringe yellowish pink: secondaries bright pink, darkest on the inner half of the wing. The underside of both wings pale pink, both wings crossed by two narrow dark pink lines.

Expanse 3 inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Megalopyge gamelia, sp. n.

Male.—Head, thorax, and abdomen white; collar and tegulæ black; antennæ yellowish. Primaries white, the costal margin from the base nearly to the apex dark grey; a black dot close to the base of the wing; a double row of small black spots crosses the wing from the apex to the middle of the inner margin; the fringe alternately black and white: secondaries white, with a submarginal row of black spots extending from the apex to the anal angle; the fringe black and white. The underside of both wings dusky white, without any markings.

Expanse $1\frac{3}{4}$ inch.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Apatelodes mehida, sp. n.

Male.—Head, antennæ, tegulæ, and abdomen pale greyish brown; the palpi and thorax black. Primaries greyish brown, the veins darker brown; a large brown spot, edged with white, on the outer side close to the apex; a dark brown elongated spot on the inner margin near the base; a straight brown line crosses the wing from the apex to the anal angle, between it and the base are two narrow curved lines extending from the costal to the inner margin: secondaries reddish brown, crossed about the middle from the costal to the inner margin by a pale greyish-brown waved band, darkest on the inner margin. Underside: primaries pale brown, the dark brown patch at the apex considerably larger, the lines crossing the wing very indistinct; secondaries dark reddish brown, with a very pale brown submarginal line extending from the costal margin to the anal angle; the underside of the abdomen dark brown.

Expanse $2\frac{1}{4}$ inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Apatelodes signata, sp. n.

Male.—Head, collar, tegulæ, thorax, and abdomen brown; antennæ yellowish brown; legs and underside of the abdomen dark brown. Primaries dark brown, irrorated with minute greyish scales; a pale brown spot at the end of the cell; a dark brown curved line crosses the wing beyond the middle from the costal to the inner margin; a submarginal greyish curved line extends from the apex to the anal angle: secondaries dark fawn-colour, crossed below the middle from the apex to the inner margin by two faint brown lines; the fringes of both wings brown. Underside: both wings pale brown, with the dark lines more distinct than on the upperside; a black spot at the end of the cell of the primaries and secondaries.—*Female* very similar to the male, but darker in colour.

Expanse, ♂ $2\frac{1}{4}$, ♀ 3 inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Apatelodes banepa, sp. n.

Male.—Head and thorax black; antennæ, collar, and tegulæ pale greyish brown; abdomen and legs brown. Primaries greyish brown, two small white spots close to the apex, edged with black on the inner side; a large elongated dark brown spot close to the base on the inner margin, and three zigzag indistinct black lines cross the wing from the costal to the inner margin; fringe brown: secondaries pale reddish brown, crossed about the middle by an indistinct whitish line.

Expanse 2 inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Lonomia bethulia, sp. n.

Male.—Head and antennæ black; collar, tegulæ, thorax, and abdomen reddish brown; legs black. Primaries pale yellowish brown, crossed near the base from the costal to the inner margin by two waved, curved, dark brown lines; three small black dots at the end of the cell, beyond which a straight, rather wide, dark brown line crosses the wing from the costal to the inner margin; a submarginal, zigzag, fine brown line extends from the apex to the anal angle: secondaries pale reddish brown, with a very fine line crossing the wing about the middle; the fringes of both wings brown. Underside very similar to the upperside, but paler in colour and with all the lines very indistinct.

Expanse $2\frac{1}{4}$ inches.

Hab. N. Peru, Huancabamba, 6000–10,000 feet (*Mus. Druce*).

This species is allied to *L. monacharia*, Mssn.; some specimens are much darker in colour than others.

Fam. **Bombycidæ.**

Hygrochroa intricata, sp. n.

Male.—Head, antennæ, collar, tegulæ, thorax, and abdomen pale olive-brown. Primaries pale olive-brown, crossed from the costal to the inner margin by two rather wide dark olive-brown bands, which are united just below the cell; the base and the apex of the wing olive-brown; a greyish-white marking on the outer margin above the anal angle and a black dot at the end of the cell; the fringe yellowish brown: secondaries pale yellowish fawn-colour, with some dark markings on the inner margin.

Expanse $1\frac{3}{4}$ inch.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Fam. **Notodontidæ.**

Marthula aurea, sp. n.

Male.—Head, palpi, and thorax dark brown; tegulæ and abdomen pale fawn-colour; legs and underside of the abdomen brown; antennæ yellowish brown. Primaries pinkish brown, becoming golden red along the costal margin; four indistinct angular brown lines cross the wing from the costal to the inner margin; two black lines close to the anal angle: secondaries white, clouded with black at the anal angle and round the outer margin; the fringe greyish. Underside: primaries uniformly blackish brown; secondaries white, the costal margin pale yellow.

Expanse 2 inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Eustema carama, sp. n.

Male.—Head, collar, tegulæ, thorax, and abdomen black, the thorax clothed with long yellowish hairs, underside of the thorax and legs black; the antennæ, anal tuft, and the underside of the abdomen yellowish brown. Primaries and secondaries pale greyish brown, the veins all black; fringes of both wings blackish brown. Underside the same as above.

Expanse $2\frac{1}{2}$ inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

This species is allied to *E. dora*, Druce, from Mexico.

Heterocampa dolens, sp. n.

Male.—Head, antennæ, collar, tegulæ, thorax, abdomen, and legs black. Primaries black, thickly irrorated with white scales; a white zigzag line crosses the wing close to the base; a large white patch beyond the cell and curved white line extending from the costal to the inner margin nearest the anal angle; the fringe alternately black and white: secondaries white, the costal margin clouded with black, the marginal line black; the fringe white. Underside similar to the upperside, but the primaries not so distinctly marked.

Expanse 2 inches.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Heterocampa longula, sp. n.

Male.—Head, antennæ, collar, and tegulæ reddish brown; thorax grey, abdomen dark grey, anal tuft white. Primaries silvery white, thickly irrorated with reddish-brown scales; a series of reddish-brown spots close to the apex; a brown spot at the end of the cell, edged with black; fringe grey: secondaries white. Underside of the thorax, abdomen, and legs white; primaries and secondaries white; the costal margin and apex of the primaries reddish brown.

Expanse $1\frac{3}{4}$ inch.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Heterocampa luteilinea, sp. n.

Male.—Head, collar, tegulæ, and thorax dark brown; the abdomen brown, the base clothed with greenish-yellow hairs, the underside of the abdomen yellowish white; the legs dark brown. Primaries dark purplish brown, the costal margin, apex, outer and inner margin edged with greenish yellow; a pale greyish double line crosses the wing from the costal to the inner margin near the base; a large elongated black spot at the end of the cell and three black spots close to the apex; two small white dots just above the anal angle: secondaries creamy white, the veins dark brown; a large black spot at the anal angle; the fringe greenish yellow. Underside: primaries brownish black, whitish on the outer margin near the anal angle; secondaries creamy white, the costal margin brownish black.

Expanse $1\frac{3}{4}$ inch.

Hab. S.E. Peru, Santo Domingo, 6000 feet (*Mus. Druce*).

Maschane Leechi, sp. n.

Female.—Head, antennæ, collar, and tegulæ reddish fawn-colour; thorax, abdomen, and legs pale fawn-colour. Primaries and secondaries pale reddish fawn-colour; primaries crossed from the apex to the inner margin close to the base by a dark brown line, lightest on the outer edge. Underside the same as above, but without any line on the primaries.

Expanse $1\frac{1}{2}$ inch.

Hab. Amazons (*Leech, Mus. Druce*).

Maschane neobule, sp. n.

Male.—Head, antennæ, and collar yellowish brown; tegulæ, thorax, and abdomen greyish. Primaries yellowish fawn-colour, almost yellow along the costal margin; a very fine brown line crosses the wing close to the base; a brown line extends from the apex to the middle of the inner margin; two round dots in the cell and a submarginal row of very minute brown dots extends from the apex to the anal angle; the fringe brown: secondaries reddish brown, palest at the base. Underside of both wings reddish cream-colour.

Expanse $1\frac{3}{4}$ inch.

Hab. Costa Rica (*Mus. Druce*).

XXIX.—*New Forms of* Saimiri, Saccopteryx, Balantiopteryx, *and* Thrichomys *from the Neotropical Region.* By Oldfield Thomas.

Saimiri Oerstedi citrinellus, subsp. n.

The Costa Rica form of the Panama *S. Oerstedi*—the head less blackened, and the limbs less yellow.

General characters as in true *Oerstedi.* Back of the same vivid orange or orange-ochraceous, or slightly paler, but anteriorly that colour narrows between the shoulders, leaving the region of the shoulder-blades greyish, like the arms. Below, the belly is scarcely, instead of being strongly, more yellowish than the white throat and axillæ, and the groins and inner sides of the thighs are whitish instead of yellow. Crown of head either altogether grey, as in *S. sciurus*, or with the tips of the hairs blackish, as in *S. boliviensis*, not deeply black as in *S. Oerstedi.* Arms to wrists and legs from thighs downwards grizzled greyish, with but little yellowish suffusion, these parts being in *Oerstedi* strongly suffused with orange-yellow. Hands orange, of rather a paler shade than in *Oerstedi*, the orange running up the outer side of the forearms to the elbow. Feet edged on each side with orange, and the toes are also the same colour, but the middle line of the metatarsus is grizzled greyish, continuous with the greyish of the legs. Proximal part of tail grizzled grey like the limbs, less yellowish than in *Oerstedi*; end of tail black as usual.

Dimensions of the type (measured in skin):—

Head and body 350 mm.; tail 415; hind foot 90.

Skull: greatest length 65; breadth of brain-case 36.

Hab. Costa Rica. Type from Pozo Azul, Pirris.

Type. Adult male. B.M. no. 4. 2. 7. 2. Collected 31 May, 1902, by Mr. C. F. Underwood. Six specimens.

The Squirrel-Monkey of Costa Rica has long been known, and this very locality, Pirris, is mentioned in Dr. von Frantzius's account * of the distribution of what he called "*Chrysothrix sciurea*," identified by Alston with *S. Oerstedi*. But a comparison of the series sent by Mr. Underwood with those representing the true *Oerstedi* †, collected in Panama and Veragua by Messrs. Watson, Batty, and Arcé, shows that the northern form differs constantly from the southern in certain characters. Of these the most tangible are the lessened black of the head, the greyer and less orange suffused limbs (especially the thighs), and the restriction of the orange of the feet to their edges, the whole of their upper surfaces being uniform "orange-ochraceous" in the true *S. Oerstedi*.

Saccopteryx bilineata centralis, subsp. n.

Similar in all essential respects to the true *S. bilineata* of northern South America, but the size is rather less and the build more delicate, as indicated by the skull. Colour as in *bilineata*, but the dorsal lines usually more brownish white, so that they do not contrast so conspicuously with the general body-colour.

Skull, as compared with that of true *bilineata*, smaller (total length 15·5 mm. as against 17) and more lightly built. Crests and ridges less developed, postorbital processes smaller and weaker. Brain-case more inflated at its antero-external-superior corners, the convexity markedly stronger and more projecting than in the larger form. Teeth smaller throughout.

Dimensions of the type (measured in spirit):—

Forearm 47 mm.

* Arch. f. Nat. xxxv. p. 260 (1869).

† The type locality of *S. Oerstedi* is not, as stated by Miller and Rehn, Cartago, Costa Rica, but Chiriqui, whence Oersted's specimen had been brought alive to Cartago. The original figure and description agree with Chiriqui specimens in all the characters distinguishing the latter from the Costa Rican form.

Head and body 50; tail 14; lower leg and foot (s. u.) 30·5; calcar 18·5.

Skull: greatest length 15·6; basal length in middle line 12; greatest breadth 10·4; interorbital breadth 4·2; breadth of brain-case 8; palate length 5·4; front of upper canine to back of m^3 6·5; front of lower canine to back of m_3 6·8.

Hab. (of type). Teapa, Tabasco, S.E. Mexico. Other specimens from Guatemala and Costa Rica.

Type. Female. B.M. no. 88. 8. 8. 20. Collected by H. H. Smith, and presented by Messrs. O. Salvin and F. D. Godman. About a dozen specimens examined.

The large members (forearms 45–50 mm.) of the restricted genus *Saccopteryx* are remarkably uniform in character over a wide geographical area, series from Ecuador and Peru on the west to Pernambuco on the east and Trinidad and Guiana in the north presenting no differences not covered by individual variation at single localities. I am therefore quite unable to distinguish Mr. Miller's *S. perspicillifer* (forearm 45–50) of Trinidad from the original *S. bilineata* (forearm 45 mm.) of Surinam. The large skull with heavy postorbital processes, as described by Miller, is equally to be found in specimens from Guiana, Para, and Pernambuco, which must among them include the true *bilineata* of Surinam. Examples with the typical length of forearm (45 mm.) occur both among our Trinidad and Guianan series, without any cranial indication that they belong to a different form from those whose forearms attain to 48 or 50 mm.

In Central America, however, the representative of *S. bilineata* seems sufficiently modified to bear a subspecific name, being distinguished by its lighter skull, more cube-shaped brain-case, smaller teeth, and rather duller coloration. But even then the difference is but slight.

The still smaller species of this group are two in number—*S. leptura*, Schr., browner in colour, with a skull of about 13·5–14 mm., and a forearm averaging about 38–40 mm.; and *S. canescens*, Thos., grey, skull only 12·5–13 mm., and length of forearm about 36–38 mm. Of the last-named, besides the type from the Lower Amazon, the Museum contains examples from the Orinoco (*Cherrie*), Surinam (*Bartlett*), and Cayenne (*Cherrie*), in each of which places *S. leptura* also occurs.

Balantiopteryx io, sp. n.

A slenderly built species allied to *B. infusca* *.

Size very small, the trunk and forearm lengths markedly

* *Saccopteryx infusca*, Thos. Ann. & Mag. Nat. Hist. (6) xx. p. 546 (1897).

less than in *B. infusca,* though the skull is as large as in that animal. General characters very much as in *B. infusca*; ears as in that species, the inner margin more evidently concave just below the tip. Tragus slender, its tip rounded, a marked lobule opposite to base of its inner margin, and another slight projection higher up. Wing- and leg-bones remarkably slender, much more so than in *B. infusca.* Wing-sacs in the centre of the membrane, as usual in *Balantiopteryx,* about a quarter of an inch internal to a line drawn directly forwards from the elbow. Feet quite free of membrane, the wings attached to the distal end of the tibiæ. Calcars slender, not reaching upwards to the knee. Base of interfemoral membrane hairy as far as the exsertion of the tail.

Colour of body above and below, and of membranes, dark brown (in alcohol); no white line along hinder edge of wings.

Skull agreeing in size with that of *B. infusca,* therefore much larger in proportion to the size of the animal than in that species. Muzzle flatter than in that species, and the inflations smaller, though equally prominent; in *B. infusca* the two inflations meet in the middle line for about 2 mm., while in *B. io* they are quite separate from one another, the nasal region having a marked concavity between them, bordered in front by an upturned edge above the centre of the nostrils. Zygomata abruptly and widely expanded. Front edge of palate with a well-marked median spine. Posterior narial fossa widely open, its outline broadly U-shaped. Basisphenoid pit large, more extended longitudinally than in *B. infusca,* longer than broad, without trace of median septum. Teeth apparently as in the allied species.

Dimensions of the type (measured in spirit):—

Forearm 36 mm.

Head and body 40; tail 12; tail free of membrane 4; ear 12; tragus on inner edge 3; thumb 5·6; third finger, metacarpal 31·5, first phalanx 11, second phalanx 15; fifth finger 36; tibia 14; lower leg and foot (c. u.) 22; calcar 10·5.

Skull: greatest length 12·3; upper length in middle line 11·4; basal length in middle line 8·7; zygomatic breadth 8·8; breadth across muzzle 6; mastoid breadth 7·6; palate length 3·3; basisphenoid pit 3·1 × 2·7.

Hab. R. Dolores, near Coban, Guatemala.

Type. Adult male. B.M. no. 86. 9. 3. 1. Collected by Mr. F. C. Sarg. Two specimens.

These are the Guatemalan specimens referred by me to *B. infusca* when describing that species, but there can be no doubt as to their distinctness both in proportions and skull-characters.

Thrichomys laurentius, sp. n.

Closely allied to *T. apereoides*, but greyer and with less tufted tail.

Fur close and straight, rather shorter than in *T. apereoides*; hairs of back about 18–20 mm. in length. General colour above approximately "broccoli-brown," the individual hairs slaty grey below, paler at base, darkening outwards, with a buffy subterminal band and a black tip. Sides, especially shoulders and hips, paler and greyer. Under surface, except for a greyish collar, pure sharply defined white, the hairs white to their bases. Head dark grey, a whitish spot above eye, another below it, and a third at outer base of ear. Long hairs of ear black. Arms and legs greyish, like sides externally, white on their inner aspects; hands and feet mixed grey and white along the metapodials, pure white laterally and on the digits. Tail with about an inch at its base clothed with hair of the texture and colour of that on the rump; the remainder cylindrical, well-haired, but not markedly crested above, and the hairs scarcely increasing in length terminally, the longest hairs barely attaining 8 mm. In *T. apereoides* the upper surface is crested with hairs which increase in length to the end, where they attain 15–18 mm. Colour of tail black above and at the end, dull whitish proximally below.

Skull on the whole as in *T. apereoides*, but the nasals are longer and the palatal foramina are more widely open, in this respect approaching those of *T. Fosteri*. Last molars similar to those of *T. apereoides*, less complicated than is usually the case in *T. Fosteri*.

Dimensions of the type (measured in the flesh):—

Head and body 215 mm.; tail 195; hind foot (s. u.) 45; ear 21.

Skull: greatest length 56·7; basilar length 41; greatest breadth 26; nasals 20·5 × 6·5; interorbital breadth 11·3; breadth across postorbital projections 17·2; palate length 19·8; diastema 11; palatal foramina 5·8 × 4·4; length of upper molar series 8·6.

Hab. São Lourenço, near Pernambuco. Alt. 50 m.

Type. Old male. B.M. no. 3. 10. 1. 68. Original number 1721. Collected 16 August, 1903, by Alphonse Robert.

By the discovery of the present animal the range of the genus *Thrichomys* is very considerably extended. Till recently only recorded from Lagoa Santa (Lund and Reinhardt), it was found in Paraguay by Mr. W. Foster, who has now sent a considerable series of the local species to the British Museum. In that country it is found only "in a small area of tumbled rock, a few acres in extent," and Mr. Robert informs me that *T. laurentius* is similarly very local in its distribution. He never met with it in any of the other places where he has collected.

Thrichomys laurentius has four mammæ, one pair placed high up on the flank behind the axillæ, and a second pair 4–5 cm. further back in front of the hips. No doubt the other species are similar in this respect.

T. laurentius is most nearly allied to *T. apereoides*, but may be distinguished by its darker colour and less bushy and crested tail. *T. Fosteri*, with a tail like that of *T. apereoides*, has a rather more greyish belly, wider palatal foramina, and more complicated third molars.

XXX.—*Descriptions of new or little-known Fishes from Mexico and British Honduras.* By C. Tate Regan, B.A.

Clupea (Opisthonema) Bulleri, sp. n.

Depth of body $3\frac{1}{5}$–$3\frac{2}{5}$ times in the total length, length of head 4 times. Snout as long as or a little longer than eye, the diameter of which is 4 times in the length of head. Maxillary extending to below anterior $\frac{1}{4}$ of eye; lower jaw projecting. Sc. 48–50/16. D. 17. A. 20–21. Last dorsal ray elongate. Origin of dorsal in advance of ventral, a little behind the vertical from the tip of pectoral. Pectoral $\frac{5}{7}$ the length of head, extending back a little more than $\frac{3}{5}$ the distance from its base to the anal. Silvery below, darker above; a more or less distinct dark spot on the shoulder; dorsal and caudal dusky.

Total length 127 mm.

Two specimens from Las Peñas, Jalisco, Mexico, collected by Dr. Buller.

This species is closely allied to *C. thrissa*, Brouss., but is distinguished by the smaller eye, lower jaw somewhat projecting, and no rows of dark spots on the upper part of the body.

Engraulis (Stolephorus) argentivittatus, sp. n.

Depth of body about 6 times in the total length, length of head $3\frac{2}{3}$ times. Snout nearly as long as eye, the diameter of which is $4\frac{1}{3}$–$4\frac{1}{2}$ times in the length of head. Maxillary extending about to posterior edge of præoperculum. D. 12–13, its origin midway between nostril and base of caudal. A. 16–17, commencing a little behind the end of dorsal. Pectoral less than $\frac{1}{2}$ the length of head. Scales deciduous. A well-defined silvery lateral band as broad as the eye.

Total length 75 mm.

Three specimens from Las Peñas, Jalisco, Mexico, collected by Dr. Buller.

Allied to *E. perfasciatus*, Poey, but with longer head, smaller eye, and shorter pectoral.

Pseudoxiphophorus pauciradiatus, sp. n.

Xiphophorus bimaculatus (part.), Heck. Sitzb. Ak. Wien, 1848, p. 297, pl. ix. fig. 2.

Pseudoxiphophorus bimaculatus (part.), Woolm. Bull. U.S. Fish. Comm. xiv. 1894, p. 65; Jord. & Everm. Fish. N. Am. p. 678 (1896).

Depth of body $3\frac{1}{2}$–4 times in the total length, length of head $3\frac{3}{4}$–$4\frac{1}{4}$ times. Snout not longer than eye, the diameter of which is $3\frac{1}{2}$–4 times in the length of head, and 2–$2\frac{1}{2}$ times in the interorbital width. 29–30 scales in a longitudinal series. D. 11–13, its origin nearer to base of caudal than to tip of snout, the length of its base about 4 times in the total length. A. 9–10, commencing in advance of the dorsal in the male, and slightly behind the dorsal in the female. Pectoral $\frac{2}{3}$–$\frac{3}{4}$ the length of head. Brownish, each scale with a darker intramarginal crescent; a black spot on the shoulder and another on the upper part of the base of caudal; dorsal with 2 series of small blackish spots.

Total length 76 mm.

Eight specimens from Orizaba, Mexico, collected by Mr. A. J. Woolman.

Two species have been confounded under the name of *P. bimaculatus*, and it seems probable that the specimens described and figured by Heller as females belong to the one described above. *P. bimaculatus* (of which *P. reticulatus*, Trosch., is a synonym) must be restricted to the species of which Heckel described and figured a male specimen and which has been redescribed by Steindachner. It differs from *P. pauciradiatus* in having a longer head and longer snout, and in the dorsal fin with 14–16 rays commencing midway between tip of snout and base of caudal, its base about $\frac{1}{3}$ of the total length.

Zoogoneticus maculatus, sp. n.

Depth of body $3\frac{1}{3}$–$3\frac{3}{4}$ times in the total length, length of head 3 times. Snout as long as eye, the diameter of which is 4–4½ times in the length of head, interorbital width 2½–2⅔ times. Mouth moderate, oblique, the lower jaw prominent. Sc. 36–38. D. 13–14, its origin about equidistant from posterior edge of præoperculum and base of caudal, its longest ray (the fourth or fifth) a little longer than the base of the fin, which is ½ the length of head or less. A. 15, commencing a little behind the dorsal, the first six rays, in the male, short, stiff, and of equal length. Pectoral ⅗–⅔ the length of head. Ventrals extending to the vent. Caudal truncate. Caudal peduncle 1⅔–2 times as long as deep. Brownish above, silvery below, with dark spots which are most conspicuous posteriorly; fins immaculate.

Total length 84 mm.

Three specimens from the Rio Santiago, Mexico, collected by Dr. A. C. Buller.

Z. pachycephalus, Gthr., and the very closely allied *Z. quitzeoensis* and *Z. robustus* of Bean, agree with this species in the number of dorsal and anal rays, but have a shorter and broader head and the caudal peduncle about as long as deep.

Dr. Meek includes *Fundulus guatemalensis*, Gthr., and *F. labialis*, Gthr., in *Zoogoneticus*, but in neither of them is there any differentiation of the anterior anal rays in the male. In the former the anal fin is similar in both sexes, in the latter it is larger in the female, and from the specimens in the British Museum one would judge that these species are not viviparous.

Characodon Geddesi, sp. n.

Depth of body 2⅔–3 (males) or about 2⅓ (pregnant females) times in the total length, length of head 3¾–4 times. Snout as long as eye, the diameter of which is 4–4¼ times in the length of head, interorbital width about 2⅓ times. About 17 rather short gill-rakers on anterior arch. Sc. 39–42. D. 18–20, its origin nearly equidistant from posterior margin of operculum and base of caudal. A. 21–23, commencing a little behind the dorsal, not modified in the male. Pectoral nearly ⅔ length of head. Ventrals extending to the vent. Caudal truncate. Caudal peduncle 1½–1¾ times as long as deep. Olivaceous, silvery below, with several darker narrow vertical bands on the upper half of the body.

Total length 70 mm.

Numerous examples of this viviparous species from Lake Tezcoco, Southern Mexico, collected by Mr. P. Geddes.

Heros (*Cichlasoma*) *octofasciatus.*

Heros octofasciatus, Regan, Revue Suisse Zool. xi. 1903, p. 417, pl. xiii. fig. 1.

Depth of body $2–2\frac{2}{5}$ times in the total length, length of head $2\frac{2}{3}–3$ times. Snout nearly as long as or a little longer than the eye, the diameter of which is $3\frac{1}{3}–4\frac{1}{3}$ times in the length of head, interorbital width about 3 times. Maxillary extending to vertical from anterior margin of eye; breadth of præorbital $\frac{1}{2}–\frac{4}{5}$ diameter of eye; cheek with 5 or 6 series of scales; fold of lower lip interrupted in the middle. Sc. $28–31\,\frac{4\frac{1}{2}–5\frac{1}{2}}{12–14}$. $3\frac{1}{2}–4$ scales between the upper lateral line and the scaly sheath at the base of the soft dorsal. D. XVII–XIX 8–10. A. VIII–X 7–8. Dorsal commencing above or a little before the axil of pectoral, the spines increasing in length to the sixth or seventh, which is $2\frac{2}{3}–3\frac{1}{2}$ times in the length of head, thence subequal; soft dorsal and anal pointed; pectoral $\frac{3}{4}–\frac{4}{5}$ length of head; ventrals extending to the base of fourth or fifth anal spine; caudal rounded; caudal peduncle $1\frac{3}{4}–2\frac{1}{4}$ times as long as deep. In the young dark cross-bands on the body, which become indistinct in the adult; a dark blotch on the middle of the side below the lateral line and another on the upper half of the base of the caudal, this latter often ocellated; in the adult a dark band running from the eye to the blotch on the side; usually some light blue spots on the head and one on each scale of the side of the body; vertical fins with small dark spots.

Total length 130 mm.

Several examples from British Honduras, collected by the Rev. J. Robertson.

I am glad to be able to give a more complete account of this species, which was originally described from a little example of 50 mm. It is closely allied to *H. multispinosus*, Gthr., which has much stronger and longer dorsal spines, and to *H. nigrofasciatus*, Gthr., which has a broader præorbital and only $2\frac{1}{2}$ scales between the upper lateral line and the sheath at the base of the soft dorsal fin.

Heros (*Heros*) *callolepis*, sp. n.

Depth of body about $2\frac{2}{3}$ times in the total length, length of head 3 times. Eye nearer to posterior edge of operculum than to end of snout, its diameter $3\frac{1}{2}$ times in the length of head and equal to the interorbital width. Maxillary not extending to below the eye; breadth of præorbital equal to the diameter of eye; cheek with 4 or 5 series of scales; lower lip with a strong continuous fold. Sc. 28–29 $\frac{4\frac{1}{2}}{12}$, $1\frac{1}{2}$–2 between upper lateral line and base of soft dorsal. L. lat. 18–20 + 10. D. XV 9–10. A. VI–VII 7–8. Dorsal commencing behind axil of pectoral, the spines rather weak, the last $2\frac{1}{2}$–$2\frac{3}{4}$ times in the length of head and not longer than the last of the anal; soft dorsal and anal pointed; pectoral about $\frac{3}{4}$ the length of head; ventral extending beyond origin of anal; caudal weakly emarginate; caudal peduncle as long as deep. Brownish, with small light blue spots on the head and one at the base of each scale on the body; a dark blotch on the lateral line below the 13th–15th dorsal spines.

Total length 100 mm.

Two specimens from Santo Domingo de Guzman, Mexico, collected by Dr. A. C. Buller.

Heros aureus, Gthr., is distinguished by the deeper body (depth $2\frac{1}{4}$–$2\frac{1}{3}$ in the total length), smaller scales (33 $\frac{6}{13}$), and longer dorsal spines (the last $\frac{1}{2}$ the length of head).

XXXI.—*Descriptions of* Holocentrum osculum, *Poey, and of a new Fish of the Genus* Centropomus. By C. Tate Regan, B.A.

Amongst the fishes collected by Dr. R. Bowdler Sharpe in the West Indies are several examples of a *Holocentrum* which I have no doubt is the little-known *H. osculum* of Poey, and as such I describe it below. I also take the opportunity to describe a new *Centropomus* from the West Indies.

Holocentrum osculum.

Holocentrum osculum, Poey, Memorias, ii. p. 156 (1860).
Holocentrum perlatum, Poey, t. c. p. 157.

Depth of body 3–$3\frac{2}{5}$ times in the total length (without caudal) and nearly equal to the length of head (opercular spine included). Snout equal in length to the interorbital width, $\frac{3}{5}$–$\frac{2}{3}$ the diameter of eye, which is 3 times in the length of head. Maxillary extending to below anterior edge of pupil, the width of its distal extremity $\frac{2}{5}$ the diameter of eye. Opercular spine strong, with 1 or 2 more or less distinct much shorter spines below; præopercular spine extending back far beyond the subopercular margin; præorbital strongly serrated and with an anterior downwardly directed spine. 15–16 gill-rakers on the lower part of anterior arch.

Sc. 53–57, $\frac{4}{8}$. D. XI, I 14–15, the fourth, fifth and sixth spines the longest, about $\frac{1}{2}$ the length of head, the soft fin elevated and pointed, extending beyond the base of caudal when laid back. A. IV 10–11, the third spine the strongest and longest, $\frac{3}{5}$–$\frac{2}{3}$ the length of head. Pectoral about $\frac{2}{3}$ the length of head. Upper lobe of caudal the longest. Caudal peduncle $2\frac{2}{3}$–3 times as long as deep. Purplish, with bronze longitudinal stripes between the series of scales; fins pale.

Total length 210 mm.

Eight examples from St. Thomas and St. Croix; (the species originally recorded from Cuba).

This species is closely allied to *H. sogo*, Bl. (*H. longipinne*, C. & V.), from which it differs notably in the smaller mouth, more slender caudal peduncle, and the shape of the spinous dorsal fin.

Centropomus argenteus, sp. n.

Centropomus parallelus (part.), Bouleng, Cat. Fish. i. p. 369 (1895).

Depth of body $3\frac{2}{3}$–4 times in the total length, length of head (excluding the subopercular flap) $2\frac{3}{4}$ times. Snout much longer than the eye, the diameter of which is about $4\frac{2}{3}$ times in the length of head, and equal to its distance from the posterior edge of præoperculum. Maxillary extending to below middle of eye; lower jaw strongly projecting. Subopercular flap extending to below origin of dorsal. Cheeks and opercles scaly. Præorbital and supraclavicle serrated; præoperculum serrated, with stronger spines at the angle, anterior ridge with two spines. 7–9 gill-rakers and 4–6 rudiments on lower part of anterior arch. 67–70 scales in a longitudinal series, 8 or 9 in a transverse series from origin of second dorsal to lateral line. D. VIII, I 10, originating behind the axil of pectoral, the third and fourth spines the longest, about $\frac{1}{2}$ the length of head. A. III, 6, second anal spine stronger and a little longer than the third, as long as or a little longer than the caudal peduncle, $\frac{3}{5}$–$\frac{5}{7}$ the length of head. Pectoral $\frac{3}{5}$ the length of head. Ventrals inserted well behind pectorals, extending back a little beyond the vent, which is situated at $\frac{2}{3}$ the distance from base of ventral spine to origin of anal. Silvery, back darker; lateral line not blackish; spinous dorsal slightly dusky, fins otherwise pale.

Total length 135 mm.

Three specimens, two from Barbadoes (presented by Mr. F. G. Beckford in 1872) and one from British Guiana.

C. parallelus is easily distinguished by the shorter snout, larger eye (diameter 4 times in length of head, equal to length of snout, and considerably greater than the distance from posterior edge of præoperculum in specimens of this size), the smaller scales ($75-90\frac{10-11}{}$), and the much more anterior vent.

C. argenteus is quite as closely allied to *C. ensiferus*, Poey, which has larger scales (50–60) and a longer pectoral, and also differs in many other characters. There can be no doubt as to the identity of *C. mexicanus*, Bocourt, with *C. parallelus*. The British Museum possesses several examples from Mexico, in some of which the lateral line is more or less pigmented. *C. constantinus*, Jord. & Everm., appears to me to be at least very closely allied to *C. undecimalis*, Bl., a species with which they do not compare it.

XXXII.—*Descriptions of Two new Genera of Frogs of the Family* Ranidæ *from Cameroon.* By G. A. Boulenger, F.R.S.

Nyctibates.

Pupil vertical. Tongue cordiform, free and notched behind. Vomerine teeth. Tympanum distinct. Fingers free, toes webbed. Outer metatarsals bound together. Omosternum and sternum cartilaginous. Terminal phalanges simple, obtuse.

Closely related to *Trichobatrachus*, Blgr.

Nyctibates corrugatus.

Vomerine teeth in two small rounded groups between the large choanæ. Head large, as long as broad; snout as long as the orbit, obliquely truncate and slanting forwards from the nostrils to the mouth; canthus rostralis strong; loreal region concave; nostril equally distant from the eye and from the end of the snout; eye large; interorbital space as broad as the upper eyelid; tympanum three fifths the diameter of the eye. Limbs rather slender; tips of fingers and toes slightly swollen; first finger a little longer than second; toes half-webbed; subarticular tubercles strong; a small, oval, inner metatarsal tubercle. The tibio-tarsal articulation reaches the eye. Upper parts with small granular asperities; back with fine oblique folds converging posteriorly, forming more or less regular chevrons; lower parts smooth. Purplish brown above; a triangular dark marking with a fine light edge between the eyes, the base turned forwards; upper lip white-edged; limbs with narrow, oblique, dark cross-bars; sides of thigh and inner side of leg blackish, speckled with whitish; lower parts whitish, with the exception of a considerable part of the thigh, the tarsus, and the foot, which are blackish brown.

From snout to vent 53 mm.

Two female specimens were obtained at Efulen, Bulu Country, Southern Cameroon, by Mr. G. L. Bates.

BULUA.

Pupil horizontal. Tongue cordiform, free and notched behind. Vomerine teeth forming long transverse series behind the choanæ. Tympanum distinct. Fingers and toes free. Outer metatarsals bound together. Omosternum and sternum cartilaginous. Terminal phalanges simple, obtuse.

A very distinct genus, to be placed near *Petropedetes*, Reichen.

Bulua ventrimarmorata.

Vomerine teeth in two curved series narrowly separated from each other and extending outwards beyond the choanæ. Head moderate, rather strongly depressed, a little broader than long; snout short, broadly rounded; no canthus rostralis; eye small; interorbital region twice as broad as the upper eyelid; tympanum a little smaller than the eye, its diameter equal to its distance from the orbit. Fingers rather short, blunt, first much longer than second; toes moderate, with swollen tips; subarticular and inner metatarsal tubercles feebly prominent. The tibio-tarsal articulation reaches the tympanum. Skin smooth. Dark purplish brown above, with indistinct darker markings; a pink spot on each side of the vent; sides of head and of thighs black, speckled with white; limbs with interrupted dark cross-bars; throat black; belly and lower surface of limbs marbled black and white. Breeding male with two groups of rather large, conical, black, horny spines on the inner side of the inner finger.

From snout to vent 40 mm.

A single male specimen from Efulen, Bulu Country, collected by Mr. G. L. Bates.

XXXIII.—*Rhynchotal Notes.*—XXII. By W. L. Distant.

Heteroptera from North Queensland.

The British Museum has recently acquired a collection of Rhynchota made by Mr. F. P. Dodd at Townsville, North Queensland. Although this order of insects is at present very imperfectly known from the continent of Australia, a sufficient number of genera and species have been described to establish by their comparison that, so far as the Rhynchota are concerned, Northern Queensland represents or belongs to a separate province in the zoo-geographical divisions of Australia. The Heteroptera are alone dealt with in this paper, the Homoptera being reserved for some future occasion. The types are all in the National Collection.

Fam. **Pentatomidæ.**

Theseus nigrescens, sp. n.

Ochraceous or stramineous, blackly punctate, the punctures arranged in longitudinal series on head and on anterior area of pronotum, those at lateral margins being continuous; antennæ, sometimes a large spot on basal area of pronotum, scutellum, membrane, body beneath, and legs black; basal half of fourth, extreme base of fifth, and inner margin of first joint of antennæ, basal lateral margins, apex, and sometimes a small basal spot to scutellum, coxæ, trochanters, longitudinal streaks to femora, a broad subbasal annulation to tibiæ, tarsi (excluding apices), lateral margins of body beneath, and discal spots to abdomen pale ochraceous.

Allied to *T. modestus*, Stål; scutellum black, more thickly, less confluently, and more finely punctate, and with a very distinct central longitudinal ridge on its posterior area.

Long. 12½ mm.

Eumecopus abdominalis, sp. n.

Above reddish brown, irrorated with ochraceous, much more strongly so on corium; head with the lateral margins, a central longitudinal fascia, margined on each side by a shorter fascia on anterior area, and a slender curved line on posterior area, narrow lateral and posterior margins, a central linear spot at anterior margin, and two small discal spots on anterior area of pronotum, a large spot at each basal angle and the apex of scutellum, and marginal and venal lines to corium very pale ochraceous or stramineous; membrane black; connexivum above and beneath flavous; abdomen beneath and apex of rostrum castaneous; sternum, legs, antennæ, and a spot on apical abdominal segment reddish ochraceous; outer streaks to femora, basal areas of tibiæ, and the tarsi flavescent; apical segmental abdominal angles flavescent; rostrum reaching, but not passing, the third abdominal segment; antennæ five-jointed, second joint scarcely more than half the length of third; lateral posterior angles of pronotum spinously produced, spines distinctly recurved.

Long. 18; exp. pronot. angl. $9\frac{1}{2}$ mm.

Eumecopus pallescens, sp. n.

Above pale stramineous, thickly piceously punctate, the punctures more confluent at lateral areas of pronotum and scutellum and in a central longitudinal streak to corium; head with the punctures in longitudinal series, the ocelli bright carmine-red; lateral margins of pronotum, scutellum and corium, a central longitudinal fascia to pronotum and scutellum, and apex of the last pale stramineous, impunctate; connexivum flavescent, inwardly darkly punctate; membrane piceous, its apical area paler; body beneath and legs pale ochraceous; apex of rostrum and stigmatal spots black; linear streaks to femora and tibiæ, apices of posterior femora and tibiæ, and apices of the tarsi brownish castaneous; antennæ pale brownish, bases of the second, third, and fourth joints a little paler in hue; apical segmental abdominal angles flavescent; rostrum reaching the fourth abdominal segment; antennæ four-jointed, second and third joints longest, second a little longer than third; lateral posterior angles of pronotum spinously straightly produced.

Long. 19–20; exp. pronot. angl. 8–$8\frac{1}{2}$ mm.

DANDINUS, gen. nov.

Elongately ovate; head broad and elongate, almost as long as the pronotum, its lateral margins a little sinuate, its apex slightly widened and rounded, lateral lobes a little longer than the central lobe, their apices inwardly angulated but not meeting; eyes small, touching the anterior margin of the pronotum; antennæ five-jointed, almost as long as head and pronotum together, first joint almost hidden beneath head, a little incrassate, second and third more slender, second longer than third, fourth and fifth thickened, subpyriform, about subequal in length; rostrum reaching posterior coxæ (imperfectly seen on carded specimen); pronotum about twice as broad between posterior lateral angles as at anterior margin, anterior lateral angles obtusely acute, very strongly transversely impressed near middle, the anterior area possessing a broad central carination with a tuberculous callosity on each side, the whole surface rugosely punctate; scutellum long, broad, passing apex of corium, very broad at base, obliquely narrowed to about middle, the lateral margins then parallel to apex, which is broadly rounded, basal area rugosely gibbous; corium moderately small and narrow, not reaching apex of scutellum; membrane short, with coarse reticulate venation; connexivum broadly exposed beyond middle; legs short, femora a little thickened.

Dandinus may be placed near the Ethiopian genus *Æschrus*, Spin.

Dandinus crassus, sp. n.

Irregularly greyish brown, thickly coarsely punctate; first, second, and third joints of antennæ, central discal fascia and some oblique discal lines on posterior area of pronotum, connexivum, and legs ochraceous; fourth and fifth joints of antennæ, annulations to femora and tibiæ, and basal area of scutellum piceous; an oblique linear stramineous spot at each basal angle of scutellum, its subapical area and inner area of corium greyish punctured with piceous; connexivum spotted with piceous; body beneath piceous, the lateral areas more or less brownish ochraceous; head somewhat obscurely punctate; pronotum thickly, coarsely, rugosely punctate; scutellum thickly, coarsely, rugosely punctate on basal area, coarsely and more sparingly punctate on posterior area, which has a distinct central carination extending for about half its length; corium sparingly and a little more finely punctate; connexivum inwardly coarsely punctate.

Long. $5\frac{1}{2}$; exp. pronot. angl. $3\frac{1}{3}$ mm.

Fam. **Coreidæ.**

Subfam. *Coreinæ.*

Pomponatius, gen. nov.

Body elongate, narrowed posteriorly; head broad, not produced beyond the antenniferous tubercles, a deep central longitudinal incision on disk, and a distinct transverse conical ridge at base; eyes longer than broad, compressed at lateral margins of head; antennæ with the first, second, and third joints subequal in length, fourth shortest, first and second regularly moderately incrassate, third and fourth pyriform; rostrum reaching the middle of mesonotum; pronotum about as long as broad at base, anterior margin concavely sinuate, the anterior angles acute, lateral margins carinate, slightly upwardly reflected, posterior lateral angles nodulose, base obliquely deflected, truncate in front of scutellum and then obliquely directed to the lateral angles; scutellum small, triangular; corium long, reaching the base of the sixth abdominal segment; membrane very small, with reticulate venation; lateral margins of abdomen beyond middle ampliately produced and moderately directed upward, the posterior apical angles of the fifth and sixth segments acute, the apex of the anal appendage in ♀ angularly bifurcate; legs short, femora apically incrassate, with a distinct tooth beneath near apex, posterior femora only extending to about half the length of abdomen; abdominal spiracles at about equal distance from anterior and lateral segmental margins.

Allied to *Chœrommatus*.

Pomponatius typicus, sp. n.

♀. Testaceous, base of pronotum and corium with piceous and flavous suffusions; head with two central fuscous fasciæ; scutellum with a black central line at base; membrane bronzy black; body beneath reddish ochraceous, two black fasciæ extending from anterior to posterior coxæ, and two black spots on basal abdominal segment behind inner margins of coxæ, on mesonotum the fasciæ have a broad outer greyish margin, outwardly speckled with black; legs stramineous, finely speckled with black, a little darker at bases and apices of tibiæ; above finely and obscurely punctate, beneath a little more distinctly punctate; membrane not quite reaching apex of abdomen.

Long. $15\frac{1}{2}$ mm.

Fam. **Lygæidæ.**

Subfam. *Geocorinæ.*

Germalus lineolosus, sp. n.

Ochraceous, with dark punctures, fuscous or piceous lines, and piceous suffusions to hemelytra. Head pale ochraceous, impunctate, a central longitudinal line and a shorter line at each ocellus piceous; antennæ ochraceous, apices of apical joints, and eyes reddish; pronotum pale ochraceous, darkly punctate, except on anterior transverse callosities and basal margin, the first of which have a central piceous spot and the second has six spots of the same colour, the disk with four fuscous lines, two central and one on each lateral area; scutellum ochraceous, with two central piceous spots, a transverse line of dark punctures near base, and the apical area darkly punctate; corium pale ochraceous, subhyaline, the claval suture and longitudinal veins punctate, apical area more or less suffused with piceous; membrane pale fuscous hyaline; connexivum ochraceous, spotted with rosy red; body beneath and legs ochraceous; lateral areas of sternum thickly darkly punctate; abdomen with a submarginal rosy-red, sometimes piceous, fascia.

Long. $4\frac{1}{2}$–5 mm.

Geocoris elegantulus, sp. n.

Head, pronotum, and sternum ochraceous; scutellum, hemelytra, and abdomen beneath black; anterior and posterior margins of pronotum, clavus, claval suture, lateral margins of corium, and narrow lateral margins of abdomen beneath creamy white; legs pale ochraceous, apices of tarsi fuscous; antennæ piceous, first joint (excluding apex) and the whole of the apical joint pale ochraceous, second and fourth joints subequal in length; eyes carmine-red, directed backward to about one third the length of pronotum; pronotum coarsely punctate behind the anterior and before the posterior margin; scutellum finely punctate; clavus and a submarginal line to corium coarsely punctate; body above sparingly, finely, longly pilose.

Long. 3 mm.

Subfam. *Aphaninæ*.

Pamera picturatus, sp. n.

Black; first and second joints of antennæ, femora, a subapical annulation to anterior and intermediate tibiæ, and basal margin of pronotum testaceous red; corium ochraceous, with the subapical area creamy white, a middle marginal line, an interior marginal line to the white area, and the apical angle indigo-black; membrane indigo-black, the apex broadly dull ochraceous; abdomen beneath with a central creamy-white transverse fascia; second joint of antennæ much longer than third and subequal to fourth; anterior lobe of pronotum elongate, globose, slightly shorter than head and at least half as long again as posterior lobe; corium finely sparingly punctate; anterior femora strongly incrassate, longly pilose above, finely spinose beneath; tibiæ moderately curved; body above sparingly longly pilose.

Long. $6\frac{1}{2}$ mm.

Allied to *P. cephalotes*, Dall.

Pamera apicalis, sp. n.

Black; basal joint of anterior and intermediate tarsi and a broad apical spot to membrane dull ochraceous; corium creamy white, thickly darkly punctate, subclaval margin, a transverse central fascia, and the apical margin black; abdomen beneath *in female* with a central transverse creamy-white fascia and the apex dull ochraceous; head, pronotum, and scutellum greyishly pilose, base of pronotum nude; apex of scutellum pale stramineous; anterior femora strongly incrassate, finely spinose beneath, longly pilose above, tibiæ nearly straight; other characters as described in preceding species.

Long. $5\frac{1}{2}$–6 mm.

Dieuches scutellatus, sp. n.

Black; lateral margins of anterior lobe of pronotum creamy white; basal joint of antennæ and extreme bases of anterior tibiæ brownish ochraceous; a central linear spot to posterior lobe of pronotum, two small subbasal spots and apex to scutellum, base, a central marginal spot, two small spots near claval margin, and a large subapical spot to corium creamy white; membrane dark fuliginous, its apex paler; bases of intermediate and posterior femora broadly creamy white; posterior lobe of pronotum very coarsely punctate, its posterior margin concavely sinuate, anterior lobe much more finely punctate, its lateral margins very slightly convex; second, third, and fourth joints of antennæ almost subequal in length; anterior femora incrassate, somewhat strongly spinose beneath.

Long. $6\frac{1}{2}$–7 mm.

Allied to *D. atricornis*, Stål.

Dieuches consanguineus, sp. n.

Black; lateral margins of pronotum (excluding base), bases of first and fourth joints of antennæ (broadly), and bases of second and third joints (narrowly), trochanters, bases of femora, and the anterior and intermediate tibiæ (excluding apices) stramineous; apex of scutellum and the corium stramineous, the last with a broad transverse medial fascia and the apical margin black, the inner basal area and clavus much suffused with brownish black; connexivum stramineous, spotted with black; second, third, and fourth joints of antennæ subequal in length; lateral margins of pronotum almost obliquely straight, very slightly sinuate, transversely impressed near middle and concave at base.

Long. $7\frac{1}{2}$–9 mm.

Allied to *D. longicollis*, Dall.

Fam. **Reduviidæ.**

Havinthus trochanterus, sp. n.

Black, shining; apex of scutellum, venation to corium, and the trochanters sanguineous; corium and clavus sparingly greyishly tomentose; connexivum with large marginal sanguineous spots; head about as long as pronotum and scutellum together, its lateral margins behind eyes granulate; ocelli castaneous; antennæ with the first joint as long as head, second and third short, together about as long as fourth; pronotum strongly constricted near middle, anterior lobe glabrous, posterior lobe very finely and obscurely punctate; connexivum robust, erosed at the segmental incisures; femora finely granulate, anterior femora prominently spinose beneath, intermediate and posterior femora more obsoletely spinose.

Long. $11\frac{1}{2}$–12 mm.

A distinct species by the greyishly tomentose and sanguineously veined corium and the sanguineous trochanters.

Fam. **Capsidæ.**

Subfam. *Mirinæ.*

Division Miraria.

Megaloceræa Doddi, sp. n.

Elongate, slender; pale ochraceous, with a slight virescent tinge; antennæ, apex of posterior tibiæ, and basal joint of posterior tarsi rosaceous; eyes black; pronotum and scutellum with a central pale longitudinal line; head with a narrow, profound, central, longitudinal incision between eyes; basal joint of antennæ moderately incrassate and about as long as head, second joint about as long as posterior tibiæ, slightly longer than third; pronotum very finely and obscurely granulate, its posterior margin concavely sinuate, the mesonotum exposed; antennæ not pilose; basal joint of posterior tarsi very long.

Long. 5 mm.

Megacœlum modestum, sp. n.

Very pale ochraceous, with a slight virescent tint; basal joint of antennæ and anterior and intermediate femora dark ochraceous, apical areas of posterior femora pale reddish castaneous; eyes, apices of rostrum and scutellum, and sometimes the central subbasal margin of pronotum piceous; membrane greyish, opaque; basal joint of antennæ a little incrassate and slightly longer than head, remaining joints much more slender but about equally thick, second joint shorter than posterior tibiæ; head with a distinct linear incision between the eyes; rostrum about reaching the posterior coxæ; posterior tarsi with the first joint shortest, the third longest.

Long. $6\frac{1}{2}$ mm.

Megacœlum townsvillensis, sp. n.

Ochraceous; legs, anterior callosities, and a large central basal spot to pronotum, cuneus, and membrane black; corium slate-black, with the lateral margins widened into an oblong spot near apex, ochraceous; lateral margins and apex of cuneus pale castaneous; antennæ ochraceous, extreme apex of first joint (sometimes concolorous) and apex of second joint black, apex of third and the whole of fourth (excluding base) fuscous; legs stramineous, femora ochraceous, apices of tarsi black; first joint of antennæ a little longer than head, second and third subequal in length; head with a distinct central longitudinal impression between eyes; pronotum very finely and obsoletely transversely wrinkled; scutellum moderately tumid; posterior tarsi with the first joint shortest, third longest.

Long. $7\frac{1}{2}$ mm.

Megacœlum suffusum, sp. n.

Dull dark ochraceous; head, antennæ, extreme margins of pronotum, scutellum, narrow lateral margins to corium, and legs pale ochraceous; eyes, pronotum (excluding extreme margins), a large central spot to scutellum, basal and apical streaks to clavus, sublateral basal streak and transverse apical fascia to corium, apical halves of posterior femora, the posterior tibiæ, and apices of tarsi black; first joint of antennæ and anterior and intermediate legs mottled with fuscous; apex of second joint, subapical fascia to third joint, and fourth joint of antennæ (excluding base) black; cuneus pale castaneous; second joint of antennæ a little longer than third; pronotum coarsely transversely rugulose; scutellum somewhat foveate at base; posterior tarsi with the first joint shortest, third longest.

Long. 6 mm.

Division Cylaparia.

Volkelius, gen. nov.

Head short, broad, transverse, abruptly deflected in front of eyes, broadly centrally sulcate on basal area, with eyes very much broader than anterior margin of pronotum; rostrum reaching the anterior coxæ; antennæ strongly pilose, with the first joint strongly incrassate, shorter than head, second joint about as long as head and pronotum together, more slender than first, but distinctly clavate at apex, third about as long as pronotum, incrassate, attenuate towards base, fourth incrassate, shorter than third, and narrowed at base and apex; pronotum rugosely punctate, with a narrow anterior collar and two transverse callosities before middle, a little tumid and convex posteriorly, and deflected anteriorly, basal margin about three times broader than anterior margin, lateral margins almost obliquely straight, lateral angles rounded but not prominent, posterior margin slightly concavely sinuate before scutellum, which is tumid, subtriangular, and profoundly, centrally, longitudinally sulcate; lateral margins of the corium carinately reflexed; cuneus longer than broad; membrane with a single oblique basal cell; legs pilose, femora a little thickened, posterior tarsi with the first and second joints almost subequal in length, third a little longest; connexivum exposed, with the posterior segmental angles prominent.

Allied to the West African genus *Sahlbergella*, Haglund.

Volkelius sulcatus, sp. n.

Reddish ochraceous; antennæ (excluding extreme base), eyes, scutellum, lateral margins (widened posteriorly) and inner apical margins of corium, membrane, spots to connexivum, and legs black; anterior and intermediate tibiæ (excluding base) and the tarsi (excluding apex) pale ochraceous; a minute pale spot to membrane near apex of cuneus; pronotum rugulosely punctate; scutellum granulate, profoundly centrally sulcate.

Long. $7\frac{1}{2}$–$8\frac{1}{2}$ mm.

Eucerocoris suspectus, sp. n.

♂. Pale reddish ochraceous; antennæ, eyes, a central annulation to posterior femora, bases of tibiæ, and the tarsi black or piceous; corium fuscous, its base, about basal half of lateral margin, and a spot near apical inner angle pale reddish ochraceous; membrane pale fuscous; legs (excluding black markings) ochraceous.

♀. Reddish or pale sanguineous; head and antennæ black; legs and abdomen beneath pale ochraceous; apical half of abdomen (excluding segmental margins), apical halves of femora, basal annulation to posterior femora, basal areas of tibiæ, and the tarsi black; corium dull purplish black, its base reddish ochraceous; membrane pale fuscous.

Head broad, deflected in front of eyes, with a distinct angulated tubercle near the inner margin of each antenna, a distinct, narrow, central, linear sulcation, eyes projecting considerably beyond anterior margin of pronotum; antennæ not hirsute, with the first joint thickened and clavate at apex, about as long as posterior tibiæ; remaining joints slender, second a little longer than first; rostrum about reaching the latitude of the intermediate coxæ; pronotum with two anterior transverse impressions, the first defining a rather broad collar, the second enclosing two transverse callosities, an impression near each posterior angle which gives it the appearance of being subprominent.

Long., ♂ $8\frac{1}{2}$, ♀ $9\frac{1}{2}$ mm.

As the species of the allied genus *Helopeltis* are well-known destructive pests to tea- and other plantations, it is probable that the species of *Eucerocoris* have similar habits.

Subfam. *Capsinæ*.

Division —— ?

Estuidus, gen nov.

Subelongate; head broad, deflected from shortly in front of eyes, which project beyond the anterior margin of pronotum; antennæ with the first joint a little shorter than the head but considerably passing its apex, second joint subequal in length to posterior tibiæ and a little thickened at apex, third and fourth joints very slender; rostrum reaching the intermediate coxæ; pronotum with the posterior about twice as broad as the anterior margin, its lateral margins sinuate, provided with a very narrow anterior collar, compressed before middle where it is strongly callose, immediately behind the constriction is a distinct discal foveation variable in size; scutellum moderately tumid, foveately sulcate at base; corium and clavus distinctly punctate, a distinct foveation at suture of corium behind claval apex; cuneus considerably longer than broad, its apex acute; membrane with a single elongate basal cell; legs of moderate length, femora very slightly thickened.

I place this genus near *Malalasta*, Dist., *Malacopeplus*, Kirk., and *Guianerius*, Dist., which will probably assist to constitute a distinct division of the subfam. Capsinæ.

Estuidus foveatus, sp. n.

Ochraceous; scutellum stramineous; antennæ, eyes, clavus (excluding base), a large subrotundate spot on posterior disk of corium, membrane, upper surfaces of femora and anterior tibiæ, the intermediate and posterior tibiæ, and the tarsi black; extreme base of first joint of antennæ ochraceous, third and fourth joints fuscous; legs finely setose; body above finely pilose, clavus and corium distinctly and somewhat coarsely punctate, cuneus pale with the margins and apex slightly fuscous; pronotal discal foveation broad and profound; scutellum glabrous, its basal sulcation linear but situate in a distinct foveation.

Var. Clavus wholly black.

Long. 7 mm.

Estuidus marginatus, sp. n.

Very pale ochraceous or stramineous; eyes, scutellum, clavus, inner area of corium, membrane, and first and second joints of antennæ black or piceous; third and fourth joints and extreme base of first joint of antennæ ochraceous; body above shining, membrane opaque with its margins hyaline; pronotal discal foveation less pronounced than in the preceding species; clavus and inner area of corium very finely and somewhat obscurely punctate; legs finely and obscurely setose.

Long. 7½ mm.

Division Capsaria.

Lygus flavoscutellatus, sp. n.

Dark shining ochraceous, body beneath much paler; scutellum and cuneus stramineus, the last with a small dark apical spot; eyes and apices of the tarsi piceous; antennæ with the third and fourth joints and the apex of the second joint fuscous, first joint a little shorter than head, second subequal in length to posterior tibiæ; pronotum very finely and obscurely granulate; scutellum glabrous; corium finely obscurely pilose and obsoletely finely granulate; apical areas of posterior femora speckled with bright pale castaneous; tibiæ darkly setose; rostrum about reaching the posterior coxæ, its apex black.

Long. $3\frac{1}{2}$–4 mm.

Pœciloscytus antennatus, sp. n.

Piceous, thickly greyishly pilose, disk of pronotum and scutellum somewhat castaneous; cuneus bright pale castaneous, its basal and apical margins very narrowly ochraceous; membrane fuscous; antennæ pale ochraceous, the first joint and apex of second piceous, fourth joint fuscous; legs piceous, anterior and intermediate tibiæ (excluding base), about apical third of posterior tibiæ, and tarsi (excluding apex) pale ochraceous; pronotum with two small, obscure, anterior discal black spots, and its posterior margin very narrowly ochraceous; first joint of antennæ shorter than head, second about as long as posterior tibiæ, third and fourth almost subequal in length; coxæ dull red.

Long. $3\frac{1}{2}$–$4\frac{1}{2}$ mm.

In this species the eyes are very large and constitute a rather aberrant feature of the genus.

Pœciloscytus flavipes, sp. n.

Black, shining, finely sparingly greyishly pilose; basal margin of head, antennæ, rostrum, coxæ, and legs very pale ochraceous; apical areas of posterior femora reddish ochraceous; third and fourth joints and apex of second joint of antennæ, apex of rostrum, and apices of tarsi piceous; cuneus castaneous, its anterior and posterior margins narrowly luteous; membrane fuliginous with paler suffusions; first joint of antennæ shorter than head, second about as long as posterior tibiæ; eyes large and prominent, but smaller than in the preceding species; pronotum granulate; posterior femora moderately thickened.

Long. $2\frac{1}{2}$–3 mm.

Camptobrochis signatus, sp. n.

Ochraceous; apex of second joint of antennæ, eyes, a broad central longitudinal fascia to scutellum, and a broad fascia at incisural margins of clavus black; first, third, and fourth joints of antennæ, inner apical area of corium, central and subapical annulations to posterior femora, apices of tarsi, lateral areas of sternum, lateral and central areas of abdomen (imperfectly seen on carded specimen) fuscous; membrane pale brownish ochraceous, the venation fuscous; first joint of antennæ very slightly thickened and almost as long as head, second joint subequal in length to posterior tibiæ; pronotum somewhat coarsely punctate, corium more finely punctate (except on lateral marginal areas, which are impunctate).

Long. $4\frac{1}{3}$ mm.

Division Bryocoraria.

Fingulus, gen. nov.

Body short, broad, convex, shining; head somewhat long, its base distinctly constricted and transverse; clypeus very prominent, compressed, subconical above, and convexly depressed; eyes of moderate size, situate much nearer to base of antennæ than to posterior margin of head, a very distinct lateral callosity at their hinder margins; antennæ with the basal joint subglobosely incrassate, a little shorter than head, second joint of ordinary thickness, more slender at base, and very slightly thickened towards apex, subequal in length to posterior tibiæ, third and fourth joints slender, third longer than fourth; rostrum imperfectly seen, owing to typical specimen being in a carded condition; pronotum convex, coarsely punctate, strongly deflected anteriorly, with a prominent ridged anterior collar, width between pronotal angles (which are subprominent) about four times that of anterior margin, lateral margins almost obliquely straight; scutellum subtriangular, sparingly coarsely punctate; lateral margins of the hemelytra a little convexly ampliately depressed, clavus and corium somewhat thickly punctate, cuneus opaque, impunctate, about as broad at base as long; membrane with two short basal cells; legs of moderate length, anterior and intermediate femora moderately thickened, posterior femora more strongly incrassate, apical joint of tarsi moderately thickened.

This genus may be provisionally placed near *Physetonotus* of the Neotropical region.

Fingulus atrocæruleus, sp. n.

Shining indigo-black; second joint of antennæ (excluding apex), apical halves of tibiæ, and the tarsi pale ochraceous; third and fourth joints of the antennæ fuscous, the extreme base of third pale ochraceous; cuneus slate-black, opaque; membrane pale hyaline, the basal area fuliginous; body beneath black, imperfectly seen owing to the typical specimen being "carded."

Long. 3 mm.

Synonymical Notes on Australian Species.

Fam. **Pentatomidæ.**

Philia regia.

Philia regia, Bergr. Proc. Roy. Soc. Victoria, vii. p. 287 (1895).
Philia leucochalcea, Bredd. Societas Entomol. xviii. p. 58 (1903).

Philia ærea.

Philia ærea, Dist. 'Entomologist,' Suppl. xxv. p. 96 (1892).
Philia compacta, Bredd. Societas Entomol. xviii. p. 57 (1903).

Dr. Bergroth drew my attention to the synonymical aspect of these two species.

Fam. **Reduviidæ.**

Genus Croscius.

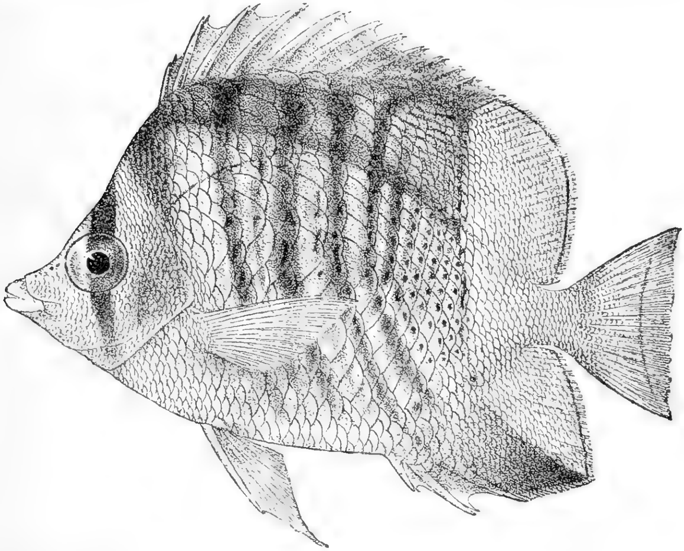
Croscius melanopterus, Stål, En. Hem. iv. p. 80 (1874).
Castruccius insignis, Dist. Ann. & Mag. Nat. Hist. (7) xi. p. 356 (1903).

As Stål only gave indications of this genus in his "Conspectus generum" and placed it in a position of the subfamily *Acanthaspinæ* which I think it should not occupy, I have hitherto failed to recognize it, and, what is worse, have redescribed it. Its place seems clearly near *Staliastes*.

XXXIV.—*Description of a new Fish of the Genus* Chætodon *from the New Hebrides.* By C. Tate Regan, B.A.

Chætodon Dixoni.

Depth of body $1\frac{1}{2}$–$1\frac{3}{5}$ times in the total length (without caudal), length of head $3\frac{1}{3}$ times. Snout as long as the eye, the diameter of which is 3 times in the length of head and greater than the interorbital width. Scales very large on the sides, becoming quite small posteriorly, about 30 in a longitudinal series. D. XIII 21–22, the anterior spines stout, increasing in length to the fourth or fifth, the soft fin rounded. A. III 16–17, the third spine slightly longer than the second, longer than the longest dorsal spine and nearly as long as the head, the soft fin pointed. Pectoral nearly as long as the head. Ventral extending to origin of anal. Caudal scarcely emarginate. Anterior $\frac{3}{4}$ of body, with spinous dorsal and anterior $\frac{1}{2}$ of anal, greyish; posterior part of body, with soft dorsal, caudal, and posterior $\frac{1}{2}$ of anal, yellow. A vertical dark brown ocular band, narrower than the eye, meeting that of the other side above and extending to the margin of the suboperculum below; a brown area below the anterior part of spinous dorsal; some dark stripes extending downwards from the spinous dorsal, running somewhat obliquely backwards below the middle of the side, and



with a darker spot on each scale; anterior part of anal becoming blackish towards its tip; soft dorsal, caudal, and anal with a blackish intramarginal line; a faint dusky blotch on the anterior part of the soft dorsal; a faint dark bar across the base of caudal.

Total length 85 mm.

Two specimens, collected and presented to the British Museum by Lieut. Kenneth Dixon, R.N.

This species is closely allied to *C. xanthurus*, Blkr., and *C. Mertensii*, C. & V., from both of which it is distinguished by the deeper body and more pointed anal fin, as well as by the ocular band without light edges and other details of coloration.

XXXV.—*On some new Species of Hymenoptera from Northern India.* By P. Cameron.

The species described in this paper are from the Khasia Hills, Assam, and Simla, and are in the collection of Mr. G. A. James Rothney.

Ichneumonidæ.

Hadrojoppa fumipennis, sp. n.

Black; the face, except for an irregular mark in the centre (it is joined to the base of the antennæ by a narrow line, and there is a shorter line on either side), the inner orbits (narrowly below, more broadly above, and the line extends slightly beyond the top of the eyes), the lower half of the outer entirely, with a narrow line above, a line on the pronotum, tegulæ, two short lines on the centre of the mesonotum (obliquely narrowed on the inner side), the scutellums, two large triangular marks on the sides of the metanotum (laterally extending on to the pleuræ), a large mark on the lower half of the mesopleuræ (broadest at the base), an irregular mark (narrowest at the base) on the centre of the metapleuræ, the apical half of the postpetiole, and two large irregular marks on the apex of the second segment, pale yellow. Legs pale yellow; the four front femora behind and at the base and apex in front, the hind coxæ below and on the inner side, the base of the femora narrowly, the apical third, the base of the hinder tibiæ narrowly (their apex more broadly), the apices of the basal three joints of the tarsi, and the apical entirely, black. Wings smoky, with a violaceous tinge; the nervures and stigma black. ♀.

Length 20–22 mm.

Antennæ ringed with white before the middle, fuscous beneath towards the apex. Face and clypeus closely punctured and thickly covered with white pubescence. Front closely punctured. Mesonotum and scutellum closely, the pleuræ less closely, punctured; the median segment more closely and strongly and more thickly covered with white pubescence. Areola twice longer than broad, roundly narrowed towards the base, the apex broadly curved inwardly; irregularly finely rugose, the apex with a broad, smooth, shining border. Postpetiole in the middle closely longitudinally striated, the second to fourth segments closely punctured, the apical smooth and shining. Gastrocœli large, deep, broad, smooth, except for a few striæ; the space between strongly striated.

The described Khasia species of this genus may be separated by the following table:—

1 (4). The petiole only marked with yellow.

2 (3). Large; the areola distinctly longer than broad, its apex broad, smooth, transverse, the yellow line on the petiole dilated backwards; the antennæ stout. Length 27 mm. .... *forticornis*.

3 (2). Medium-sized; the areola not distinctly longer than broad, its apex not transverse; the yellow line on the petiole not dilated backwards; the antennæ not stout. Length 17 mm. .... *maculiceps.*
4 (1). The second or following segments marked with yellow.
5 (6). The second segment with two yellow marks, the others immaculate; the areola sharply narrowed at the base .... *fumipennis.*
6 (5). The second segment broadly yellow at the apex; the third and fourth segments with two large marks on the apex; the areola broadly rounded at the base .... *annulitarsis.*

Mutillidæ.

Mutilla inoa, sp. n.

Black, densely covered with silvery pubescence; the second and third abdominal segments ferruginous; the scutellum pyramidal, its basal slope smooth and shining in the middle; the basal area on the median segment of equal width throughout and reaching to the top of the apical slope; the wings fusco-violaceous, paler at the base. ♂.

Length 15 mm.

Antennæ black, the scape covered with white hair. Head rugosely punctured, with a smooth space on the sides of the ocelli; the front and occiput thickly covered with long white hair, the vertex more sparsely with longer black hair. Face and clypeus bare, smooth and shining, the apex of the clypeus transverse and clearly separated from the sides. Base of mandibles thickly covered with silvery pubescence; the subapical tooth distinct. The malar space ends in a tubercle or blunt rounded tooth on the inner and outer side. Pronotum thickly covered with silvery pubescence; on the basal slope is a central and two lateral smooth spots; the propleuræ rugosely punctured, the apex smooth, the middle depressed and obscurely stoutly striated. Mesonotum rugosely punctured and thickly covered with longish black hair. Scutellum pyramidal, rugose, the basal slope smooth and shining; the base and apex of the smooth part longitudinally furrowed; the apical slope is oblique; the basal is also oblique, but more rounded than the apical; the hair is long, on the basal slope black, on the apical fuscous. Median segment coarsely reticulated, the base thickly covered with depressed silvery pubescence; the central area is of equal width throughout. Metapleuræ (except in the centre) reticulated. The second and third cubital cellules at the top are about equal in length. Abdomen black; the extreme apex of the first and the whole of the second and third segments ferruginous; the pubesence is white, on the apical two segments black; the pygidium rugosely punctured, with a smooth space, dilated at the base and apex in the middle. The ventral keel with a slight broad curve. The epipygium is smooth at the base; the rest depressed, irregularly rugose, with the sides smooth and raised. The apex of the radius is straight and oblique and distinct from the lower part. The second abdominal segment is punctured, smooth in the centre; above it is gradually rounded.

Comes near to *M. perdita*, Cam.

Mutilla artaxa, sp. n.

Length 15 mm.

Hab. Simla.

This species agrees so closely in form, coloration, and structure with *M. inoa* that it might be considered identical with it, if it were not for the difference in the form of the ventral keel and of the pygidium. The two may be separated thus:—

The ventral keel slightly narrowed in the middle; the smooth space on the pygidium V-shaped (broad at the base, becoming gradually wider towards the apex), narrow, the sides straight .... *inoa.*

The ventral keel broadly projecting downwards at the base, forming a large triangular tooth; the smooth space on pygidium large, broader at the apex than at the base; the sides curved inwardly at the base and apex .... *artaxa*, Cam.

The form of the scutellum is the same, but in *artaxa* the smooth space is not furrowed; the basal area on the median segment is the same; the apical abscissa of the radius is gradually rounded, and does not form two parts, as in *inoa*.

Mutilla trebia, sp. n.

Black; the basal segment of the abdomen and the second (except at the apex) dark red, the second at the apex covered with black, the third, fourth, and fifth with white pubescence. Wings fuscous violaceous, the second segment with an oblique slope on the basal half. ♂.

Length 15 mm.

Head rugosely punctured above the antennæ; the front and cheeks thickly covered with long silvery hair; clypeus smooth and bare. Prothorax rugosely punctured; the apex of the propleuræ smooth; the mesonotum rugosely punctured, with two longitudinal furrows, and covered with dark fuscous hair. Scutellum more coarsely rugosely punctured, thickly covered with long pale hair, and not raised above the level of the mesonotum. Median segment coarsely reticulated; the central area short and wide, its base not twice its length, its apical half narrowed. Propleuræ punctured, except at the apex; the mesopleuræ punctured, except at the base and apex; the metapleuræ with one row of large reticulations on the apex, the lower middle part with some large round punctures. The basal two abdominal segments are dark red; the apex of the second black and covered with black hair; the ventral keel is almost straight and the apex is oblique and forms an incision with the obliquely rounded base of the second segment. The second segment is obliquely depressed from the middle on the basal and apical slopes; the white pubescent bands on the third, fourth, and fifth segments are broad; the pubescence on the apical segment is black.

This species is not unlike *pandara*, Cam.; that is a more slenderly built species and is smaller.

Fossores.

Tiphia.

i. *Median segment with three keels.*

A. The first transverse median nervure placed distinctly behind the basal, which is curved and thickened before the cubital nervure; a stout keel, broad and square at the base, extends on to the middle of the ventral surface of the petiole.

Tiphia clavinerva, sp. n.

Nigra; abdominis apice dense fulvo-piloso; alis fere fulvo-hyalinis, nervis fuscis, stigmate nigro. ♂.

Long. 9 mm.

Scape of antennæ sparsely covered with long fuscous hair; aciculated, sparsely punctured, shining; the flagellum opaque, thickly covered with pale down. Front and vertex shining, strongly punctured, more sparsely laterally below the ocelli. Face and clypeus closely punctured, thickly covered with fuscous pubescence; the apex of the clypeus has a rounded incision. Mandibles shining, rufous before the middle, the base sparsely covered with pale and golden hair; palpi rufotestaceous. Pronotum sparsely punctured on the basal half, shining; the base thickly covered with long pale fuscous hair. Mesonotum punctured, more sparsely and irregularly on the sides, and thickly covered with short fuscous pubescence. Scutellum punctured like the mesonotum; post-scutellum more closely and finely punctured. The middle of the metanotum bears three parallel keels; the space enclosed by them is strongly irregularly aciculated; the sides are closely striated; the apex is strongly aciculated and thickly covered with a pale pubescence; the top is depressed and longitudinally striated. Propleuræ smooth and shining; the base below strongly aciculated. Mesopleuræ sparsely punctured and thickly covered with pale pubescence. Metapleuræ striated (except at the base, which is strongly aciculated). Prosternum largely roundly tuberculated laterally on the apical half; the middle depressed. Mesopleuræ with two curved divergent furrows; the space between at the apex depressed in the middle. Legs thickly covered with white hair; the fore femora and tibiæ and the middle tibiæ less broadly rufous. Abdomen shining; the third and following segments thickly covered with bright fulvous pubescence; before the apex of the petiole is a narrow, longitudinally striated, transverse furrow; on the base of the second segment is a deeper, more regularly striated furrow; the apical segments are strongly punctured; the pygidium is smooth down the middle. Beneath, the base of the petiole is strongly aciculated, opaque, sharply keeled at the base and less strongly down the sides; the apex is more strongly obliquely raised; in front of this is a stout strongly aciculated keel which reaches near to the middle, becoming narrower and smoother as it does so; the middle is sparsely punctured; the apical half very smooth and shining; the second ventral segment is sparsely, the others more closely and distinctly, punctured and thickly covered with fuscous hair. The transverse median nervure is received distinctly behind the transverse basal; the apex of the radius is roundly curved; the second transverse cubital nervure is straight, oblique; the third is rounded outwardly at the top and oblique below; the second recurrent nervure is received in the middle of the cellule.

B. The first transverse median nervure not placed distinctly behind the basal; the petiole without a stout keel on its ventral surface.

Tiphia himalayensis, sp. n.

Black, densely covered with longish dark silvery pubescence; the pro- and metapleuræ closely obliquely striated;

the wings fuscous violaceous, the second transverse cubital nervure roundly bisinuate. ♀.

Length 15–16 mm.

Front and vertex coarsely punctured, more sparsely on the ocellar region; the clypeus closely punctured, its apex smooth and broadly rounded. Mandibles broadly piceous. Middle of pronotum strongly punctured; the apex smooth, the basal slope closely punctured. The middle of the mesonotum is strongly punctured; the sides are sparsely punctured. Scutellum sparsely and deeply punctured on the base and apex; the postscutellum is sparsely punctured. Median segment 3-keeled, opaque, strongly aciculated, smoother, more shining on the sides at the apex, and irregularly striated near the bordering keel. The apical slope is coarsely aciculated. Pro- and metapleuræ closely obliquely striated, the mesopleuræ strongly and closely punctured. Wings uniformly fuscous violaceous and highly iridescent; the second transverse cubital nervure is roundly curved outwardly above and below, the upper part more roundly and distinctly than the lower. The tibiæ and tarsi are thickly covered with dark silvery hair; the spines are rufous. Abdomen shining; the apical, dorsal, and the ventral segments thickly covered with long silvery hair; the basal half of the pygidium is thickly haired; in the middle is a longitudinal keel.

Tiphia robusta, sp. n.

Black; the hinder femora bright red; the wings dark fuscous violaceous, the nervures and stigma black. ♀.

Length 15 mm.

Head above the antennæ coarsely and strongly punctured; there is a smooth patch behind each of the hinder ocelli and a smooth line down the front in the centre; the apex of the clypeus smooth. Mandibles black, dull rufous beyond the middle. The apex and the basal slope of the pronotum smooth, the middle strongly but not very closely punctured. The centre and sides of the mesonotum are rather strongly but not closely punctured; the scutellum is similarly punctured on the sides and apex; the postscutellum is punctured laterally. Median segment 3-keeled, opaque, aciculated; the outer keels converge slightly near the apex; the central keel becomes thinner towards the apex. Propleuræ smooth, with a few indistinct scattered punctures; the mesopleuræ closely and strongly punctured; the metapleuræ closely striated, except at the base below. Legs black, the hinder femora bright red; the tibiæ and tarsi are covered thickly with white hair; the calcaria black. Wings dark fuscous violaceous; the nervures and stigma black. Abdomen black, shining, finely punctured, the apical segment thickly covered with long black hair, except on the apex; the ventral segments are fringed with white hair.

Comes near to *T. rufofemorata* and *T. khasiana*, but these species are both smaller and have the middle femora red. The upper half of the second transverse cubital nervure is roundly curved outwardly.

Tiphia denticula, sp. n.

Long. 12 mm. ♂.

This species comes near to *T. canaliculata*, but is more slenderly built; the depression on the apex of the median segment is not so wide nor so deep, nor is it so regularly striated; the basal abscissa of the radius is distinctly angled above the middle, not gradually rounded as in *canaliculata*; the lower abscissa of the apical part of the radius is longer, and there is a more distinct angle formed by it with the second recurrent nervure.

Head opaque, closely rugosely punctured and thickly covered with long white soft hair; the front is indistinctly keeled in the middle. Clypeus closely rugosely punctured, its apex smooth and transverse. Mandibles black, as are also the palpi. Pro- and mesonotum shining, closely punctured (except on the apex of the former); the scutellum and postscutellum are similarly punctured. Median segment irregularly coarsely aciculated; the three keels extend to the apex, but the outer become weaker towards the apex, which is broadly depressed, shining, and bears a stout longitudinal keel in the centre. The apical slope is coarsely aciculated and keeled down the middle. The basal half of the propleuræ is aciculated and obscurely striated; the mesopleuræ strongly and closely punctured; the metapleuræ striolated, aciculated at the base. Wings uniformly fuscous, with a violaceous tinge; the nervures and stigma black; the transverse basal nervure is thickened near the top, the transverse median is received shortly behind it; both the recurrent nervures are received shortly beyond the middle. There is a distinct curved broad tooth on the underside of the petiole at the base, from which a keel runs to the middle. The hair on the apical and on the ventral segments is long and white.

Tiphia tuberculata, sp. n.

Nigra, mandibulis rufis, tarsis testaceis; alis fusco-hyalinis, nervis fuscis, tegulis rufis; basi petioli subtus tuberculata. ♀.
Long. 8 mm.

Antennæ black, the apical joints rufous beneath; the scape is finely and closely punctured above, the sides and lower side covered with long silvery hair; the base of the flagellum is sparsely covered with white hair; the rest of it bears a white pubescence. The front is closely punctured below, more sparsely above; the vertex is similarly punctured; both are thickly covered with long fuscous hair; the clypeus smooth, shining, punctured closely at the base, its apex rounded. Mandibles red, black at the apex; their underside fringed with long golden hair. Palpi testaceous, the apical joints paler. Pronotum coarsely punctured, its apex smooth, the basal slope finely and closely punctured. The middle of the mesonotum is strongly but not closely punctured, its base and sides smooth, bare; the base in the middle slightly depressed. Scutellum strongly punctured (except in the middle); the postscutellum finely punctured. Median segment strongly aciculated; the three keels are almost parallel and all reach to the apex; the space bounded by them has a blistered appearance; the apex at the sides is depressed and bears a few striæ; the apical slope is blistered, is thickly covered with a white pubescence, and is obscurely keeled down the middle. The top of the propleuræ is smooth, the rest obscurely punctured; below the middle is an oblique keel. Mesopleuræ closely punctured, the apical slope strongly aciculated; the pubescence is thick and pale. Metapleuræ closely striated, much more finely, almost strongly aciculated on the base below. Mesosternum sparsely punctured, shining; the hair long and fuscous; the apical area is triangular at the base; finely furrowed down the middle, the apex in the middle triangularly depressed. Legs black; the fore knees, the apex of the tibiæ, and the tarsal spines rufous; the tibial spines are pale. The second transverse cubital nervure is roundly curved outwardly in the middle; the first recurrent nervure is received shortly, but distinctly, before the middle of the cellule and is roundly curved above; the second is received close to the apical third of the cellule. Abdomen shining, sparsely punctured, the middle and apical segments thickly covered with long white hair; the base of the second segment is depressed and marked with longitudinal keels all over; the apical half of the pygidium is rufous and smooth. The petiole beneath is smooth; the base punctured closely; its middle with a blunt raised tooth; its basal slope is longer, more rounded than the apical, which has an oblique slope.

Comes near to *T. spinosa*, but is smaller; the median segment is not transversely striated in the middle; the tooth on the petiole is blunter and longer; the under surface of the petiole at the apex is smooth and shining; the top of the propleuræ smooth and shining, and the mandibles are rufous.

Tiphia fulvinerva, sp. n.

Nigra, albo hirsuta, propleuris striolatis; metanoto opaco, medio tres-carinato; alis fulvo-hyalinis, stigmate nigro, nervis fulvis. ♀. Long. 17 mm.

Scape of the antennæ thickly covered with long white hair; the second and third joints are smooth and shining, sparsely covered with pale hair; the other joints are opaque and thickly covered with a fulvous down. Front and vertex bearing large, deep, clearly separated punctures, and with long fuscous hair; there is an elongated smooth space before the ocelli; above and between the antennæ is a stout keel. Clypeus closely punctured, its apex smooth and depressed. Mandibles black, obscure rufous near the middle, their lower side fringed with long pale golden hair. Palpi dark testaceous. The basal slope of the pronotum obscurely punctured, smooth below; the basal half of the upper part is strongly punctured, the apical smooth. Mesonotum irregularly punctured, sparsely covered with fuscous hair; the scutellum has a few punctures in the middle; the apex has a row of large deep ones; the sides are less strongly punctured. Propleuræ closely striated; the basal keel smooth and shining; the top with a row of punctures; the lower edge is opaque and strongly shagreened. Mesopleuræ strongly and deeply punctured and covered with long pale hair. Metapleuræ closely but not very strongly striated; the base opaque, shagreened. The basal half of the mesosternum strongly and deeply punctured, the apical smooth and shining; in its centre at the apex is a V-shaped area, clearly bounded by deep furrows; it is widely furrowed down the middle; the furrow is bordered by one or two punctures; its sides at the apex are triangular. Wings fulvo-hyaline; the nervures fulvous, the stigma darker; the apex of the radius is obliquely depressed and thickened; the first recurrent nervure is broadly rounded outwardly at the top; the second is oblique and is received shortly beyond the middle. Legs thickly covered with silvery hair; the tibial and tarsal spines rufous. Abdomen shining; the petiole with the punctures large; the other segments have them smaller and closer; the apical segments are thickly covered with long pale hair; the pygidium has the basal half black and strongly rugosely punctured; the apical half is for the greater part rufous; in its centre is a longitudinal keel; on the sides are a few indistinct keels. The median segment is strongly aciculated, opaque, and has in the middle three keels; the central reaches near to the apex, to which it is joined by three minute ones; the apex has an oblique slope, is shagreened, opaque, and thickly covered with white pubescence. The ventral segments are fringed with long fulvous hair; the hypopygium is closely and strongly punctured (except in the middle) at the apex. The clypeus is broadly rounded at the apex.

Comes into Bingham's section B and b^2 and b^3, but is different from anything included therein. It might come into section "C. Wings golden yellow," but it is quite distinct from *T. auripennis*, the representative of the section.

Tiphia simlaensis, sp. n.

Nigra, capite pronotoque dense punctatis; metanoto opaco, dense aciculato, medio bicarinato; alis fusco-violaceis, nervis stigmateque nigris. ♀.

Long. 12 mm.

Hab. Simla.

The scape of the antennæ is covered with long white hair; the second and third joints are smooth, shining, sparsely covered with white hair; the others are opaque and thickly covered with a pale down. Front and vertex closely and strongly punctured, more sparsely near the ocelli; they are thickly covered with pale hair. The base of the clypeus is closely and strongly punctured, the apex smooth and shining, its middle roundly and distinctly incised. Mandibles smooth and shining, their middle broadly rufous; palpi fuscous. The lower part of the pronotum at the base is smooth and shining, the upper finely and closely punctured; the top is strongly and closely punctured (except on the apex). Mesonotum shining and marked with widely separated large punctures. The scutellum is punctured round the edges and more sparsely in the middle; the postscutellum is similarly, but more closely, punctured; at its sides is an opaque, coarsely aciculated depression. The basal region of the median segment is opaque, coarsely aciculated, the sides near the base finely striated; the apex is smoother and more shining; there are two keels which reach to the apex and a less distinct one which reaches on to the middle; the apex has a blistered appearance, is sparsely, obscurely punctured, and has an indistinct keel down the middle. The upper part of the propleuræ is aciculated, the lower finely and closely longitudinally striated; the middle of the mesopleuræ is closely punctured and thickly covered with long white hair; the apical half of the metapleuræ is strongly striated; the striæ are distinctly separated. The basal half of the mesosternum is punctured; from the middle, on either side, a curved furrow runs to the sides at the apex; the space bounded by them is strongly punctured; outside them it is smooth. Legs black, the hair white; the calcaria rufous, as are also the tarsal spines. Wings uniformly fuscous violaceous, the nervures and stigma black; the second transverse cubital nervure is only slightly oblique and is roundly curved above; the second recurrent nervure is received at the base of the basal third of the cellule. Abdomen shining; the segments finely and sparsely punctured in the middle; the apical segments thickly covered with long white hair; the pygidium strongly punctured, the apex smooth, keeled in the middle, depressed laterally.

ii. *Median segment with five keels.*

Tiphia quinquecarinata, sp. n.

Nigra, flagello antennarum, mandibulis, tarsis abdominisque apice rufis; alis fulvo-hyalinis, nervis rufis, stigmate nigro. ♀.
Long. 11 mm.

Antennæ rufous, the flagellum black above, thickly covered with a pale down; the scape black, shining, sparsely covered with long white hair. Head shining; the front and vertex punctured, but not very closely, and sparsely covered with fuscous hair. Clypeus projecting; its apex rounded. Mandibles rufous, black at the base, their underside fringed with long golden hair; palpi testaceous. Thorax shining; the pronotum marked, but not closely, with large punctures, its apex smooth. Mesonotum strongly and closely punctured in the middle, more sparsely on the sides, and thickly covered with fuscous hairs. Scutellum with a row of large punctures round the apex, and there is a more scattered and irregular row on the sides; postscutellum smooth, without punctures. The three central keels on the median segment are parallel;

the outer pair converge slightly towards the apex; the central hardly reaches to the apex; the two bordering it are distinctly separated from it; the space enclosed by the keels is coarsely aciculated (except at the apex); the apex has a sharp oblique slope, is strongly aciculated, and covered with a pale down. Propleuræ shining; the upper part smooth, the lower very finely longitudinally striated; the raised basal edge is impunctate, very smooth, and shining. Mesopleuræ shining, sparsely punctured in the middle, and covered with white pubescence. The base of the metapleuræ smooth at the base, the rest closely striated. Mesosternum shining, the basal two thirds sparsely, but distinctly, punctured; the apex smooth; the apical area is triangularly narrowed at the base, becoming gradually wider towards the apex; it is almost opaque, sparsely punctured, and thickly covered with short white hair; the middle furrow becomes triangularly widened at the apex. The four anterior tarsi and the front tibiæ beneath are rufous; the hair on the four hinder tibiæ is silvery; the spines are rufous; the calcaria reddish testaceous. Wings hyaline, with a fuscous tinge; the nervures testaceous, the stigma black; the second transverse cubital nervure is roundly curved outwardly on the upper half; the lower part is straight, oblique. Petiole shining; the sides and apex punctured; the punctured band on the apex bounded at the base by a furrow; the apices of the segments are finely punctured and covered with pale hair; the pygidium has the apical half rufous; the middle has a band of long pale hair; the triangular apical part of the basal ventral segment is very smooth, glabrous, and shining; the apex of the hypopygium is testaceous and is covered with long fulvous hair.

In Bingham's table this species comes into "B. a^2. Median segment with five longitudinal keels." *T. lyrata* may be separated from it by the apex of the petiole being longitudinally striated; the other species of the section (*T. flavipennis*) is easily known from it by the clypeus having two blunt teeth on the apex.

Salius trichiosoma, sp. n.

Niger, dense longe nigro pilosus; alis fusco-hyalinis, basi flavo-hyalinis; pedibus ferrugineis, basi late nigris. ♀.

Long. 22 mm.

Claws with one tooth. Antennæ long, black, bare, moderately stout. Head opaque, black, densely covered with long black hair; there is a narrow furrow on the front.

Apex of clypeus transverse; the labrum slightly projecting laterally and to a less extent in the centre; it is fringed with long bright rufous hair. Mandibles and palpi black. Thorax opaque, alutaceous, densely covered with long black hair; the pleuræ obscurely punctured and with a distinct oblique furrow near the middle. The apex of the median segment is bare, smooth, and shining. Wings fulvous hyaline, the apex with the fulvous tinge less well marked and with a violaceous tinge. The stigma and costa are black; the nervures are testaceous; the second cubital cellule is distinctly shorter than the third above and below; the third transverse cubital nervure has the upper half straight and oblique, the lower is not so oblique and broadly rounded. Legs rufo-testaceous, the tarsi paler, the coxæ, trochanters, and basal half of the femora black. Abdomen smooth and shining.

A distinct species. Characteristic is the long, dense, black hair on the head and thorax.

Salius Frederici, sp. n.

Black; the antennæ (except at the base and apex) fulvous; the tibiæ (except at the apex and the hinder tarsi) rufous; the apices of the joints of the hinder tarsi black; the wings flavo-hyaline, the base of the anterior dark smoky to the transverse basal nervure, the hinder pair with the basal half dark fuscous, the apical yellow. ♂.

Long. 23 mm.

Claws with one stout tooth. Antennæ as long as the body, distinctly tapering towards the apex. Head black, sparsely covered with long black hair; the inner orbits narrowly, the face, clypeus, and labrum dark rufo-testaceous. A distinct, deep, narrow furrow extends from the ocelli to the middle of the front. Clypeus roundly convex; its middle at the apex transverse, the sides rounded. Mandibles black, the upper part testaceous. The head is obliquely narrowed behind the eyes and is well developed there; there is a testaceous line on the outer orbits above. Thorax opaque, sparsely covered with long black hair; the median segment is longish, has a gradually rounded slope, and is obscurely transversely striated. Wings yellowish hyaline; the base above is dark fuscous, with a violaceous cloud to the transverse basal nervure, below the cloud extends to the submedian nervure; the second and third cubital cellules are almost equal in length at the top and bottom; the third transverse cubital nervure has the upper half straight and oblique; the lower half is more rounded. The four front tibiæ are darker coloured than the hinder pair; the four front tarsi are almost entirely black.

Resembles in coloration *S. anthracinus*, Sm., but that belongs to the group with bidentate claws.

Salius lugubrinus, sp. n.

Niger, pruinosus; alis hyalinis, fusco-bifasciatis. ♀.
Long. 7 mm.

Antennæ slightly pruinose; the underside of the scape thickly covered with short white hair. Front and vertex almost bare; the face and clypeus thickly covered with silvery pubescence; the apex of the clypeus transverse, smooth, and shining; in the centre of the front is a narrow longitudinal furrow. Apex of the mandibles reddish; the palpi black, thickly covered with white pubescence. Thorax alutaceous, shining; metanotum smooth; on its apex are two longish depressions. Legs black, pruinose, more thickly at the base. Wings hyaline; a large conical cloud extends from the base of the cubital nervure along the transverse basal nervure to the opposite side; there is a large cloud occupying the greater part of the radial cellule, the middle cubital cellules, and the middle of the discoidal cellules on either side of the second recurrent nervure to near the edge of the wing; the third cubital cellule is much narrowed above, being there scarcely half the length of the second; below it is slightly longer; the first recurrent nervure is received near the base of the apical third, the second shortly, but distinctly, before the middle. Abdomen smooth and shining, pruinose; the hypopygium is thickly covered with long fuscous hair.

Pseudagenia lepcha, sp. n.

Blue, the hinder femora for the greater part red; the head and thorax punctured and thickly covered with white pubescence; the scutellum (except in the centre) closely longitudinally striated; the median segment coarsely, irregularly striated; the wings fuscous hyaline, with a violaceous tinge; the nervures and stigma fuscous. ♀ ♂.

Long. 13–15 mm.

Hab. Simla and Khasia.

Antennæ black, the scape with a blue tint and covered with a white pile. Front and vertex closely and distinctly punctured; the clypeus, on the sides, bears some shallow scattered punctures; the raised centre is closely and distinctly punctured; the parts above the antennæ and behind the eyes are thinly covered with long white hair. Mandibles black, the base thickly covered with white pubescence. Palpi black. Thorax blue, with purple and brassy tints; above it is closely, but not very strongly, punctured; the sides of the scutellum are closely, irregularly, longitudinally striated; the postscutellum towards the apex is irregularly transversely striated. Median segment coarsely, irregularly, transversely striated; there is a broad shallow furrow down the middle. The hollowed part of the propleuræ bears a few striæ; the mesopleuræ coarsely rugose, the punctures running into oblique striæ towards the apex; the metapleuræ above closely, strongly, obliquely striated, the base below is minutely punctured, the apex coarsely closely reticulated. The four anterior legs are blue; the tibiæ and tarsi darker coloured; the hinder femora red, narrowly purple at the base and apex. Wings uniformly fuscous hyaline, highly iridescent and with a violaceous tint; the stigma and nervures are fuscous. Abdomen bright metallic blue, very smooth, and shining.

Allied to *P. blanda* and *P. prophetica*, from both of which it may be known by the strongly and closely punctured head and thorax, by the punctured and longitudinally striated scutellum, and by the wings being not clear hyaline. The head and thorax may have dark purple and brassy tints. With the male the anterior femora and tibiæ may be testaceous in front.

Cerceris violaceipennis, sp. n.

Black; the lower half of the inner orbits broadly, the antennal keel, a reversed crown-shaped mark below it, a broad line on the pronotum, the sides of the scutellum, the postscutellum, the base of the petiole, the apical two thirds of the third segment, and the apices of the following three segments narrowly, rufous; the legs black, the apices of the four front femora and the four anterior tibiæ in front yellow; the wings smoky, darker in front, the nervures and stigma black. ♂.

Long. 8 mm.

Scape of antennæ for the greater part yellow; the base of the flagellum broadly, the apex narrowly beneath, brownish. Head closely and distinctly punctured; the face and clypeus thickly covered with silvery pubescence. Clypeus broadly roundly projecting, the lower inner orbits, a large mark, transverse at the base, becoming obliquely narrowed below and ending in the middle in a rounded point, and the antennal keel are yellow. Thorax black; a broad band on the pronotum behind, the tegulæ, the sides of the scutellum, and the postscutellum reddish. The area on the median segment is closely and uniformly punctured; the rest of the segment more strongly and deeply punctured all over. The segment is more thickly and uniformly covered with fuscous pubescence than the rest of the thorax. Abdomen closely punctured; the base of the first segment broadly, a small mark in the centre of the second segment on the apex, the apical two thirds or so of the third, and the apices of the three following segments narrowly red. Pygidium coarsely, but not very closely, punctured. There is an elongated mark on the sides of the second ventral segment and a small one on the sides of the fifth.

The wings have a distinct violaceous tinge and are highly iridescent. The foveæ on the median segment are large; the metapleuræ are shining and only slightly punctured compared with the mesopleuræ; the propleuræ are stoutly obliquely striated. In coloration the species agrees closely with *C. bimaculata*, Cam., but is abundantly distinct otherwise.

Cerceris latibalteata, sp. n.

Black; a broad line, obliquely narrowed above, on the lower inner orbits, the antennal keel, the basal half of the mandibles, a line on the hinder part of the pronotum, the scutellum, postscutellum, the greater part of the third abdominal segment, and a line on the apex of the fifth yellow; the wings fuscous, the radial and the front of the cubital cellules smoky; the stigma and nervures black. ♀.

Long. 7 mm.

Antennæ black; the flagellum broadly brownish beneath. Head entirely black; above the antennæ closely punctured; the apex of the clypeus projects broadly, is transverse, and is more shining than the face. The thorax is not strongly or very distinctly punctured; an irregular line on the apex of the pronotum, the base of the tegulæ, and the scutellums are yellow. The area on the median segment is shining, is indistinctly finely punctured, and has a narrow furrow down the centre. Propleuræ obscurely striated; the mesopleuræ punctured, and with a wide and deep longitudinal furrow in the centre. Metapleuræ shining, obsoletely punctured, and obscurely striated under the wings. Legs black; the front tibiæ anteriorly and the tarsi yellowish. The greater part of the third and the apex of the fifth segments are reddish; the pygidium irregularly shagreened and punctured.

Larra bicolorata, sp. n.

Nigra, nitida, pruinosa; femoribus posticis rufis; alis fusco-violaceis, stigmate nigro, nervis fuscis. ♀.
Long. 12 mm.

Scape of antennæ and pedicle bare, smooth, and shining; the flagellum opaque, covered with a microscopic pubescence. Head shining; the front and vertex bare, sparsely minutely punctured; the ocellar region is depressed; the raised part in front of the ocelli is furrowed down the middle; the middle of the front is deeply furrowed; the sides are more broadly and not so deeply furrowed. Face and clypeus closely punctured and thickly covered with pale pubescence; the labrum is fringed with long rufous hair. The base of the mandibles closely punctured and covered with white pubescence, the middle broadly rufous; the palpi black, fuscous towards the apex, and thickly covered with white pubescence. Pro- and mesonotum closely and distinctly punctured and covered with a short down, having a fulvous hue on the latter, which is broadly depressed in the middle at the base and on the sides towards the apex. Median segment closely and distinctly punctured on the sides, which are slightly depressed; the central part closely, transversely, irregularly striated; the middle is slightly furrowed and keeled down the centre of the furrow; the keel is fainter towards the apex; the apical part has an oblique slope, is closely punctured, the sides above transversely striated; on the apex are a few longitudinal striæ; the central furrow is deep and extends to the top of the apical fourth of the segment. Propleuræ closely punctured, obscurely striated in the middle below; the mesopleuræ are more distinctly punctured; the tubercles are large and depressed at the base; behind they are bordered by a thick band of white pubescence; the basal perpendicular and the upper longitudinal furrows are deep and obscurely striated. Metapleuræ closely punctured. Mesosternum closely and distinctly punctured, furrowed down the middle, and there is a transverse furrow before the middle coxæ; the metasternum is opaque, alutaceous, keeled round the sides, the base and apex are rounded, there is a distinct furrow down the middle. Wings fuscous violaceous; the first cubital cellule at the top is half the length of the second; both the recurrent nervures are received behind the middle of the cellule. Legs thickly pruinose; the hinder femora bright red; the tibiæ and tarsi thickly spinose; the tarsal spines and the claws rufous. Abdomen very smooth and shining; the apices of the segments pruinose; the pygidium has a few scattered punctures and hairs; the epipygium is more closely and distinctly punctured and has a shallow furrow on either side at the apex.

Larra pygidialis, sp. n.

Nigra, femoribus posticis rufis; alis fusco-violaceis, cellula cubitali 2ª duplo longiore quam 1ª. ♀.

Long. 17–18 mm.

The scape of the antennæ sparsely, the flagellum thickly, covered with white hair; the second joint shining, sparsely haired. Head shining, the front sparsely punctured and covered with white hair. The face and clypeus closely punctured (except on the apex of the latter) and thickly covered with white pubescence. The tooth of the mandibles and a large space before their apex rufous, and fringed below with long pale golden hair. The palpi brownish and thickly covered with white hair. Pro- and mesonotum minutely punctured; the mesonotum thickly covered with fuscous pubescence. Median segment minutely punctured; its middle from the base to the top of the apical furrow closely transversely striated. Pleuræ shining; the furrows on the mesopleuræ distinct, the basal perpendicular one striated. The metasternal area is thickly pilose; there is a central keel which reaches to the apex and is much stouter at the base; there is a narrower lateral keel which reaches to the middle only. Legs thickly covered with white pubescence; the tarsal spines are rufous, as is also the base of the hinder calcaria; the hinder femora are red, black at the extreme apex. The costa and stigma are black; the nervures are fuscous; the apical abscissa of the radius is very slightly oblique; the first cubital cellule is half the length of the second; the second recurrent nervure is roundly curved and is received in the middle. Abdomen shining, pruinose; the apices of the middle three segments depressed; the pygidium sparsely haired; strongly irregularly punctured, the basal punctures smaller, those on the middle and apex almost running into striæ; the sides are furrowed; the outer edge is sharply raised; the sides of the segments are punctured (except below) and are sparsely covered with brownish hairs.

This is a larger species than *L. bicolorata*, with which it agrees in coloration; it may be known from it by the furrow on the apex of the median segment not reaching to the apex, nor originating at the top, by the middle of the basal part not having a keel, by the mesopleuræ not being so strongly punctured, and by the abdomen being shorter compared with the head and thorax—it being shorter than these united, whereas in *L. pygidialis* it is distinctly longer.

Tachytes rufipalpis, sp. n.

Nigra, facie tibiisque dense aureo pilosis; abdomine argenteo lineato; alis flavo-hyalinis, nervis flavis. ♀.
Long. 17 mm.

Scape of antennæ densely covered with pale golden pubescence; beneath aciculated and thickly covered with long pale hair; the flagellum, especially at the base, thickly covered with silvery pile. The vertex is closely and distinctly punctured and covered with long, soft, fuscous hair; behind the ocelli is a large semicircular, almost triangular, deep depression; round the inner side of the hinder ocelli is a smooth shining keel, which is continued halfway down the outer side of the ocellar region; the ocelli are placed thus ·.·; the face below the ocelli is thickly covered with bright golden pubescence; the clypeus is closely and distinctly punctured, its upper part thickly covered with golden hair, its apex depressed, smooth, and shining. The mandibles closely punctured at the base, opaque, the rest smooth and shining; the palpi are rufo-testaceous. The base of the pronotum bears a pale golden pile; mesonotum alutaceous and thickly covered with fuscous pubescence; the scutellum is more strongly and distinctly punctured. Median segment thickly covered with long fuscous pubescence, alutaceous. Pleuræ alutaceous; the mesopleuræ thickly covered with golden pile and less thickly with fuscous pubescence. Mesosternum closely punctured and thickly covered with long pale pubescence; the area between the middle coxæ is keeled laterally and down the middle. Legs densely pruinose; the tibiæ thickly covered on the outer side with bright golden pubescence; the tibial and tarsal spines are bright rufous; the calcaria are dark rufous, darker at the base. Wings yellowish, more hyaline and without a yellow tint at the apex; the nervures are bright yellow; the upper two thirds of the first transverse cubital nervure is roundly curved, the lower part is straight, oblique; the first recurrent nervure is received at slightly less than the length of the top of the second cubital cellule from the first transverse cubital nervure, the second distinctly before the middle. Abdomen black, the basal four segments broadly banded with silvery pubescence; the pygidium is densely covered with bright golden stiff pubescence; the hypopygium is sparsely punctured near the apex; the sides at the apex are stoutly keeled.

Comes near to *T. Saundersi* in Bingham's work, but is abundantly distinct.

Tachytes assamensis, sp. n.

Nigra, palpis, femoribus dimidio apicali, tibiis tarsisque rufis; alis fulvo-hyalinis, nervis stigmateque rufis. ♀.
Long. 17 mm.

Antennæ black; the scape beneath thickly covered with long pale fulvous hair. The front, face, and clypeus thickly covered with bright rufous pubescence and long fulvous hair; the vertex alutaceous and covered with long dark fulvous hair. Apex of clypeus bare, smooth. Mandibles with the basal half rufous above; the base thickly covered with golden pubescence. Palpi rufo-testaceous. Thorax thickly covered with longish bright rufous pubescence, the pubescence on the pleuræ and breast sparser, not hiding the colour of the skin; the hair on the scutellum and median segment is longer. Legs rufous; the coxæ, trochanters, and base of femora black. The apex of the wings want the yellowish tint; the radial cellule is infuscated; the first cubital cellule is slightly shorter than the second; the first transverse cubital nervure is roundly curved; the first recurrent nervure is received near the basal third, the second shortly beyond the middle. Abdomen black, shining; the basal segment covered with long dark fulvous hair; the apical and basal segments are sparsely covered with long black hair; the pygidium thickly covered with stiff rufous hair; the hypopygium has the sides and apex punctured; the middle bare, smooth, and shining.

Tachytes fulvo-pilosa, sp. n.

Nigra, dense aureo hirta; alis flavo-hyalinis, nervis stigmateque flavis; scapo antennarum dense aureo piloso. ♀.
Long. 20 mm.

Scape of antennæ densely covered with golden pubescence; the flagellum opaque, covered closely with a microscopic pile. Head densely covered with bright golden pubescence. Eyes converging above, where they are separated by the length of the fourth antennal joint. Clypeus (except at the base) closely punctured, the apex smooth and bare; the base of the mandibles covered with golden pubescence; the palpi are covered with a pale pile. Pro- and mesothorax thickly covered with bright golden depressed pubescence; the median segment with pale fulvous hair. The basal portion of the median segment is closely transversely striated; the transverse striæ are irregularly intersected by longitudinal ones; on the basal half in the centre is a longitudinal one; the apex has an oblique slope, is irregularly transversely striated, in the middle is a deep furrow. Propleuræ shagreened, covered with pale fulvous pubescence; the mesopleuræ closely punctured and thickly covered with rufo-fulvous pubescence, intermixed with long pale fuscous hair, as are also the metapleuræ and the mesosternum. The mesosternal furrow is narrow and shallow; the transverse furrow at the middle coxæ is deeper and wider; the metasternal process is narrowly, but distinctly, furrowed down the middle; the apex is divided into two somewhat triangular processes. Legs densely covered with a golden pile; the hinder tibiæ are distinctly keeled in the middle behind; the calcaria black; the tibial and tarsal spines bright rufous. Wings yellowish hyaline, the apex slightly infuscated; the nervures and stigma yellow; the first cubital cellule at the top is hardly one third of the length of the second; the first transverse cubital nervure is broadly curved; the two recurrent nervures are united near the top, shortly appendiculated, and are received near the apex of the basal third. The basal three abdominal segments are covered with depressed golden pubescence; the pygidial area black, sparsely covered with golden hair; the hypopygium is closely and distinctly, the penultimate segment sparsely, punctured. The lateral folds on the inner orbits are prominent; the sculpture of the front and vertex is hid by the dense pubescence; the frontal furrow appears to be wide and shallow.

Allied to *T. Saundersi* and *T. Rothneyi*, but is quite distinct.

Tachytes fulvo-vestita, sp. n.

Long. 15 mm.

Scape of antennæ (except above) thickly covered with pale fulvous pubescence and more sparsely with pale fulvous hairs; the flagellum with a pale down. Vertex alutaceous, sparsely covered with long fuscous hair; the front, face, and clypeus thickly with long golden pubescence; the apex of the clypeus almost bare, sparsely punctured. Mandibles black, broadly rufous in the middle and above to near the base; the latter is thickly covered with golden pubescence; palpi rufo-testaceous; the basal joint black at the base. The eyes at the top are separated by the length of the third antennal joint; the ocellus is round, not dilated before or behind. Thorax thickly covered with long bright hair, which is thickest on the mesonotum. The metasternal area is flat at the base and narrowly keeled in the middle; the apex has the sides raised, the raised part becoming higher towards the apex, which has a slightly oblique slope; the middle is narrow and deep at the bottom. Legs rufo-testaceous; the coxæ, trochanters, and base of femora are black, which is broadest on the anterior, narrowest on the posterior pair; the spines are few, stout, and rufous; there are none on the metatarsus. Wings yellowish hyaline, the apex fuscous; the first cubital cellule above is about one fourth longer than the second; the second recurrent nervure is received shortly, but distinctly, beyond the middle; the second is received the length of the top of the second cubital cellule from the base, the space between the two is a little greater than the length of the first cubital cellule above. Abdomen shining; the petiole covered with long pale hairs, the pygidium with stiff rufous hairs.

Comes near to *T. fulvopilosa*; may be known from it by the hinder tibiæ not being so stout, by the metatarsus being more slender and without spines, by the eyes at the top not being so widely separated, and by the different form of the metasternal area.

Tachytes maculipennis, sp. n.

Nigra, femoribus late, tibiis tarsisque rufo-testaceis; capite thoraceque pallide fulvo-pilosis; alis hyalinis, fusco maculatis. ♂.

Long. 12–13 mm.

Antennæ black, the scape broadly testaceous below; the scape beneath thickly covered with pale fulvous hair; the flagellum with a pale down; the front, face, and clypeus thickly covered with golden pubescence; the ocellar region and vertex alutaceous, covered with long pale fulvous hair; the hinder ocelli are more distinct than usual and are placed near each other; there is a narrow furrow in the middle of the vertex. The basal third of the mandibles pallid yellow; the middle rufous, the apex black; the base is covered with pale golden pubescence; the palpi rufo-testaceous. The thorax is thickly covered with golden pubescence and with long pale fulvous hair. The pronotum is deeply and distinctly separated from the mesonotum, which is closely punctured. The hair on the postscutellum and the median segment is long and thick; on the apex of the basal region of the latter is a small, smooth, triangular space. The propleuræ are rather bare; in the middle is a curved, smooth and shining, narrow furrow. The pubescence on the meso- and metapleuræ is dense; the hair is long and paler. Legs rufous; the coxæ, trochanters, the four anterior femora broadly behind to near the apex, and the hinder at the base above and more broadly below, black; the front femora behind are covered with golden, the posterior four with pale, pubescence. Wings hyaline; along the nervures suffused with fulvous clouds; the lower third of the first transverse cubital nervure is straight, the upper part is oblique; the first recurrent nervure is received nearly the length of the second cubital cellule from the base of the cellule, the second shortly beyond the middle. Abdomen shining, smooth; the segments banded with silvery pubescence; the pygidium is densely covered with silvery pubescence; the hypopygium is roundly and deeply incised on the apex.

Liris violaceipennis, sp. n.

Niger, dense argenteo pilosus; alis fusco-violaceis. ♀.
Long. 13 mm.

The middle of the scape brownish beneath, thickly covered with silvery pubescence; the flagellum with a pale pile. Front and vertex alutaceous, opaque; the ocellus has a triangular process in front; behind the ocellar region is a deep triangular depression; there is a longitudinal shallow furrow behind the ocellus. The cheeks and clypeus are thickly covered with silvery pubescence; palpi thickly covered with white pubescence. Pro- and mesonotum thickly covered with a pale down; on the centre the down has a fulvous tint. Median segment opaque, alutaceous; the apical slope has a narrow shallow furrow in the middle; the sides are obscurely transversely striated. Metapleuræ obscurely irregularly striated. Sternal process large, distinctly keeled down the middle; its apical lobes rounded. Wings with a distinct violaceous tint; the second cubital cellule at the top is nearly four times longer than the first; the upper half of the first transverse cubital nervure has, above the middle, a different slope from the lower half; the second recurrent nervure is received near the apex of the basal third of the cellule; the two recurrent nervures are separated by the length of the top of the first cubital cellule from each other. Legs pruinose; the spines and calcaria black. Abdomen with the segments banded with silvery pubescence; the pile on the pygidium is dark golden in certain lights; the hypopygium is slightly triangularly depressed at the apex.

Comes near to *L. nigripennis,* Cam.; that may be known from it by the head and thorax having a golden pile, by the pile on the pygidium being golden, by the apex of the median segment being more closely and uniformly transversely striated, by the femora having golden hair, and it is altogether a larger and stouter insect.

Tachysphex tinctipennis, sp. n.

Niger, capite thoraceque dense albo pilosis; alis hyalinis, cellula cubitali 1ª duplo longiore quam 2ª. ♀.

Long. fere 10 mm.

Scape of antennæ shining, densely covered with silvery pubescence, the flagellum with a pale pile; the pedicle densely pilose. Front and vertex closely punctured, the vertex less closely behind the ocelli, the front densely covered with white pubescence, the ocellar region raised, a shallow furrow down the middle; the depression behind them is deep in the middle. The apex of the clypeus is shining, bare, slightly wrinkled. The mandibles behind the tooth are finely rugose, pilose; palpi dark testaceous. Mesonotum densely punctured and thickly covered with fuscous pubescence. Scutellum shining, less closely punctured; postscutellum finely rugose. The basal part of the median segment is irregularly longitudinally striated, the apical closely finely reticulated; the apex has an almost perpendicular slope and is transversely striated. Propleuræ shining; mesopleuræ closely and distinctly punctured, the tubercles behind thickly banded with silvery pubescence, the perpendicular furrow is crenulated; the metapleuræ closely, slightly obliquely, striated. Mesosternum closely punctured, thickly covered with white pubescence; the metasternal process is depressed at the base, raised at the apex; there is a stout keel in the middle at the base. The first cubital cellule is double the length of the second on the top, the first transverse cubital nervure has an oblique slope near the middle; the second recurrent nervure is received shortly behind the middle. Legs thickly covered with a silvery pile; the tibial and tarsal spines are silvery white. Abdominal segments with silvery bands; the pygidium bare, shining, and bearing a few scattered punctures.

This species comes close to *T. bengalensis*; it has not the wings clear hyaline, they having a distinct fuscous tinge. In *T. bengalensis* the second recurrent nervure is received distinctly beyond the middle, in the present species distinctly behind it; the median segment is not so distinctly reticulated; the basal half is more distinctly longitudinally striated; and it is a smaller and more slenderly built species.

Larra apicepennis, sp. n.

Nigra, mandibulis late rufis, basi metanoti reticulata, apice striolato; alis hyalinis, apice fumatis. ♀.

Long. 7 mm.

Head above the antennæ coarsely aciculated, the furrow below the single ocellus deep; the clypeus shining at the apex, semicircularly depressed above and closely punctured; pro- and mesothorax closely punctured; scutellum more shining and with the punctures more widely separated. The basal part of the metanotum is closely and finely reticulated, the reticulations becoming finer and closer towards the apex; the apex has an oblique slope and is finely and closely transversely striated, the striæ being much stronger on the apical half; the middle furrow is deep. Legs black, pruinose, the tibiæ and tarsi strongly spined. Wings hyaline and iridescent to the base of the stigma, the rest slightly, but distinctly, smoky; the apical abscissa of the radius is oblique and is as long as the top of the first cubital cellule, which is above nearly twice the length of the second; the upper and middle parts of the third transverse cubital nervure have oblique slopes, the lower part is roundly curved. Abdomen pruinose, shining; the basal third of the pygidial area is smooth, bare, and shining, the rest is closely punctured and covered with a rufous pile; the hypopygium is strongly, but not very closely, punctured. The metapleuræ are obscurely obliquely striated.

The wings have a steel-blue reflection in certain lights.

Apidæ.

Halictus carinifrons, sp. n.

Black, the flagellum of the antennæ brownish beneath;

the hair is white, on the underside of the tarsi fulvous; the wings hyaline, the nervures and stigma black. ♀.

Long. 6–7 mm.

Head smooth and shining, sparsely haired, the mouth fringed with longish rufous hair; there is a distinct longitudinal keel on the lower half of the front. Mandibles piceous towards the apex. The area on the median segment is closely irregularly reticulated; at the sides it bears some longitudinal keels; its apical slope is straight and slightly oblique; on the apical half is a large, somewhat oval, deep fovea; its sides and top are keeled, but not strongly. The spines on the calcaria are as long as the thickness of the spur; they extend to near the apex and become gradually shorter from the base to the apex. Abdomen smooth and impunctate, above it is almost bare; below the hair-fringes on the basal five segments are broad, long, and white; the apices of the segments are brownish, the anal fimbria is distinct, rounded behind, and rufous in colour. The labrum is entire, rounded, and slightly narrowed towards the apex. The pleural tubercle is broadly fringed behind with white hair.

XXXVI.—*An undescribed Genus of* Coreidæ *from Borneo.* By W. L. Distant.

HETEROPTERA.

Fam. **Coreidæ.**

Subfam. *Coreinæ.*

Division Mictaria.

Kennetus, gen. nov.

♂. Body elongate, somewhat slender; head longer than broad, cleft between the apices of the lateral lobes, eyes well separated from the anterior margin of the pronotum; antennæ long, first joint a little shorter than fourth and about as long as anterior femora, second and third joints shortest, second a little longer than third; rostrum reaching anterior coxæ, first joint extending to base of head; pronotum with lateral angles very longly produced in elongate processes which are a little convex above and concave beneath, directed moderately upward and forward, but their apices barely attaining to the latitude of the head, their anterior and posterior margins serrate, the latter more strongly so, their apices broad and medially angulate, lateral pronotal margins in front of processes and lateral abdominal margins finely serrate; scutellum of moderate size, subtriangular; membrane as long as lateral margin of corium, veins strong and obliquely longitudinal; second abdominal segment with a tuberculous spine on each side near its posterior margin; anterior and intermediate femora moderately thickened, toothed beneath near apex, posterior femora incrassate, moderately curved, strongly spinous on their under surface, the strongest spine being near apex, and with about three strong curved spines on their upper surface; trochanters with an apical spine; anterior and intermediate tibiæ slender, moderately thickened at apices, and longitudinally furrowed; posterior tibiæ dilated on each side, the inner margin toothed beyond middle, the upper margin with a small upright spine at apex; tarsi with the first joint robust and about as long as the remaining joints together.

Allied to *Prionolomia* and *Prioptychomia*.

Kennetus alces, sp. n.

♂. Brownish testaceous, finely pilose, head greyishly pilose; sternum with a broad oblique greyish fascia extending from anterior to posterior coxæ; abdomen beneath dark ochraceous, its lateral margins and apex greyishly pilose; apical joint of antennæ fuscous; apical areas of produced pronotal processes, the tibiæ, and tarsi castaneous; membrane shining cupreous; scutellum with an elongate spot at each basal angle and the apex ochraceous; pronotum finely rugulose; scutellum transversely striate; apices of pronotal process centrally angulately produced.

♂. Long. 31 mm.; exp. pronot. angl. 23 mm.; abdomen at base 8 mm.

Hab. Borneo: Matang (Coll. Dist. and Sarawak Mus.).

This fine Heteropteron was sent to me for identification by Mr. R. Shelford.

MERCENNUS, nom. n.

Melania, Dist. Proc. Zool. Soc. 1901, i. p. 326 (nom. præocc.).

Type, *M. gracilis*, Westw.—Singapore, Java, Borneo.

XXXVII.—*The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.*

IV. *On the Lepidoptera Rhopalocera collected by W. J. Burchell in Brazil*, 1825–1830. By CORA B. SANDERS, of Lady Margaret Hall, Oxford.

[Plate VI.]

IN the course of the identification and arrangement of the large collection of butterflies in the Hope Department the Burchell specimens fell into their places in the various groups. Every fragment has been retained, even when the series of individuals was a very long one, because of the historic interest which attaches to the carefully preserved data. The identification and arrangement are the careful work of Mr. W. Holland, and in cases of special difficulty I have taken the specimens to London for comparison with those in the Godman-Salvin Collection and the British Museum. In making out many of the most puzzling species of that difficult subfamily the Ithomiinæ the late Mr. Osbert Salvin, F.R.S., very kindly gave me the invaluable help of his intimate knowledge and long experience. Dr. F. D. Godman, F.R.S., has similarly come to my aid with the most difficult of the Satyrinæ, and has also promised to name the whole of the Burchell specimens in the group upon which he is so distinguished an authority—the Hesperiidæ. Kind help has also been afforded by Mr. F. A. Heron, of the British Museum. When the arrangement of the Rhopalocera was sufficiently advanced I suggested to Miss Sanders that it would be of much interest to prepare an account of the Burchell specimens, incorporating all the data and observations recorded on the specimens and in the note-books. As I have explained above, Miss Sanders is not responsible for the identification of the species, although she has taken specimens to London to compare them afresh when it appeared possible that there might be some slight difference between them and the individuals captured in more recent years. For such possible differences Miss Sanders has kept the keenest outlook, aided in the search by Mr. Holland and myself; and it will be seen that the quest has not been altogether fruitless. The explanation of any recognizable differences, as due to a genuine change of form in three quarters of a century or to alteration in the distribution of forms, will be considered in each case as it arises. It may be said, however, that the evidence of some change is greater than we ventured to hope for at the outset of the enquiry.

I have claimed that the Burchell Collection, with its numberless accurate data, is of the highest historic importance in enabling us to carry back "the detailed record of the occurrence of many thousands of species in two most interesting parts of the world, and to construct a trustworthy standard by which to measure the rate of future change" (Ann. & Mag. Nat. Hist., Jan. 1904, p. 46). The trustworthiness of the standard depends upon the persistence of the data unaltered from Burchell's time to this. There is, fortunately, the means of checking these data by comparison with a list of the Brazilian Arthropoda made under Professor Westwood's direction during the years which immediately followed the gift of the collection in 1866. A second list of the dates of every individual of a species in Professor Westwood's handwriting is found on one specimen of many species, and this has often been a valuable check upon the complete list when errors were suspected.

The first section of the butterflies is written in Professor Westwood's own handwriting, and deals with the Heliconiidæ in the old broad sense, comprising the Ithomiinæ, the genera *Lycorea* and *Ituna* of the Danainæ, and the Heliconiinæ. Although in the form of rough notes and very difficult to disentangle, it is a model of accuracy. It records the whole of Burchell's notes written on the labels accompanying the specimens, but apparently none of the facts to be found in his manuscript note-books. Beyond the Heliconiidæ the list of butterflies is continued in an extremely clear handwriting, with great neatness of arrangement, but containing occasional slips and mistakes which can be detected by careful comparison with the existing data. It is evident that Professor Westwood arranged the vast mass of material into groups and subgroups, and in each of these separated the forms into what he believed were distinct species. An assistant employed under his direction then copied the notes written by Burchell on the labels attached to each specimen. In some cases Westwood himself added names to the forms thus grouped together in the list; but in the vast majority of cases the list remains as it was written by his assistant. My inference from the handwriting has been kindly confirmed by my friend Miss Swann, who tells me that her uncle, Professor Westwood, employed an assistant to write for him about the time at which these lists were copied. The backs of old University Notices were employed for this purpose, and a rather valuable record of the acts of the University during some of the years before the appearance of the 'Gazette' is to be found on the reverse sides of the sheets!

A few Notices of the years 1864, 1865, and 1867 are thus employed, together with large numbers issued in 1866 and 1869. A single paper with the date 1871 is made use of. It is therefore almost certain that the list was begun at once and finished within about six years of the gift. My first experience of the Department was in the summer of 1873, and I feel sure that the work was not going on then and was not resumed at a later date. Professor Westwood was keenly interested in the collection and appreciated it at its true worth. About six months after its arrival in Oxford he had already made a preliminary survey, and, on Nov. 26th, 1866, gave an account of it to the Ashmolean Society. The 'Proceedings' of this Society are very rare, and I have thought it well to reprint the passages in which the collection is described and its great significance demonstrated.

" *On the Data afforded by the Burchellian Collection as to the Geographical and Modificational Ranges of certain Brazilian Insects.* By J. O. WESTWOOD, M.A., F.L.S., Hope Professor of Zoology.

['Proceedings of the Ashmolean Society,' New Series, No. I. Read Monday, Nov. 26th, 1866.]

"Professor Westwood gave an account of the very extensive collections in various branches of zoology formed in South Africa and Brazil by the late Dr. W. J. Burchell, and presented to the University of Oxford by his surviving sister, in recognition of the honour conferred on her brother by the degree of D.C.L. some years previously. The collection was extremely rich, both in the number of species and also of individuals, and was especially valuable from the great care which had been taken in attaching the date of capture to every specimen, whereby, in conjunction with the journal kept by Dr. Burchell, the amount of geographical range and modificational change of each species could be accurately determined. The Brazilian portion of the collection had been made during a visit extending over three years [in reality nearly five years], in which period Dr. Burchell investigated the natural history of Rio Janeiro and its neighbourhood, thence proceeding southwards to Santos and San Paulo, thence north-westwards to Goyaz, and thence due north by the Tocantins to Para and its neighbourhood. Copious note-books were kept, and entries made daily, so that it may safely be affirmed that in respect to its geographical data no collection equal to this has ever reached Europe. The donation of the collection to the University was also very opportune at the present moment, when the question of the existence of species, and the extent of variation to which they are subject, are especially attracting the attention of zoologists."

After giving an account of the views of various writers on these questions and expressing his own belief "in the independent and original creation of species," Professor Westwood concluded as follows:—

"A careful study of the Burchellian collection required to be made, and it could not be doubted that it would afford satisfactory data for ascertaining the specific status of many of the insects which had fallen under Dr. Burchell's notice."

It is a keen pleasure to me to realize that in gradually publishing an account of the Burchell Collection I am carrying on a work to which my great predecessor devoted so much time and thought.

A search through Burchell's manuscript brought to light a scrap of paper covered with figures which tell us much of the man and his work. It is a memorandum of the dates at which he unpacked each section of his immense collection of insects and relaxed and set out the specimens. The majority of the dates refer to the "Lepidoptera &c.," and these are reproduced below:—

"Lepidoptera &c. relaxed and put out.

[Specimens captured between following dates.]				Relaxed and set out [between following dates].		
7. 9. 28	to	28. 2. 29	[Set]	26. 12. 39	to	8. 1. 40
28. 2. 29	,,	29. 4. 29	,,	9. 1. 40	,,	3. 2. 40
30. 4. 29	,,	5. 2. 30	,,	4. 2. 40	,,	9. 4. 40
Lepidoptera &c. relaxed and put out from the Cedarwood Box containing [captures] from 20. 7. 27 to 16. 4. 28.						
25. 8. 27	to A.[M.]	29. 8. 27	[Set]	12. 2. 44	——	——
6. 8. 27	,,	26. 8. 27	,,	6. 4. 46	to	30. 4. 46
11. 2. 26	,,	14. 2. 26	,,	30. 4. 46	,,	20. 6. 46
27. 1. 26	,,	9. 2. 26	,,	29. 6. 46	,,	22. 7. 46
Lepidoptera of Rio de Janeiro, Minas, &c., &c.						
27. 1. 26	to	8. 2. 26	[Set]	24. 7. 46	to	28. 7. 46
——	,,	27. 1. 26	,,	28. 7. 46	,,	31. 7. 46
14. 1. 26	,,	——	,,	[31. 7. 46]	,,	1. 8. 46
31. 12. 25	,,	14. 1. 26	,,	1. 8. 46	,,	5. 8. 46
6. 12. 25	,,	31. 12. 25	,,	6. 8. 46	,,	10. 8. 46
7. 11. 25	,,	6. 12. 25	,,	11. 8. 46	,,	14. 8. 46
4. 11. 25	,,	6. 11. 25	,,	15. 8. 46	,,	19. 8. 46
7. 11. 25	,,	6. 12. 25	,,	20. 8. 46	,,	21. 8. 46
29. 10. 25	,,	4. 11. 25	,,	21. 8. 46	,,	22. 8. 46
999]27. 10. 25	,,	29. 10. 25	,,	22. 8. 46	,,	8. 9. 46
819]23. 10. 25	,,	998]27. 10. 25	,,	8. 9. 46	,,	23. 9. 46

N.B.—Finished putting out and unpacking the whole of my Brazilian Insects on 26. 9. 46."

This mechanical labour was therefore completed when Burchell was about 63 years of age, 16½ years after the Brazilian journey came to an end in February 1830.

It is hardly necessary to add that the specimens were set in our old insular style, sloping and low upon the pin. Nearly all the butterflies have now been reset in accordance with modern requirements.

Burchell's method of keeping his notes on the Arthropoda was changed as time went on. At first he sorted out the captures of each day into what he believed to be species, and gave a list of these, and, in another column, the number of individuals belonging to each. Opposite these numbers observations of habits were sometimes recorded. During his journey to Rio, between April 2 and July 6, 1825, he had captured 97 kinds, distinguished by the numbers *1–97* (in Portugal, at Madeira, at Teneriffe, and on the ship). Between July 26 and Oct. 27, 1825, he had similarly distinguished species *98–1022* (during the earlier months of his residence at Rio and the greater part of his excursion into Minas Geraes). The labour was probably excessive and in the majority of cases served no specially valuable purpose; for the same work could be done better after his return home. Accordingly we find that he employed this method for the last time on Oct. 27, 1825, explaining a new meaning for all the numbers beyond *1022* in these words:—" N.B. The following Numbers are of such Insects *only* as require special and particular remark: of all the others their *locality* and *season* can be known only by referring to that same date in the Journal, or in the Catalogus Geographicus of the Botanical Collection: or to the following list of dates." The Journal is unfortunately lost, but the other two books are in the Hope Department, the second (" the following list of dates ") being what I have called the " Brazilian note-book." In this latter the numbers *1023* to *1345* (Jan. 1, 1826, to March 18, 1829) occur among other entries which are distinguished by dates alone, and not by numbers. All the numbers beyond *1022* and some of the dates refer to observations made upon the living forms. The numbers of individuals are not given, but can sometimes be inferred from the descriptions. The last number *1345* refers to an observation made at Porto Reál (Naçionale) on March 18th, 1829; so that all the observations made during the descent of the Tocantins and at Pará, in fact from March 19, 1829, to Feb. 10, 1830, are lost, having been contained in the missing volume alluded to on p. 98 (Ann. & Mag. Nat. Hist., Feb. 1904).

It is much to be hoped that an opportunity may be found for publishing the two Oxford note-books, both on account of their high intrinsic interest and because of the irreparable injury which their loss or destruction would inflict upon this historic collection. In order to render this and the following papers of greater permanent value, and to bring them into relation with such a publication whenever it may be issued, I propose to reproduce any of Burchell's reference numbers which are still to be found attached to the specimens. The vast majority of these are, however, distinguished by their dates, and have no such numbers. The following example will serve clearly to distinguish between Burchell's reference numbers and those which are now added to bring the specimens into relation with these papers :—

Bz. 907. III. + 25. 10. 25. 2 ♀ = **37, 38.**

Burchell's reference number will be printed *before* the date of capture and in italics, while the numbers now added will always appear *after* the date and printed in heavy type. *Bz.* indicates that the date or number immediately following is an original label, written in Brazil. *III.* refers to the number of individuals recorded in Burchell's note-book as far as the number 1022. In this case two are accounted for by specimens **37** and **38**, while the third is to be found upon **40** under an allied species. The + indicates that the specimens also bear labels which were carefully written and added after Burchell's return to England. Examples are seen in the labels to the right of figs. 9 and 10 on Pl. VI., where the Brazilian number is lowest. When *Bz.* is wanting, Burchell had copied the reference number and removed the original, as in the label accompanying fig. 11. *Bz.* without the + is used when the specimen bears only a Brazilian label (as in fig. 6). In all such cases as this the dates have been recovered from the Brazilian note-book. All the other figures on Plate VI. are without Brazilian labels, and bear dates, sometimes accompanied by notes (figs. 5 and 8), carefully written after the return home; and this is true of the great majority of the specimens hereafter recorded, all, indeed, of which the dates are not preceded by italicized letters or numbers. In many cases the original Brazilian date was never copied and remains as the only label. Such dates are preceded by *Bz.*

I trust that these directions will enable the reader to ascertain at a glance exactly what records of the great naturalist accompany or refer to each specimen in the collection to which he devoted so large a part of his life.

E. B. POULTON.

Oxford, Jan. 25, 1904.

I. *Ithomiinæ.*

Heterosais edessa, Hew.

16. 9. 26. 2 ♂ = **1, 2.** Santos. "Close above the Monastery of São Bento." "Ad marginem Sylvæ."

23. 9. 26. 4 ♂ = **3–6,** 1 ♀ = **7.** Santos. **3** and **7** bear Brazilian labels.

26. 11. 26. ♂ = **8.** Santos. "In the chácara (where I resided) near the Monastery of São Bento."

It has already been stated that the list of Ithomiinæ is in Professor Westwood's handwriting.

The determination and sexing of specimens **1–8** agree with Westwood's. His notes show that there were two more specimens which cannot now be found. Both were males and dated 12. 1. 26 (Rio) and 23. 9. 26 (Santos).

Hymenitis adasa, Hew.

Bz. 693. I. 22. 10. 25. ♀ = **9.** Minas Geraes. "In a Roça (about 4 miles S.S.W. of the house of Discoberto), on the road towards San João de Nepomucena." "*Papilio.*"

8. 2. 26. 3 ♀ = **10–12.** Organ Mountains. Near head of R. Pacaqué. "In a ride to the Cattle Pounds and the Milho Roça."

Agrees with Westwood's notes except as regards **12.** Concerning this specimen he had written "Very like *adasa*, but with difft. veins," and "Not in Hewitson Coll. or book." On **11** he had written in pencil "♀ agrees with *adasa* ♀ Hew. in its veins of h. w. but not with ♂."

Hymenitis erruca, Hew.

23. 9. 26. 2 ♂ = **13, 14.** Santos.

Determined by Westwood as *polissena* ♂. On **13** he wrote "seems identical with *Polissena* from Quito."

Pseudoscada sp. near *utilla*, Hew.

8. 2. 26. ♂ = **15.** Organ Mountains. (As **10–12.**)

Compared with Hewitson's specimens of *utilla* in the British Museum **15** appears to be a less heavily marked form of the same species.

Determined by Westwood as ♂ *acilla.*

Pseudoscada Jessica, Hew.

11. 2. 26. 2 ♂ = **16, 17.** Organ Mountains. "By the River Pacaqué." "In a walk to the Ipé trees."
14. 2. 26. ♂ = **18.** Organ Mountains. Near R. Pacaqué.

Agrees in all respects with Westwood's notes. Burchell's manuscript label was missing from **18.** The date was recovered from Westwood's list.

Pseudoscada acilla, Hew.

4. 11. 25. ♂ = **19.** Minas Geraes. Francisco Manoel's Rancho. Near Nepŏmucéna.
8. 2. 26. ♂ = **20.** Organ Mountains. (As **10–12.**)
9. 2. 26. ♂ = **21.** " " "By the River Pacaqué."

Agrees in all respects with Westwood, except that **15** was also included under *acilla.*

Ithomia agnosia, Hew.

10. 11. 25. 3 ♂ = **22–24.** Minas Geraes.

These three specimens were carefully compared with twenty-three in the Hope Department, one in the British Museum, and a series in the Godman-Salvin Collection, none, however, being from Brazil. A very few examples (one from Colombia) in the Godman-Salvin Collection occur approaching the Burchell form. The Burchell specimens vary from the usual form in having no extension of the black diagonal band on the fore wing into the interspace between the second and third median nervules, and a narrower marginal band on the hind wing. The general effect of the difference between these in the specimens mentioned above is that the transparent part of the wings is much more prominent in the Burchell examples. In fact the difference resembles that between *phenomoe* and *Burchelli* (compare figs. 3 and 4 with 1 and 2 on Pl. VI.), described on p. 315. In both cases South-East Brazil is characterized by a form in which the transparent area of the wings is increased at the expense of the black markings.

Agrees with Westwood's notes. He had written the words "*agnosia,* var.," on **22.**

Ithomia phono, Hübn.

No data. ♀ = **25.**
Bz. 196. I. 8. 9. 25. ♀ = **26.** Rio Janeiro (along the Aqueduct). "*Papilio* (*Heliconius*) In Sylva."

852. I.+ 24. 10. 25. ♀ = **27.** Minas Geraes. "About João Pedro's at Discoberto: at the margin of the forest." "*Papilio.*"

10. 1. 26. ♀ = **28.** Rio de Janeiro, Praia Grande, and vicinity.

14. 1. 26. ♀ = **29.** Rio de Janeiro. Valley of Laranjeiros and about São João de Carahý at Laranjeiros.

11. 2. 26. 2 ♂ = **30, 31.** Organ Mountains. (As **16, 17.**)

Bz. 18. 3. 26. 2 ♂ = **32, 33.** Rio de Janeiro. Along the Carioca Aqueduct.

16. 9. 26. 2 ♂ = **34, 35.** Santos. (As **1, 2.**) Brazilian label on **34.**

Agrees in all respects with Westwood, save that as regards either **32** or **33** he had written "1 ♂ with v[ein] of H. W. abnormal."

Pteronymia hemixanthe, Feld.

Bz. 335. II. 15. 10. 25. ♀ = **36.** Minas Geraes. "*Pap*[*ilio*]. At the Discobérto do Antonio Velho. In floribus Liatrideæ albifloræ."

907. III.+ 25. 10. 25. 2 ♀ = **37, 38.** Minas Geraes. "*P*[*apilio*]. At Discoberto, near João Pedro's house."

Specimens not sexed by Westwood. His determination agrees.

Pteronymia euritea, Cram.

Bz. 317. I. 14. 10. 25. ♂ = **39.** Minas Geraes. Discoberto. "Horta."

Bz. 907. III.+ 25. 10. 25. ♀ = **40.** Minas Geraes. (As **37, 38.**)

8. 11. 25. ♂ = **41.** Minas Geraes. "Sylvatica."

8. 2. 26. 2 ♂ = **42, 43.** Organ Mountains. (As **10–12.**)

9. 2. 26. 2 ♂ ♀ = **44, 45.** " " (As **21.**)

11. 2. 26. 2 ♂ ♀ = **46, 47.** " " (As **16, 17.**)

14. 2. 26. ♀ = **48.** " " (As **18.**)

21. 2. 26. ♂ = **49.** " " Near the R. Pacaqué, "along the road by the Rancho for $1\frac{1}{2}$ mile from the house."

18. 3. 26. 2 ♂ = **50, 51.** Rio de Janeiro. (As **32, 33.**)

Bz. 26. 11. 26. ♀ = **52.** Santos. (As **8.**)

[The fact that the two closely similar species, *hemixanthe* and *euritea*, are to be found flying together is of much interest. Their remarkable resemblance in the fresh state is well shown by the inability of this acute observer to discriminate between them. Thus no. *907* was found upon two specimens of the first-named species (**37** and **38**) and upon one of the last-named (**40**). But the group also includes another less nearly related species which Burchell failed to separate. The number *335* is found upon *P. hemixanthe* (**36**) and *Heteroscada yanetta* (**130**), indicating that they were taken for the same species on the same day visiting the same flowers, accompanied by *Pteronymia sao* (**53**) and *Dircenna dero* (**67**, **68**), both of which were recognized as distinct. Furthermore, in the note-book we find the numbers "*335* . . . (*317*)," indicating a second time that the latter, *P. euritea* (**39**), was considered to be the same as *hemixanthe*, and, in this case, the same as *H. yanetta* also.

Burchell was able to penetrate the disguise of other examples of mimicry, such as the resemblance of certain Hemiptera for the Hymenoptera; but in the remarkable synaposematic likeness between the nearly allied species of Ithomiinæ there was nothing to arrest his attention.—E. B. P.]

Specimens not sexed by Westwood. His determination agrees. He gives the dates of six additional specimens of *euritea* which cannot now be found. One of these bore the same date as **42**, **43**, two the same as **44**, **45**, one the same as **48**. One was dated 4. 11. 25 (Minas Geraes, near Nepomucena, Francisco Manoel's. The notes show that the specimen might have been captured by "some tropeiros from the rancho"). One was dated 31. 12. 25 (Rio; on the Corcovádo Mountain, and in the Valley of Laranjéiros).

Pteronymia sao, Hübn.

Bz. 338. I. 15. 10. 25. ♀ = **53**. Minas Geraes. "*Pap*[*ilio*] cum *335*." (As **36**. The whole note applies to **53**.)

Agrees in all respects with Westwood's notes.

Pteronymia nr. *artena*, Hew.

8. 2. 26. ♀ = **54**. Organ Mountains. (As **10**–**12**.)
14. 2. 26. ♂ = **55**. ,, ,, (As **18**.)

Compared with Hewitson's type of *artena* in the British Museum, **54** and **55** appear to be a less heavily marked form of the same species.

On **55** Westwood had written "*artena* but with only a minute white stigma instead of a larger 4-patch," and as regards **54** a difference in venation is alluded to and explained by reference to a rough diagram. The sexing agrees.

Pteronymia sylvo, Hübn.

12. 11. 25. ♂ = **56**. Minas Geraes. "At Mandioca."

10. 3. 26. ♀ = **57.** Rio de Janeiro.
20. 3. 26. ♀ = **58.** „ „ "Along the Carioca Aqueduct."

Specimens not sexed by Westwood. His determination agrees.

Leucothyris nr. *makrena.*

4. 11. 25. ♂ = **59.** Minas Geraes. (As **19.**)

Westwood had written "*Makrena* var. absq[ue] fascia in cellula al. ant.," but the fascia here alluded to appears to vary considerably. The sexing agrees.

Leucothyris phenomoe, Dbl. & Hew.

11. 2. 26. ♂ = **60** (Pl. VI. fig. 3). Organ Mountains. (As **16, 17.**)
14. 2. 26. ♂ = **61** (Pl. VI. fig. 4). Organ Mountains. (As **18.**)
Bz. 19. 3. 26. ♂ = **62.** Rio de Jan. "In the Valley of Catombí."
23. 9. 26. ♂ = **63.** Santos.

Burchell's labels, written in England, are reproduced to the right of the figures to which they respectively refer.

Specimens not sexed by Westwood, except **61** ♂. His determination agrees.

Leucothyris phenomoe, Dbl & Hew., n. subsp. *Burchelli.*
(Pl. VI. figs. 1 & 2.)

19. 5. 29. 2 ♂ = **64** (Pl. VI. fig. 1), **65** (Pl. VI. fig. 2). Descent of the Rio Tocantins, between S. Antonio and Itaboca. Araguay.

Burchell's labels, written in England, are reproduced to the right of the figures to which they respectively refer.

[The form *Burchelli* is at once distinguished from typical *phenomoe* by the greater development of the black markings in general, giving the insect an entirely different aspect, which will be appreciated when figures 1 and 2 on Pl. VI. are compared with 3 and 4. The black borders of both wings, including the inner margin of the fore wing, are broader in *Burchelli*, as is the black band which obliquely crosses the middle of the cell in the fore wing. But the chief difference is seen in the principal marking, which descends obliquely from the costa of the fore wing across the apical boundary of the cell. This broad black band is, in *Burchelli*, prolonged beyond the cell in the interspace between the second and third median nervules so far that its total length is about 50 per cent. greater than in *phenomoe*. Furthermore, in the former, but not in the latter, the band is continued in a much narrower form along the second median nervule until it joins the black hind marginal border near the anal angle of the wing. The development of this important marking gives it a different shape, the proximal border being markedly concave in *phenomoe*, straight or slightly convex in *Burchelli*, the concavity of the distal border being more pronounced in *Burchelli*.

The type of *Burchelli*, specimen **64** from the junction of the Rio Araguay with the Rio Tocantins, is represented in Pl. VI. fig. 1.

Distribution (based on the specimens in the Godman-Salvin Collection and the Hope Department).—*Burchelli* occurs in the northern part of Eastern Brazil, *phenomoe* in the southern part, in Argentina, and Venezuela.—E. B. P.]

On specimen no. **65** there is a scrap of paper on which Professor Westwood had written in pencil "Like *phenomoe*, but larger black band. [? is it a] black var." There is uncertainty as to the correct interpretation of the letters enclosed in square brackets. On **63** he had written a list of the dates of specimens **60–65**, and opposite 19. 5. 29 are the words "2 ind^{s}. fascia longiori." In his list of Heliconiidæ the words are "2 ind. fascia ad apicem cellulæ magis elongata." There is also a statement that he submitted a specimen to Hewitson, who probably suggested the name "*flora* black var.," which has been added in pencil. These butterflies were carefully compared with others in the Hope Department and the Godman-Salvin Collection, and it was found that this heavy type of marking is probably characteristic of a large section of the northern part of Eastern Brazil, for two similar forms captured by the late T. Belt in Maranhão exist at Oxford, while the Godman-Salvin Collection contains one similar form from Pernambuco and one from Bahia. The latter collection also contains eight specimens from Argentina, one from Rio, and a series from Venezuela. All these, together with the Burchell specimens from South-East Brazil (nos. **60–63**) and two Miers specimens (probably Rio) at Oxford, are of the ordinary form, with lighter markings, as also are six specimens in the British Museum, which, however, are without localities.

Dircenna hulda, Feld.

31. 1. 26. ♀ = **66**. Rio de Janeiro. "Valley of Catombí and a high mountain on the N.W. side of the Aqueduct."

"All of this date were from off plants, mostly up the Valley of Catumbí."

The specimen was named by Westwood *epidero.*

Dircenna dero, Hübn.

Bz. 340. II. 15. 10. 25. 2 ♀ = **67, 68** (Pl. VI. fig. 6). Minas Geraes. "*P[apilio]* cum *335.*" (As **36**, and taken with it "in floribus Liatrideæ albifloræ.")

Bz. 475. II. 16. 10. 25. 2 ♀ = **69, 70.** Minas Geraes. Discoberto. "*Papilio.*"

Burchell wrote "*475* . . . (*340*)" in his Brazilian note-book, indicating his recognition that the four specimens **67–70** belonged to the same species.

Bz. 546. I. 18. 10. 25. ♀ = **71.** Minas Geraes. Discoberto. "*Papilio.*"

28. 10. 25. ♀ = **72** (Pl. VI. fig. 7). Minas Geraes. "In the Forest on the West and on the East side of S. João de Nĕpomucéna."

29. 10. 25. ♀ = **73.** Minas Geraes. "In the Forest on the S.E. side of S. João de Nĕpomucéna."

1. 8. 27. ♂ = **74** (Pl. VI. fig. 5). Near S. Paulo: on road between Jundiahy and Capivary. "Iter faciendo."

Burchell's manuscript labels are reproduced to the right of the three figures on Pl. VI. (5–7) to which they respectively refer. That accompanying fig. 6 was written in Brazil, the others in England.

Westwood, in his complete list, mentions two individuals captured on 28. 10. 25. He also gave a list of captures on a label attached to **70**, and this agrees with the numbers and dates here recorded. It is therefore probable that the former is erroneous and that there were not more than eight individuals. On **68** Westwood had written "This is the only individual with the veins of H. W. suffused with black." The specimen is shown on Pl. VI. fig. 6, where the feature mentioned by Westwood can be clearly seen when comparison is made with figs. 5 and 7. Westwood does not note the sexes. He employs the name *dero* only.

[I have followed H. W. Bates in regarding *D. rhoëo,* Feld., as a form of *dero,* differing "only in the greater breadth and irregularity of the dusky black border of the hind wing, especially in the female, and in the nervures which traverse the disk of the same wing being of a yellowish colour instead of black. In the female the discocellulars and the terminal parts of the median branches are accompanied by dusky streaks." *D. dero,* on the other hand, "has the hyaline disks of the wings always clearer and the black borders more sharply defined than *D. rhoëo*. *D. dero* is peculiar to South-East Brazil, and is not found in the Amazon region, where the local form *D. rhoëo* takes its place. I have seen specimens of *D. rhoëo* also from the neighbourhood of Bogotá, New Granada. It flies in thinned parts of the forest in Ygapó, or flooded districts, in the dry season." (Trans. Linn. Soc. Lond. vol. xxiii., 1862, pp. 520, 521.)

I have quoted from Bates in full because, if his information be correct, we have here certain evidence of change in a local subspecific form within the narrow limits of five-and-twenty years. *All* Burchell's specimens come from South-East Brazil, and only two of them, viz. nos. **67** and **74** (Pl. VI. fig. 5), can be regarded as *dero*. All the rest are examples of the heavily marked yellowish hind-winged *rhoëo* (compare figs. 6 and 7 with 5). It would be unwise to build too much on the conclusion that a change has occurred, especially as the interval cannot be more than about twenty-five years, inasmuch as Bates, when he wrote in 1861, was dealing with experiences which went back many years. But if his statements that "*dero* is peculiar to South-East Brazil" and that *rhoëo* takes its place to the north be confirmed, we are compelled to admit that a rapid change has occurred in the former area and that in 1825 *rhoëo* was dominant there. We should be obliged to regard the biological history as traversing the history laid down by systematics; for *dero*, with the older name, would then be but a very modern local form of the more ancestral although more recently named *rhoëo*. Should further enquiry support Bates's statement, it seems probable that synaposematic grouping has directed the trend of evolution—that resemblance to more heavily marked transparent Ithomiine associates in the north has been an advantage which has caused the persistence of the pronounced black markings of *rhoëo*, while *dero* has been selected as an approach towards less heavily marked members of Ithomiine groups in the south.

Ithomiine butterflies with a general resemblance to one another have a marked tendency to fly together, as Bates points out in this very species (*l. c.* p. 521). It has already been found in the case of *Leucothyris phenomoe* that the northern part of Eastern Brazil is characterized by a more heavily marked form (*Burchelli*) than the southern part (see p. 315). In many other cases the tendency towards a reduction of the black markings of transparent and black Ithomiinæ in South-Eastern Brazil has been shown in this memoir. It was apparent in *Pseudoscada* sp. nr. *utilla* (**15**), *Ithomia agnosia* (**22–24**), and *Pteronymia* nr. *artena* (**54, 55**). This reduction of black and increase of transparency occurring independently in many genera is probably due to selection in the direction of synaposematic or Müllerian resemblance.—E. B. P.]

Ceratinia eupompe, Hübn.

29. 10. 25. ♀ = **75.** Minas Geraes. (As **73.**)
4. 11. 25. ♂ = **76.** Minas Geraes. (As **19.**)
8. 2. 26. ♂ = **77.** Organ Mountains. (As **10–12.**)
9. 2. 26. 3 ♀ = **78–80.** „ „ (As **21.**)
11. 2. 26. ♀ = **81.** „ „ (As **16, 17.**)
12. 2. 26. 2 ♀ = **82, 83.** Organ Mountains. "By the River Pacaqué."
No data. ♀ = **84.**

Westwood's notes and label agree in including an additional specimen dated 14. 2. 26 (Organ Mountains). In other respects his MS. agrees with the data here recorded. The determination agrees, but sexes are unnoted.

Ceratinia euryanassa, Feld.

Bz. 563. I. 19. 10. 25. ♀ = **85.** Minas Geraes. Discoberto. "*Pap*[*ilio*]."
10. 11. 25. ♂ = **86.** Minas Geraes. Discoberto.
26. 9. 26. 5 ♂ = **87–91,** 4 ♀ = **92–95** (**92** and **95** bear Brazilian labels). Santos. "In a walk to Montserrat." "These *Papiliones* very plentiful in the woods": this referring of course to all specimens taken.
No data. ♀ = **96.**

Westwood gives two more individuals captured 26. 9. 26, and omits the date 10. 11. 25. The latter may be a slip or may be due to the later transposition of labels. In other respects and in the determination Westwood's notes agree, but sexes are omitted.

Ceratinia dæta, Boisd.

Bz. 330. II. 14. 10. 25. ♂ = **97.** Minas Geraes. Discoberto. "*Papilio* (*Horta*)."

It is probable that this specimen should bear the number *336* and that it was captured with **98** on Oct. 15th. See note on **108.**

Bz. 336. II. 15. 10. 25. ♂ = **98.** Minas Geraes. "At the Discoberto do Antonio Velho. *Pap*[*ilio*]. In Sylvis."
Bz. + 12. 11. 25. ♂ = **99.** Minas Geraes. "At Mandioca." "*Langsdorfi*" is written on the Brazilian label.

12. 2. 26. ♂ = **100.** Organ Mountains. (As **82, 83.**)
21. 2. 26. ♀ = **101.** " " (As **49.**)
No data. ♀ = **102.**

The numbers and dates agree with Westwood's notes. Westwood's determination was *Ithomia melphis,* a synonym of *dœta.* The sexes were unnoted.

Ceratinia Barii, Bates.

26. 5. 29. ♂ = **103.** Rio Tocantins, N. of Itabóca, below the Falls of Guaríba. "Sylva."
Brit. Mus. "*Ninonia* Hew. var. *barii.*"
Named by Westwood *Ithomia ninonia.* Sex unnoted.

Mechanitis polymnia, Linn.

30. 10. 25. (Date probably erroneous, and should be 3. 3. 28 or 10. 12. 29. See below.) ♀ = **104.** Minas Geraes. "(In the Forest.) On the N.E. side of the arraial of São João de Něpomucéna." Locality probably erroneous, and should be Goyaz or Pará.
5. 3. 28. ♂ = **105.** Goyaz. "Caught by the Rio Vermelho, near the Carioca Aqueduct, by 'C'." C refers to Congo, Burchell's native assistant.
7. 6. 29. ♀ = **106.** Rio Tocantins. S. of Pará, Sta. Anna.
7. 7. 29. ♀ = **107.** Pará. "Eastward of my house."

[**105** was submitted to the late Mr. Osbert Salvin on Jan. 16, 1896. He considered it to be the "Guiana form of *Mechanitis polymnia.*" Although without the black hind wing which is so common in Guiana, the black markings are strongly developed on the secondaries of all the three female specimens, resembling many of the individuals from Surinam &c. The occurrence of such strongly marked forms so far to the south as Goyaz was a surprise to me. The somewhat faint but distinct subapical light bar of the fore wing, which is characteristic in Guiana, is evanescent or absent in these specimens. —E. B. P.]

Westwood records two additional specimens, captured 3. 3. 28 (Goyaz. "Caught in the town by the Rio Vermelho; by C[ongo]") and 10. 12. 29 (Pará. "Suburbanæ"). On the other hand, he does not give the date now affixed to **104,** viz. 30. 10. 25. It is probable that a label has been transposed in the manipulation of the specimens, and that **104** should bear the date 3. 3. 28 or 10. 12. 29. In other respects and in the determination Westwood's notes agree with these records. The sexes were unnoted.

Mechanitis lysimnia, Fabr.

Bz. 336. II. 15. 10. 25. ♀ = **108.** Minas Geraes. (As **98.**)

[It is probable that this specimen should bear the number *330* and that it was one of the "*Papilio* (*Horta*)" captured on Oct. 14 at Discoberto. Burchell probably accidentally interchanged its label with that of **97**, either originally in Brazil or later when he set the specimens. The evidence is as follows:—The Brazilian note-book shows that two individuals believed by Burchell to be one form "*Papilio* (*Horta*)," captured on Oct. 14, were numbered *330*, and that two others also believed to be one form, taken on Oct. 15 "in Sylvis," were numbered *336*. Professor Westwood's list, repeated on a specimen of each species, agrees with the existing specimens in showing one *336* on *Mechanitis lysimnia* (**108**) and the other on *Ceratinia dæta* (**98**). One *330* is on *dæta* (**97**) and the other is now missing, but both of Westwood's lists agree in recording that it was affixed to a specimen of *lysimnia* which cannot now be found. Either Burchell twice paired *dæta* and *lysimnia* as the same form on consecutive days or he accidentally interchanged one *330* with one *336*. The following fact confirms the opinion that he made the latter mistake and not the former. A few days later, on Oct. 19th, we find in his note-book the following entry: "*563 . . .* (*336*)," indicating his belief that the single specimen denoted by the first number was the same species as the two individuals denoted by the second. Now *563* is *Ceratinia euryanassa* (**85**), a species which closely resembles *C. dæta*, but only bears a very rough likeness to *M. lysimnia*. It is therefore probable that *330* was intended for two specimens of *M. lysimnia* and *336* for two of *C. dæta*.—E. B. P.]

4. 11. 25. ♂ = **109,** 2 ♀ = **110, 111.** Minas Geraes. (As **19.**)

10. 11. 25. 2 ♂ = **112, 113.** Minas Geraes.

6. 12. 25. ♂ = **114.** Rio de Janeiro. "In an excursion to the Summit of the Corcovado by the road by the Convent of Sta. Theresa, and along the Aqueduct."

31. 1. 26. ♀ = **115.** Rio de Janeiro. (As **66.**)

9. 2. 26. ♀ = **116.** Organ Mountains. (As **21.**)

12. 2. 26. ♀ = **117.** " " (As **82, 83.**)

16. 2. 26. ♀ = **118.** " " Near River Pacaqué.

21. 2. 26. ♀ = **119.** " " (As **49.**)

28. 2. 26. ♀ = **120.** "On the Rio Magé."

1. 3. 26. ♀ = **121.** "Along the River Magé, upwards to the Fazénda da Lagóa."

7. 3. 26. ♀ = **122.** Rio de Janeiro. "At Catombí."
Bz. 9. 3. 26. ♂ = **123.** Rio de Janeiro.
10. 3. 26. ♂ = **123** A. Rio de Janeiro.
15. 9. 26. ♂ = **124.** Santos. "*Papil*[*io*]. At edge of the Forest, at S. Bento Monastery."
Bz. 14. 12. 26. ♀ = **125.** Cubatão, Lower Slopes of the Sérra.
16. 12. 26. ♀ = **126.** Cubatão. "Middle Part of the ascent up the Sérra."
4. 3. 28. ♀ = **127.** Goyaz. (As **105.**)

Westwood's name and list agree, except that he includes two more specimens which cannot now be found—one distinguished by the number *330*, and a second specimen captured with **116** on 9. 2. 26. Sexes unnoted.

Aeria olena, Weym.

Bz. 579. I. 21. 10. 25. ♀ = **128.** Minas Geraes. "In a rossa at Discoberto, and along a channel (on the margin of the Forest) which conducts water to the house." "*Pap*[*ilio*]."

Named *I. elara* in Westwood's list, which otherwise agrees. Unsexed.

Heteroscada gazoria, Godt.

10. 11. 25. ♂ = **129.** Minas Geraes.

Westwood's list agrees. He calls the specimen "*Napeogenes?*" in list, but on the insect itself he had written "*Yanina*, Hew. f. 116, pl. 19, vol. ii. Hew. Exot. butt. *Euritea*, Dry., not Cramer." Unsexed.

Heteroscada yanetta, Hew.

Bz. 335. II. 15. 10. 25. ♂ = **130.** Minas Geraes. (As **36.**)

Agrees with Westwood's list. Named *Napeogenes*. Unsexed. "Coll. Hew. but not named" in pencil indicates an unsuccessful reference to his friend Hewitson.

Heteroscada fenella, Hew.

29. 10. 25. ♀ = **131.** Minas Geraes. (As **72.**)

Agrees with Westwood's list "Lent. Hewitson." The name "*fenella*, H." written in pencil by Westwood across Burchell's label. Unsexed.

Melinæa paraiya, Reak.

8. 2. 26. ♂ = **132.** Organ Mountains. (As **10–12.**)

Agrees with Westwood's list, where, however, it is named as a var. of *egina.* "*Mech*[s]. *egina*" is written on a label attached to the specimen. Unsexed.

Melinœa egina, Cram.

7. 7. 29. ♂ = **133.** Pará. (As **107.**)
28. 7. 29. ♂ = **134.** Pará.
Bz. 26. 1. 30. ♂ = **135.** Pará.
Agrees with Westwood's list. Unsexed.

Melinœa ethra, Godt.

8. 2. 26. ♂ = **136.** Organ Mountains. (As **10–12.**)
Agrees with Westwood's list. Named by him *Mech. ethra.* Sex unnoted.

Methona themisto, Hübn.

14. 7. 29. ♂ = **137.** Pará.
31. 7. 29. 2 ♂ = **138, 139.** Pará.
Westwood's list indicates the former existence of a fourth specimen captured at Pará on 30. 7. 29. His name agrees. Sexes unnoted.

[To be continued.]

XXXVIII.—*Note on an undescribed Weasel from the Atlas Mountains, and on the Occurrence of a Weasel in the Azores.* By G. E. H. Barrett-Hamilton.

Through the courtesy of the Director and Officials of the British Museum of Natural History, I am enabled to publish a short description of a weasel which is clearly distinguishable from the forms recognized by me in my paper published in this Journal in January 1900.

This form, which may be known as *Putorius nivalis atlas*, is remarkable for its size and robustness, in which it is perhaps only excelled by the true *P. n. africanus* of Desmarest. On the other hand, the line of demarcation between the colours of the upper and under surfaces, a highly characteristic feature in the weasels, is widely different from that of *P. n. africanus* and other forms with a similar arrangement, such as *P. n. numidicus*, *P. n. boccamela*, and *P. n. subpalmatus*, and allies it to *P. n. ibericus* and *P. n. siculus*. In its tail, however, which carries a distinct terminal "pencil" of dark brown hairs, it resembles *P. n. numidicus* and *P. n. africanus.*

Colour.—Above between "mummy-brown" and "Mars brown" *, the under-fur a shade lighter. Below, except the lower surface of the tail, but including the inner and lower surfaces of the fore legs, the soles of the fore feet, and the inner and lower surfaces of the hind legs almost down to the ankles, white slightly washed with yellow. The line of demarcation is decided, and runs on each side directly from a point slightly anterior to the angle of the mouth to its debouchment at the shoulders and thence to the hind legs. The upper surfaces of all four feet are white for a distance of about 13 and 11 mm. in the case of fore and hind feet respectively from the base of the claws. In the hind feet the white colour only just reaches the soles at their external borders. The tail is brown above and below, and terminates in a moderately developed "pencil" of longer hairs of a deeper shade than the rest of the upper surface. There is no trace of white on the ears.

The *dimensions* of the hind foot and ear, both taken from the type specimen when in spirit, are 42 and 21·5 mm. respectively. No record was taken of the lengths of either head and body or tail in the flesh, but the latter reaches a length, including the terminal hairs, of 98 mm. in the dried skin.

The *skull*, although strongly built, massive, and with sagittal and lambdoid crests well developed, is less so than that of *P. n. africanus* of the Azores. The postorbital processes are moderately prominent, the nasal region moderately broad and depressed anteriorly, and the posterior narial aperture narrowed. The incisive foramina are elongated, having a length of about 2 mm., and recall those of the *P. ermineus* group. The following are the dimensions (in millimetres) of the type:—Greatest length 48; basal length 44·5; greatest breadth at zygoma 26; palatal length 20.

The *type*, a female, no. 2. 1. 7. 4 of the British Museum Collection, from the Atlas Mountains, Morocco, was presented by Mr. E. G. Meade-Waldo.

Opportunity may here be taken to point out that the specimens recently received by the British Museum bear out the opinion, some time since expressed by Professor J. V. Barboza du Bocage †, that Desmarest's type specimen of

* Names of colours printed in inverted commas are taken from Mr. Robert Ridgway's 'Nomenclature of Colors,' 1886.

† Jornal de Sci. Math., Phys. e Nat. ser. 2, no. xiii. (Lisbon, 1895) pp. 24–27.

P. africanus came, not from Egypt, but from the island of St. Thomas, in the Gulf of Guinea, where there occurs a form of weasel indistinguishable from the above type. The name *africanus* will therefore be most naturally applied to the weasel of St. Thomas and to a similar form of which Mr. W. R. Ogilvie-Grant recently procured a specimen at Terceira, in the Azores, leaving the name *subpalmatus*, Hemprich and Ehrenberg, the exact allocation of which has long been uncertain, for the weasels (formerly known as *P. africanus*) of Egypt and Malta. The true *africanus* is now shown to be a far larger and stronger animal than *P. n. subpalmatus*, and it possesses a far more distinct caudal "pencil" of dark brown hairs. It has a wavy line of demarcation, and the much restricted white colour of the under surface is strongly washed with deep "buff-yellow." The dimensions of the Azorean specimen reach, for the animal measured in the flesh, head and body 266, tail 116, hind foot 44, and ear 18 mm.; and for the skull, greatest length 49, basal length 45·5, greatest breadth at zygoma 28, and palatal length 21 mm. It was caught in a rat-trap, which had been set for a buzzard.

The occurrence of a weasel on the Azores must be regarded as a fact of considerable interest from the point of view of the student of geographical distribution, still more so as the animal is quite distinct from any known form inhabiting Europe or the adjacent portions of Africa. That a similar and undistinguishable weasel should be found on the remote Island of St. Thomas is somewhat surprising, but it seems a plausible hypothesis that the latter stock may have been derived by introduction from the former.

BIBLIOGRAPHICAL NOTICE.

Report on the Sea Fisheries and Fishing Industries of the Thames Estuary. Prepared by Dr. James Murie. London: 1903. Printed by order of the Kent and Essex Sea Fisheries Committee.

This report reflects great credit on the enthusiastic naturalist who, almost unaided, has accumulated in its pages an extraordinary mass of original and well-arranged information. Much has been done of late years for the improvement of the scientific aspect of our sea fisheries, but the Thames estuary had been entirely neglected.

After introducing his readers to the physical formation of the Thames estuary and to the history of Leigh-on-Sea, the fishing-station where his observations have been made, the author deals successively with the various members of the fauna which are in some way or other of commercial importance—Seals and Cetaceans, Food-fishes, Oysters, Mussels and other Molluscs, Shrimps, Lobsters, and Crabs, all receiving due notice from both the life-history and economical points of view. Some of these subjects are treated with a profusion of details, much of which is entirely original, which raises Dr. Murie's contribution to a high scientific level. The compilation of a vast amount of scattered information respecting rare occurrences will prove a great boon to workers on the distribution of fishes on our coasts—a subject on which much remains to be done.

The chapter dealing with the Herring family (Clupeidæ) is a most important piece of work, and the contribution therein on Whitebait adds greatly to our knowledge of a question which has been frequently discussed before and since Dr. Günther settled the question by ascertaining the Whitebait of the Thames to consist mainly of young herrings. Dr. Murie has taken great pains to ascertain the nature of the mixed series of small fish &c. which are sent collectively to the market under this commonly known appellation, and he has added 20 to the 11 species which had already been listed by Frank Buckland in 1879.

In dealing with the Weavers (*Trachinus*), so notoriously dreaded by whitebaiters and shrimpers for their poisonous stings, the author contributes a useful footnote recommending the best treatment in case of accident.

Among the more remarkable fishes mentioned in the report, *Aphia pellucida*, the White Goby, deserves special attention. It was supposed to be rare in the district, but Dr. Murie finds it astonishingly numerous, especially in March and April. According to Prof. Collett, who has made a special study of this curious fish in the Christiania Fjord, the adults die after breeding, and therefore accomplish their life in the course of a year. Dr. Murie throws doubt on this conclusion, for reasons which, however, are reserved for a later communication.

In concluding this brief notice, we congratulate the Kent and Essex Fisheries Committee on having had the good fortune of bringing out a little book which will render such signal service, and we look forward to the publication of further instalments of the series of Reports of which the first is now before us.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 18th, 1903.—Sir Archibald Geikie, D.C.L., D.Sc., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. 'Notes on some Upper Jurassic Ammonites, with special reference to Specimens in the University Museum, Oxford.' By Miss Maud Healey.

In the course of re-arranging the Upper Jurassic fossils in the

Oxford University Museum, the attention of the Authoress has been called to the large amount of prevailing misconception with regard to Sowerby's species *Ammonites plicatilis* and *Am. biplex*. The type-specimen of *Perisphinctes plicatilis* (Sow.) is refigured and described. It is in the form of a cast, but only an indefinite statement exists as to the locality from which it was derived. It appears to be an Upper Corallian form, and is usually taken as the zone-fossil of that horizon. Sowerby's two figures of *Perisphinctes biplex* represent different specimens, one of which is dismissed from consideration. The other, probably from a Kimmeridge-Clay nodule found in the Suffolk Drift, is refigured and described. The Authoress considers that it would be wisest to abandon the name altogether, or at least to restrict it to the abnormal specimen to which it was first attached. The original specimen of *Perisphinctes variocostatus* (Buckland) came from the so-called Oxford Clay at Hawnes, 4 miles south of Bedford; but the Authoress gives evidence in favour of her belief that it was really derived from the Ampthill Clay. Sowerby's *Ammonites rotundus* is the last species figured, and it is doubtfully identified as a variety of *Olcostephanus Pallasianus* (d'Orb.). It was derived from the Kimmeridge Clay of Chippinghurst, $6\frac{1}{2}$ miles south of Oxford, and is the zone-fossil of the Upper Kimmeridge Clay.

2. 'On the Occurrence of *Edestus* in the Coal-Measures of Britain.' By Edwin Tulley Newton, Esq., F.R.S., V.P.G.S.

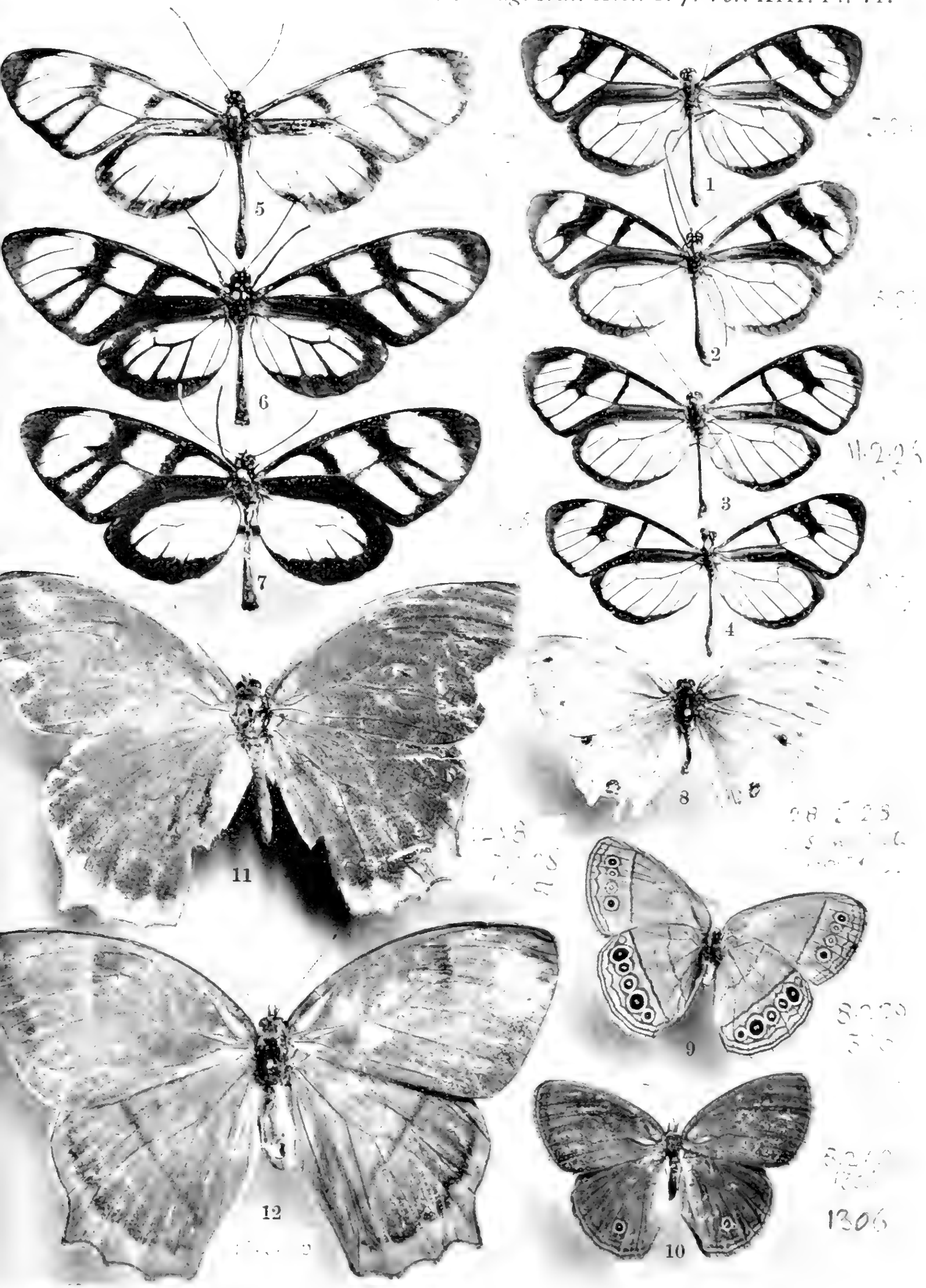
This genus was originally described from the United States, and was afterwards recognized in beds of similar age in Russia and Australia. The genus was afterwards placed with *Helicoprion* and *Campyloprion* in the family Edestidæ. The specimen described in the present paper was obtained by Mr. J. Pringle from one of the marine bands which occurs between the 'Twist Coal' and the 'Gin-Mine Coal,' in the Smallthorn sinking of Messrs. Robert Heath & Son's pits at Nettlebank (North Staffordshire). Several other marine bands, chiefly met with during the sinking of shafts in this coalfield, have been studied by Mr. J. T. Stobbs, who called the attention of the Geological Survey to the exposure from which this specimen was obtained. The specimen is a single segment of a fossil very closely resembling *Edestus minor*, and consists of an elongated basal portion, bearing at one extremity a smoothed, enamelled, and serrated crown. A description of the fossil shows that it is not to be referred to any existing species, and a new name is given to it. While it seems most in accordance with present knowledge to regard the 'spiral saw' of *Helicoprion* as the enrolled, symphysial dentition of an Elasmobranch, possibly allied to the Cestracionts, it does not seem nearly so probable that the forms referred to *Edestus* are of the same nature. In the opinion of the Author the latter are more likely to be dorsal defences. The paper concludes with a bibliography of the subject.

January 6th, 1904.—Sir Archibald Geikie, D.C.L., D.Sc., Sec.R.S., Vice-President, in the Chair.

The following communication was read:—

'Implementiferous Sections at Wolvercote (Oxfordshire).' By Alexander Montgomerie Bell, Esq., M.A., F.G.S.

This section shows the following beds:—(1) Oxford Clay; (2) old surface, in which are pits or troughs chiefly filled with gravel and enveloped in weathered clay; (3) a large river-bed, containing gravel at the base, and layers of clay above; (4) Neolithic surface-layer, 2 feet thick. The gravel of the river-bed contains quartzite-pebbles, some of exceptional size, and is covered by a thin lenticular layer of peat and sand, yielding thirty flowering-plants and many mosses; the clays over this have probably been formed in a lake, possibly due to a beaver-dam. In the gravel-bed are found implements formed of flint quarried from the Chalk, or of quartzite from pebbles of the Northern Drift, all remarkable for their size, beauty, and freshness, together with the remains of large mammals, including the mammoth. The old surface, from which the river-bed has been eroded, has also yielded implements associated with quartzites, quartz-pebbles, and lydianstone, gravel from the Thames Valley, limestone-pebbles, Oolitic fossils, and sand. This deposit is regarded as remanié from the Northern Drift, probably laid down under the action of ice, as shown by the flask-like shape of the pits, the vertical position of some of the pebbles, and the jamming-in of masses of sand, probably in a frozen condition. Further, the Oxford Clay beneath the surface is weathered and shaken to a depth of 10 or 12 feet, except where cut off by the descending depth of the river-bed. The implements are small, ordinary in shape, and made of flint, not quarried, but mostly taken from the Drift, and they are much weathered, stained, and patinated. The occurrence of an older set of implements, differing so markedly from those of the river-drift, leads the Author to explain the peculiar implementiferous drift of Iffley as containing implements of two kinds and two dates. Those that are unweathered are contemporaneous with the deposit, and like those of the Wolvercote river-bed; while those that are stained with ochre, or deeply patinated, have been derived, like the Oolitic fossils, Tertiary conglomerate, quartzites, and volcanic rocks, from an older deposit. The Author believes that the frequent occurrence of weathered and unweathered implements in a single deposit may be explained generally in this way; and he further infers that the time between the Drift and the River-bed was prolonged, and that the interval may have been as long as that which separates the epoch of the River-bed from the present day, his evidence being simply the patination of the flints. In conclusion the Author suggests that there are three classes of implement-bearing drifts, the ice-drifts being the earliest and the river-drifts the latest, while the wash-drifts may belong to more than one stage.



Alfred Robinson, photo.

André & Sleigh, Limited.

All the figures are the natural size.

Butterflies Captured in Brazil,

By W. J. BURCHELL (1825–29), with the corresponding manuscript labels.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 77. MAY 1904.

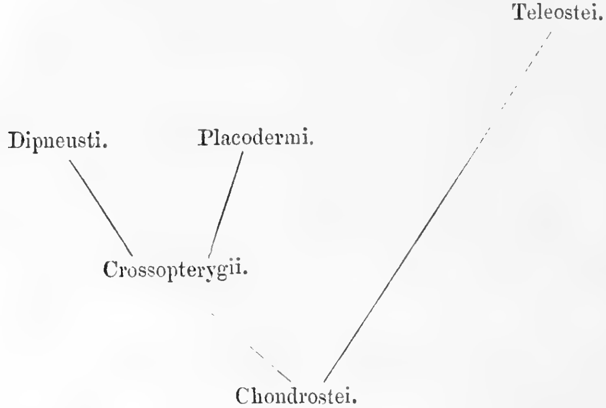
XXXIX.—*The Phylogeny of the Teleostomi.* By C. Tate Regan, B.A.

[Plate VII.]

In the following paper I have tried to give an account of the phylogeny of the main groups of the Teleostomi, based on the evidence of the available morphological data. In forming my conclusions I have been helped by criticism and advice from Mr. Boulenger and Dr. W. G. Ridewood, to both of whom I gratefully express my acknowledgments. I trust that the reasons given for differing from the classifications hitherto proposed will prove sufficient: the aim of this paper is constructive rather than destructive, and I have not thought it necessary in every case to give all the available arguments against theories of relationship which I do not accept, but have rather tried to establish the ideas of phylogeny which are here put forward on a sound morphological basis.

The class Pisces, as usually understood, comprises Vertebrates with jaws, with gills supported by visceral arches, and with paired limbs in which the endoskeletal supports have not yet attained the pentadactyle arrangement of higher Vertebrates. Two subclasses may be recognized—Chondropterygii and Teleostomi. The latter are distinguished by the development of membrane-bones, including an operculum * covering the chamber into which the gill-clefts open.

The Teleostomi may be divided into five orders, the relations of which are expressed in the following diagram:—



The Chondrostei and Crossopterygii correspond to the groups usually so named; the Dipneusti comprise the Sirenoidei only; the Placodermi include the Arthrodira, Antiarcha, and Osteostraci; and to the Teleostei the Ganoidei Holostei are added.

These orders may be defined as follows:—

Order 1. CHONDROSTEI.

Median fins with the dermal rays in greater number than their endoskeletal supports, which are typically in two principal series, baseosts and axonosts, with an outer series of small marginal cartilages. Caudal typically completely heterocercal (rarely abbreviate heterocercal or diphycercal). Paired fins not notably lobate. Pectoral baseosts articulating with an anterior coraco-scapular cartilage and a posterior metapterygium †. Ventrals with a well-developed series of baseosts articulating internally with a series of axonosts, which may be separate or more or less completely fused. Hyostylic. Hyomandibular without posterior process for

* In some specialized forms (*e. g.* Aspredinidæ) the operculum is wanting.

† It is impossible to say whether in the most primitive Teleostomi the metapterygium was already developed or whether it was represented by a series of separate axonosts.

the articulation of the operculum; symplectic not ossified. Branchiostegals not attached to epihyal and ceratohyal. Gular plates, if present, not specially enlarged. Clavicle distinct from the cleithrum. Notochord persistent. Pericardium * communicating with the cœlom.

Order 2. CROSSOPTERYGII.

Median fins with the dermal rays often in greater number than their endoskeletal supports, which are often in two series. Caudal heterocercal or diphycercal. Pectorals lobate, with metapterygium often segmented. Ventrals lobate or not, with supports variously arranged. Hyostylic. Branchiostegals replaced by a pair of large gular plates. Clavicle distinct from the cleithrum. Vertebral column variously developed.

Order 3. DIPNEUSTI.

Median fins with the dermal rays in greater number than their endoskeletal supports, which are in two series. Caudal heterocercal or diphycercal. Paired fins acutely lobate, with endoskeletal supports arranged as a segmented axis with or without lateral branches. Autostylic, the palato-quadrate being fused with the cranium and the hyomandibular reduced or absent. Sometimes a pair of large gular plates, but branchiostegal rays never present. Clavicle not distinct from the cleithrum. Notochord persistent.

Order 4. PLACODERMI.

Median fins membranous, without dermal rays, consisting of a single dorsal, supported by regular series of baseosts and axonosts, and a heterocercal caudal. Pectoral fin, if functional, represented by a jointed Arthropod-like limb, with internal muscles and external dermal plates, sometimes reduced to a fixed spine, or absent. Ventral fin, if present, with a series of baseosts and a single large axonostal cartilage. ? Autostylic. Notochord persistent. Usually a well-developed dermal armour.

Order 5. TELEOSTEI.

Median fins with the dermal rays equal in number to their endoskeletal supports, which are typically in one series, the

* I have taken this character from Bashford Dean, 'Fishes Living and Fossil,' p. 260.

baseosts being either small or absent. Caudal abbreviate heterocercal, homocercal, or diphycercal. Paired fins usually not lobate. Pectoral metapterygium sometimes well developed and serving for the articulation of the posterior baseosts, more often reduced and apparently forming the first of the baseost series. Ventral with the dermal rays directly attached to a single basal bone, the baseosts rudimentary or absent. Hyostylic. Hyomandibular with a posterior process for the articulation of the operculum; symplectic ossified and usually suturally united to the quadrate. Branchiostegal rays attached to the epihyal and ceratohyal. No paired gular plates. Clavicle not distinct from the cleithrum. Vertebral column variously developed. No communication between pericardium and cœlom.

It need hardly be pointed out here that I cannot expect the characters used in the above ordinal definitions to prove constant in every case. Experience shows that, however well defined groups may seem to be, as our knowledge of them becomes more complete annectent forms come to light, and it is self-evident that if we were acquainted with all the forms which have existed we should have a perfect phylogenetic arrangement, but no division into groups. Consequently the generalizations which I have made may or may not be applicable to those unsatisfactorily known extinct forms (*e. g.* Catopteridæ) which can only be provisionally assigned to a position in the system.

Chondrostei.

The Chondrostei, which have been regarded by some as modified Crossopterygii, are undoubtedly the most generalized of all Teleostomi.

The ventral fins of *Polyodon*, *Acipenser*, and *Scaphirhynchus* have been well described and figured by Thacher * in 1877, and also by Davidoff † in 1879, the former of whom regarded their structure as most important evidence of the truth of his theory of the similar origin of the median and paired fins. This view was also accepted by Bridge ‡, who, in 1878, referring to *Polyodon*, wrote:—"The evident formation of the ventral fins by the coalescence of a series of

* Tr. Connect. Ac. iv. 1877, p. 234, pls. i. & ii.

† Morph. Jahrb. v. 1879, p. 450, pl. xxviii. See also Wiedersheim, 'Gliedmassenskelett,' p. 60 (1892).

‡ Phil. Trans. clxix. 1878, pp. 683–734.

originally distinct cartilaginous rays is clearly indicative of a more primitive condition of these structures than can be found in any other living vertebrate animal."

The Chondrostean ventral fin having been thus described as principally composed of a series of basal cartilages (baseosts) supporting the dermal rays, articulated internally to another series of cartilages (axonosts) which exhibited some fusion anteriorly, it was inexcusably careless of Cope * to propose a classification ignoring this, his order Podopterygia (*i. e.* Chondrostei) being characterized as possessing median fins with numerous axonosts, pectoral *without axonost* and rudimentary baseosts, and ventral with *one axonost* and several baseosts. In Smith Woodward's classification †, which is based on that of Cope, the structure of the paired fins in the Chondrostei has also remained unappreciated. Finally Traquair ‡, in discussing the evolution of fishes, whilst paying considerable attention to the paired fins of Crossopterygii and Dipneusti, does not even think them worthy of notice in the comprehensive order Actinopterygii. So that it would almost seem as if the structure of the paired fins in the Chondrostei, of the highest importance in any discussion as to the affinities of that order and of the very greatest interest as evidence in favour of the lateral fin fold theory, although well known to the morphologists, is in danger of being forgotten by the systematists.

The ventral fins of *Psephurus gladius* are even more primitive than those of *Polyodon* §, and as they have not yet been described, so far as I am aware, I propose to do so and to compare their structure with that of the anal and pectoral fins. All three fins—pectoral, ventral, and anal—strongly resemble each other in external appearance, being extended and composed of numerous articulated dermal rays, at the base of which there is in each case a similar muscular lobe projecting beyond the body-wall, and in which the series of baseosts is imbedded.

On dissection the anal fin is seen to be supported by a series of cartilages, baseosts, 21 in number, which articulate internally with a similar series of axonosts. The latter,

* Am. Nat. xxi. 1887, p. 1017.

† Cat. Foss. Fish. (4 vols. 1889–1901) and Vert. Palæont. (1898).

‡ Presidential Address to Zool. Section of Brit. Assoc. (1900).

§ St. George Mivart, in 1879 (Tr. Z. S. x. p. 457), described and figured the anal fin of *Polyodon* as the ventral, the mistake being due to a wrongly labelled specimen in the Museum of the College of Surgeons, but it is curious to note that on receiving Thacher's paper he did not realize this, but supposed the difference to be due to individual variation.

however, are reduced in number to 18, owing to the fusion of the first 3 and the next 2. The ventral fin is supported by a series of 12 baseosts, exactly similar to those of the anal, which also articulate with a series of axonosts, which in this case are 8 in number, owing to the fusion of the anterior 5. In both anal and ventral the cartilages of the "baseost" series, or radials, show a tendency to segment into 3, thus forming proximal, median, and distal series of segments, whilst external to the last, and completely overlapped by the dermal rays, are a series of short "marginal" cartilages. In the specimen described the anal fin is 23 mm. in length and is composed of 70 dermal rays supported by 21 baseosts, whilst the ventral is 11 mm. in length and is composed of 38 rays supported by 12 baseosts, a proportionate correspondence sufficiently close to be remarkable.

I would submit, then, that the extremely similar structure of the anal and ventral fins in *Psephurus* can only be explained on the theory of a directly similar origin, and that the theory that the structure of the anal is primitive, whilst that of the ventral is derived in some way from a biserial archipterygium, is fantastic and entirely unsupported by evidence. Thus, in an actual living species we have clearer and more complete evidence of the similar origin of the median and paired fins than in the extinct *Cladodus*, which has been considered so important.

The pectoral fin of *Psephurus* is more specialized than the ventral; the baseosts are 7 in number, the anterior 3 being attached to the large coraco-scapular cartilage, which represents the fused anterior axonosts and which underlies a membrane-bone, the cleithrum. The posterior axonosts are also fused to form a single cartilage, the metapterygium. In other living Chondrostei the pectoral fin is very similar to that of *Psephurus*, whilst in the ventral fin the extent of fusion of the axonosts and the number of the baseosts show some variation. In the Palæoniscidæ, so far the earliest and most generalized Chondrostei known, the ventral fins often had an extended * base and were composed of numerous rays. In one genus, the Liassic *Coccolepis*, a series of baseosts have been discovered. The axonosts have not so far been distinguished, but there is every justification for believing that in this generalized family fins so similar to those of *Psephurus* had their supports arranged in the same primitive manner. As regards the pectorals, the coraco-scapular cartilage with

* It is interesting to note that in the Devonian genus *Cheirolepis* the ventral fin is longer than the anal.

the overlying cleithrum must be regarded as typical of the ancestral Teleostome; whether the fusion of the posterior axonosts also is corelated with this, or whether the metapterygium was represented in the early Teleostomi by a series of separate axonosts, there is no evidence to show, but the structure of the pectoral in all Teleostomi is easily explicable as a modification of that of *Psephurus*.

In the structure of their median, as well as of the paired fins, the Chondrostei are essentially primitive, and the condition of the vertebral column also bears witness to their low position. It appears to me fairly well established for both living forms and for those extinct ones which undoubtedly belong to this order that the hyomandibular does not develop a posterior process for articulation with the inner face of the operculum, as is the case in all Teleostei.

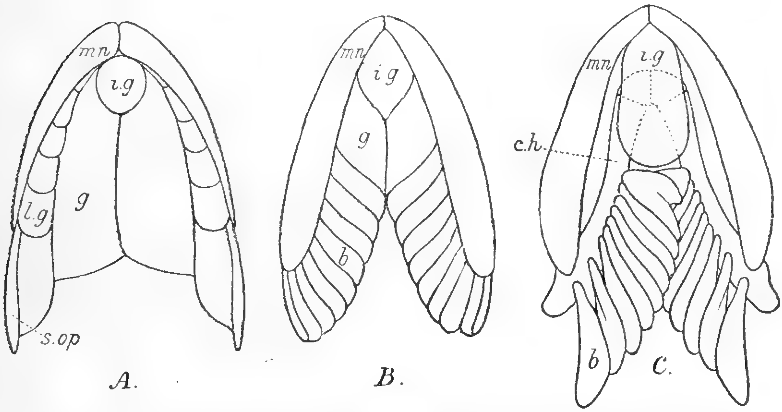


Fig. 1.—Diagrams to show the arrangement of the branchiostegals and gular plates in a typical Crossopterygian, Chondrostean, and Teleost. A. *Rhizodopsis sauroides* (after Traquair); B. *Rhabdolepis macropterus* (after Traquair); C. *Amia calva*. *i.g.*, intergular; *g.*, gular plates; *l.g.*, lateral gulars; *b.*, branchiostegals; *c.h.*, cerato-hyal; *s.op.*, suboperculum; *mn.*, lower jaw.

In the Palæoniscidæ the arrangement of the plates supporting the gill-membranes and extending forward between the mandibular rami, as described by Traquair *, is one from which the conditions which obtain in other Teleostomi are readily derivable. On each side there is a continuous series of obviously homologous plates, the upper two or three of which are enlarged as the opercular bones, those following being the bran-

* Mon. Palæont. Soc., Palæoniscidæ, p. 21 (1877).

chiostegals, the anterior pair of which are considerably larger than the rest and may be termed "gular plates." In front of the gular plates there is sometimes an unpaired "intergular." The anterior branchiostegals and the gular plates occupy the whole of the space between the mandibular rami, to which they are apposed, whilst each meets its fellow in the middle line. Within the order Chondrostei the gular plates and branchiostegals may disappear, but we never get the conditions characteristic of either Crossopterygii or Teleostei.

We have only just begun to realize that the clavicles proper (infraclavicles) which Parker thought he recognized in so many Teleostean fishes (Siluridæ, Hemibranchii, Lophobranchii, *Ostracion*) are entirely wanting in that group, and the presence of this bone as a distinct element in the Chondrostei and Crossopterygii becomes therefore of ordinal value.

The arrangement of the bones of the cranial roof in the Chondrostean Palæoniscidæ is essentially similar to that of the more generalized representatives of the other orders (the Dipneusti excepted). Assuming the interfrontal pineal foramen to be a primitive structure, we may expect to discover a Palæoniscid-like fish possessing this feature, and had such a one existed in the early Silurian it would have been in every way fitted to become the progenitor of the Teleostomi.

CROSSOPTERYGII.

The Crossopterygii are modified Chondrostei, from which order the more generalized forms differ but slightly. The lobate pectoral fin has been shown by Dollo * to be an adaptive specialization, and is not to be regarded as of greater importance than the lobate pectoral of some Teleosts (e. g. *Periophthalmus*, Pediculati); it may easily have been derived from the Chondrostean type in the following manner:—

The pectoral fin began to be used at times as a support for the body, and even as an ambulatory limb. This change of function produced a changed orientation in the muscular lobe at the base of the fin, which, originally parallel to the body-wall and attached to it for its whole length, became set at an angle to the body and detached from it posteriorly. As the lobe separated the dermal rays extended round on to its inner side. † The arrangement of the skeletal supports scarcely

* Bull. Soc. Belg. Géol. ix. 1895, p. 79.

† I am by no means satisfied that the pectoral fin of the extinct genera *Tristichopterus* and *Eusthenopteron* is correctly described as unibasal. That of *Tristichopterus*, as originally described and figured by

changed, but the metapterygium became segmented (or this segmentation may be primitive, each segment representing an axonost). From such an asymmetrical fin the symmetrical fins of *Ceratodus* would be derived by an increase in length of the lobe and of the number of axial segments and the development of posterior cartilages for the support of the inner series of dermal rays. The evolution of the ventral fins would be on similar lines.

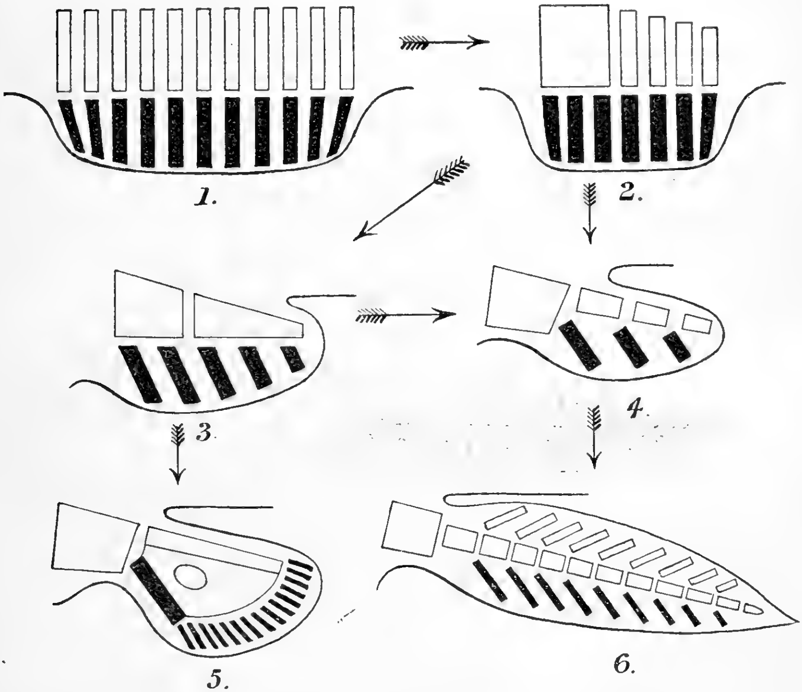


Fig. 2.—Diagrams to illustrate the evolution of lobate paired fins; the axonosts are unshaded, the baseosts shaded 1, primitive condition; 2 and 3, stages seen respectively in ventral and pectoral of *Acipenser*; 4, obtusely lobate fin; 5, pectoral of *Polypterus*; 6, acutely lobate fin.

In the pectoral fin of *Polypterus* there are two basal pieces articulated to the coraco-scapular ossifications, which

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Traquair (Tr. R. Soc. Edin. xxvii. 1876, p. 383, pl. xxxii. fig. 9), would seem to consist of an axis (metapterygium) of three segments and of three baseosts, of which the first appears to be attached to the coraco-scapular.

are inserted close together and diverge distally. Of these the posterior, metapterygium, is the longer, whilst the shorter anterior one is the first baseost. *Polypterus* is peculiar among Crossopterygii in that the metapterygium is not split up into or followed by a series of segments, whilst the baseosts are numerous and are attached to the distal edge of a lamina which has developed between the two basal bones, and in which an ossification has arisen. Nevertheless this type of fin does not appear to me to justify the proposal which has been made to regard the Cladistia as a distinct order.

As to the structure of the ventral fins of the Crossopterygii, in those forms in which they were non-lobate this was probably as in the Chondrostei, and the modern *Polypterus* has an arrangement similar to that which is sometimes seen in *Scaphirhynchus*—*i. e.*, a single basal piece supporting a short series of baseosts. There is evidence, too, that the supports of the obtusely lobate ventrals were very similar to those of the obtusely lobate pectorals.

The replacement of the branchiostegal rays by the development of the paired gular plates is a characteristic feature of the

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In *Eusthenopteron* the same arrangement has been described by Whiteaves (Tr. R. Soc. Canada, 1888, p. 87). Before I had seen either of these descriptions I had formed the opinion that the so-called "basal cartilage" in the pectoral of *Eusthenopteron* figured by Smith Woodward (Vert. Palæont. p. 25, fig. 23) was probably coraco-scapular, on account of its shape and bulk, and it appears to me to bear a most suspicious resemblance to the ossification named coraco-scapular by Traquair in *Tristichopterus* and to the coraco-scapular of the recent *Polypterus*. The so-called postaxial process would then be the downwardly projecting portion of the coracoid; otherwise it seems to me to be inexplicable, since the dermal rays do not appear to extend so far, and if such a process developed on the basal segment, why not on the second?

The alternative supposition, which is the one apparently now adopted by Smith Woodward and Traquair (Geol. Mag. 1890, p. 19), is that this bone is the basal segment of the axis. If this be so, then it follows that in the specimens of *Tristichopterus* on which Traquair's description was based this large bone had not been preserved or was hidden.

Unless we assume that *Polypterus* originated independently of other Crossopterygii, it seems to me clear that the primitive Crossopterygian must have had a pectoral in which the first baseost retained its attachment to the coraco-scapular, for I regard the theory that the acutely lobate symmetrical fin has given rise to the obtusely lobate asymmetrical fin as exploded, and I shall require more satisfactory evidence than has yet been forthcoming to convince me that this condition is not realized in *Tristichopterus* or *Eusthenopteron*, as would appear from the original description of each.

I must add that I have been in correspondence with Dr. Traquair, who has very kindly told me that he is not inclined to accept my view, which I put forward here merely for the purpose of stating a case.

Crossopterygii, but the supposed homology of the lateral gulars with the branchiostegals is doubtful. As has been pointed out above, in the Palæoniscidæ the gular plates and branchiostegal rays are serially homologous, whereas the Crossopterygian lateral gulars are plates developed between the principal gulars and the mandibular rami. Moreover, whilst the Palæoniscid branchiostegals are so imbricated that each overlaps the one in front of it, the lateral gulars exhibit precisely the reverse arrangement. Nevertheless, in the Devonian Palæoniscid *Cheirolepis*, as figured by Traquair *, the anterior branchiostegal extends forward between gular plate and lower jaw, and this might be regarded as leading to the Crossopterygian condition.

In the Crossopterygii we see the development of the bone which Boulenger has shown to be the representative of the squamosal of higher Vertebrates. This is fused with the præoperculum in *Polypterus*, but coexists with it in several extinct forms, and corresponds to the upper bone of the postorbital (as distinct from the circumorbital) series of the Palæoniscidæ. The bone internal to it, which is the one usually called squamosal in fishes, is without doubt the true supratemporal †, and should be so named throughout the Teleostomi, whether or no it includes a "pterotic" ossification in certain Teleosts, whilst the series which lie posterior to the parietals and true supratemporals might be termed dermo-occipitals, thus avoiding confusion with the true supraoccipital.

Many Crossopterygii have a pineal foramen, a feature as yet undiscovered in any Chondrostei, and they must have evolved in the Silurian from some primitive type belonging to the latter order.

Dipneusti.

The relations of the Dipneusti to the Crossopterygii have been elucidated by Dollo ‡ in a convincing essay. He gives good reasons for believing that *Dipterus* is the most generalized of all Dipneusti, and that it has originated from a Crossopterygian type closely allied to *Holoptychius*. It is only necessary to add here that his views as to the specialized character of the lobate paired fins receive additional confirmation from the demonstration of the primitive nature of the non-lobate paired fins of the Chondrostei.

* Ann. & Mag. Nat. Hist. (4) xv. 1875, p. 237.

† This conclusion is not invalidated by the fact that *Polypterus* has no supratemporal, the bone so named by Boulenger being the "accessory hyomandibular" of Traquair.

‡ Bull. Soc. Belg. Géol. ix. 1895, p. 79.

Placodermi.

The close relationship of the Coccosteidæ and Asterolepidæ had been generally recognized until they were so widely and unnecessarily separated by Cope, a proceeding which has found more support than it deserved, and I have no hesitation in uniting the groups of which these families are representative, together with the Osteostraci, in a single order of Teleostomi. It has been stated that the bones of the skull of the Coccosteidæ cannot be homologized with those of other Teleostomes; but, as has recently been pointed out by Jækel *, if we take a generalized type such as *Coccosteus*, the

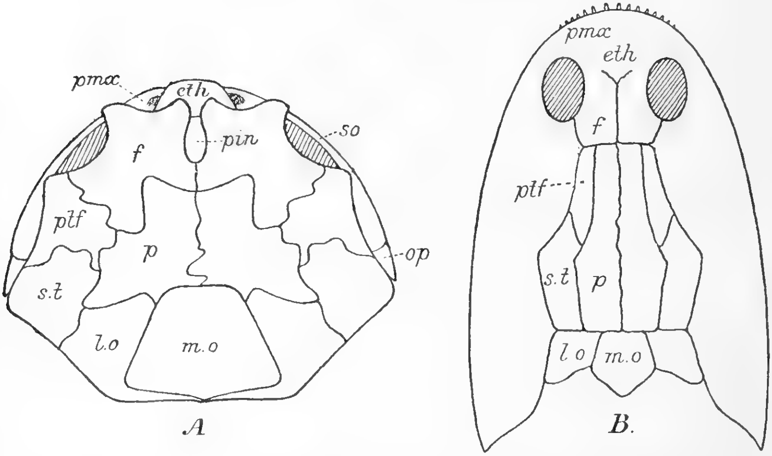

Fig. 3.—Diagrams to show the arrangement of the bones of the cranial roof in *Coccosteus* (A) and in a typical Crossopterygian (*Rhizodopsis*) (B) (both after Traquair). *m.o.*, median dermo-occipital; *l.o.*, lateral dermal occipital; *p.*, parietal; *f.*, frontal; *ptf.*, postfrontal; *s.t.*, supratemporal; *pin.*, pineal; *eth.*, ethmoid; *pmx.*, præmaxillary; *so.*, suborbital; *op.*, operculum.

cranial roof-bones are arranged as in a generalized Crossopterygian or Stegocephalian. Posteriorly we see the three large dermo-occipital plates which we so frequently meet with in the Rhizodontidæ and Osteolepidæ. In front of these are the paired parietals and frontals, the latter bounding the orbits laterally and partly separated medianly by a pineal †

* Sitzb. Ges. naturf. Berlin, 1902, p. 103.

† The pineal plate occupies the position of the pineal foramen of some Osteolepids.

plate. Paired postfrontals and supratemporals are well developed, whilst anteriorly a median ethmoid separates the præmaxillaries. A single large bone on the cheek which sends forward a process below the orbits represents the sub- and postorbitals, and may include the maxillary also. The opercular bones are represented by the operculum only. The nostrils are lateral, between præmaxillary and ethmoid. Gular plates and branchiostegal rays are apparently wanting. In the arrangement of the bones of the cranial roof *Coccosteus* is almost a typical Crossopterygian, and the arrangement of the supports of the dorsal fin in two regular series and the structure of the ventral fin, which appears to be essentially similar to that of *Polypterus* *, cannot be said to negative this view.

A comparison of *Coccosteus* with *Pterichthys* shows the following important points of agreement:—

(1) The anterior part of the trunk is enclosed in an armour of bony plates which are not united to those of the head, so that the latter is freely movable.
(2) There is a single dorsal fin which is membranous.
(3) There is a single opercular bone † and a pitted pineal bone.
(4) *The dermal armour ‡ is in both cases composed of dense bone with a cancellated structure in its thicker portions, with an outer layer of ganoine, with a tuberculated surface, and with open grooves for the sensory canals.*
(5) The arrangement of the bones of the head, but especially that of the dermal plates of the body, can easily be reduced to a common plan.

In the skull of *Pterichthys* we recognize posteriorly the three dermo-occipitals, the supratemporals, and the operculum of *Coccosteus*, whilst anteriorly the median ethmoid and laterally the large suborbital plate are still in the same relative positions. The præmaxillaries are now entirely on the lower surface, but, as in *Coccosteus*, they seem to border the nostrils. The orbits have approached each other until they are only separated by the pineal plate. The postfrontal is fused with the suborbital.

If Jækel be correct in regarding *Homosteus* as intermediate

* It is noteworthy that *Coccosteus* resembles *Polypterus* in the position of the nostrils also.

† In both cases this bone has been interpreted by some authorities as other than opercular, so that it would be perhaps better to say "there is in both a similarly placed bone which may be regarded as an operculum."

‡ See Smith Woodward, 'Vertebrate Palæontology,' p. 12 (1898), and Cat. Foss. Fish. ii. p. xix (1891).

between *Coccosteus* and *Pterichthys*, then the frontals have been displaced forwards and have either disappeared or become fused with the ethmoid or with the suborbital plates, and the so-called postmedian represents the parietals. On the other hand, there is the possibility that this element may be frontal in origin and that the median dermo-occipital may include the parietals, and I incline to this latter view.

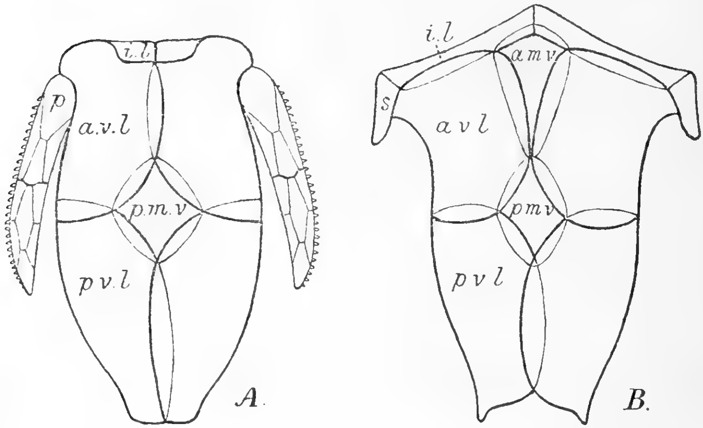

Fig. 4.—Ventral plates of trunk-armour of (A) *Pterichthys* (after Traquair) and (B) *Coccosteus* (after Traquair). *i.l.*, interlateral; *s.*, lateral spine; *p.*, pectoral limb; *a.m.v.*, anterior median ventral; *p.m.v.*, posterior median ventral; *a.v.l.*, anterior ventro-lateral; *p.v.l.*, posterior ventro-lateral. The faint lines indicate the extent of the overlap; the suture between the interlateral and the lateral spine in *Coccosteus* has been inserted.

The arrangement of the plates of the armour of the trunk is on a very similar plan in both Coccosteidæ and Asterolepidæ, 1 or 2 median dorsal plates, 1 or 2 pairs of anterior and posterior lateral plates, and on the ventral surface 4 large plates in exactly the same position and overlapping each other and a smaller four-sided median piece in a very similar manner, whilst a small anterior median plate may or may not be present. The semilunars of the Asterolepidæ seem to correspond to the elements (interlaterals) which have been regarded as clavicles in the Coccosteidæ.

The case of *Acanthaspis* may be cited as evidence of the similarity of the plates of these two families in structure and arrangement. This genus, according to Smith Woodward *,

* Vert. Palæont. p. 16.

"has a dermal armour resembling that of the Antiarcha in minute structure and a ventral plastron quite similar to that of the latter. The lateral appendages, however, instead of being complex and movable, are simple and fixed." Nevertheless Traquair * has given good reasons for regarding *Acanthaspis* as a Coccosteid, and it would even seem that the fixed spinous appendage may be diagnostic of that family.

So far, then, *Coccosteus* has been shown to resemble the more generalized Crossopterygii in the arrangement of the bones of the cranial roof, and reasons have been given for regarding the Asterolepidæ as closely related to the Coccosteidæ †.

What, then, of the peculiar pectoral limb of the Asterolepidæ? It has been sometimes assumed that this is not homologous with the pectoral fin of other fishes, but evidence in support of this assumption has not been forthcoming. Bashford Dean even goes so far as to say that these appendages are now known to be the lateral head-angles [? of *Cephalaspis*] produced and jointed for locomotion. This extraordinary theory is evidently based on a complete misconception as to the position of the Asterolepid limbs, and so needs no discussion. Smith Woodward seems to think that the fixed spinous appendage of *Acanthaspis* in some way supports the view of the independent origin of the Asterolepid pectoral, and I suppose therefore that he regards it as a stage in the development of the latter. Personally, I am unable to imagine that a fixed spine could possibly give rise to a jointed Arthropod-like limb with internal muscles. In fact, the structure of such a limb, articulated to an anterior plate of the body, in which latter is a large foramen, indicating that tendons, blood-vessels, and nerves passed to the muscles of the limb from the body, postulates for me an unarmed ancestor with a muscular limb already developed. Just as the similar limbs of the Crustacea are generally held to have been

* Geol. Mag. (3) x. 1893, p. 148.

† The reasons which have been given for regarding Coccosteids and Asterolepids as not related are (1) the more vascular bone of the latter, (2) the presence of specialized paired fins in the former, and (3) the well-ossified jaws of the Coccosteids. With regard to these, the resemblances in the structure of the bony plates are very remarkable, and the differences are evidently not well marked, or there could be no doubt as to the position of a genus after the minute structure of the bone had been ascertained. The Asterolepid pectoral is surely specialized enough, and it is purely gratuitous to assume its non-homology with that of other fishes.

As to the non-ossified lower jaw of the Asterolepids, instances are not wanting in Chondrostei and Teleostei of degeneration of membrane-bones or of the reversion of a bone to its primitive cartilaginous condition.

derived from the Annelid parapodia, muscular projections used in progression, by increase in size accompanied by hardening and segmentation of the exoskeleton, so do I conceive the Asterolepid limb to have been derived from the lobate Crossopterygian pectoral fin, already being used to support the body and for ambulatory progression, by the development of dermal plates on the muscular lobe of the fin at the same time that the anterior part of the trunk became armoured. The fixed spinous appendage of the Coccosteidæ seems to represent the pectoral limb of the Asterolepidæ, so that we may regard the former as the more generalized in the structure of the skull, the latter in that of the pectoral limb.

We now pass to the Cephalaspidæ and the related forms included in the Osteostraci. The reasons for regarding these as allied to the Asterolepidæ have been given by Smith Woodward, and they appear to me sufficient and convincing, and may be briefly summarized here. In both groups we have a similar caudal region, with a single dorsal fin in the same position and with the caudal fin heterocercal, with a well-developed lower lobe. Then, again, in two Osteostracan genera, *Trematuspis* and *Didymaspis*, the anterior part of the trunk is enclosed in armour, consisting of a dorsal shield to which a ventral shield is opposed, the dorsal shield being distinct from the head-shield in the former genus, but fused with it in the latter. Since the head-shield is continuous, the nostrils must have been inferior, as in the Asterolepidæ, whilst the orbits are approximated and separated only by a pineal plate, as in that family. Finally, the exoskeleton is composed of true bone in its inner layers, as in other "Ganoid" fishes. Where I differ from Dr. Smith Woodward with respect to this group is that whereas he looks upon the genera which most nearly approach the Asterolepidæ as the most specialized, I regard them on that account as the most generalized, and the loose pineal plate and the ganoine layer of *Tremataspis* appear to me in favour of my view. Conceived as specialized and degenerate Asterolepidæ, the structure of the Osteostraci is easily explicable, but I cannot reconcile the Asterolepid structure with the idea that they are a further development of the Osteostraci or of anything like them, whilst if the resemblances between Asterolepidæ and Coccosteidæ are due to convergence (as they must be if they belong to different subclasses), then morphology has ceased to be a guide to relationship. Finally, the Heterostraci must be considered, since they have often been associated with the

Cephalaspidæ, although it has long been known that they differ from them fundamentally in the microscopic structure of their dermal armour, bone lacunæ being entirely absent, whilst there is great similarity to the tooth-structure of the Elasmobranchs. Lankester has strongly maintained that the Heterostraci and Osteostraci are an unnatural association, and as long ago as 1867 he wrote*:—"The Heterostraci are associated at present with the Osteostraci because they are found in the same beds, because they have, like *Cephalaspis*, a large head-shield, and because there is nothing else with which to associate them—the shields are not so closely similar in plan, much less in histological structure†, as to warrant any inference of similarity in other parts." Within the last few years Traquair‡ has discovered new forms which seem to place it beyond doubt that the Heterostraci are armoured Chondropterygii. He has also discovered a new genus, *Ateleaspis*, which he considers is annectent between Heterostraci and Cephalaspidæ, but this view I am not prepared to accept. *Ateleaspis* is certainly very closely allied to *Cephalaspis*, but I cannot see that there is the least reason for regarding it as allied to anything else. The shield is divided superficially into hexagonal areas, which are compared to those of *Cephalaspis*, in which genus this appearance has been shown by Lankester§ to be due to the arrangement of the vascular canals, which may even cause the shield to crack along these lines, whilst in pl. x. fig. 5, a specimen of *Cephalaspis asper* is figured in which the polygonal areas are very strongly brought out by the great pressure and the infiltration to which the shield has been subjected. If Lankester is correct, and the polygonal areas of *Cephalaspis* are due to the arrangement of the vascular canals, then they are not due to the coalescence of originally separate polygonal pieces, as suggested by Traquair, who believes he has found in *Ateleaspis* a stage in this development. Traquair's idea that the superficial tubercles of the shield of *Ateleaspis* represent originally separate Cœlolepid denticles appears to me

* Mon. Palæont. Soc., Cephalaspidæ, p. 62 (1867).

† The difference in structure of the dermal armour of *Pteraspis* and *Cephalaspis* is essentially that between a "placoid" and a "ganoid" scale. There is no reason why the former should not have given rise to the latter and to membrane-bones, by fusion and by the development of a bony substratum, more than once. On the other hand, the evidence shows that the Teleostomi, as here understood, are monophyletic.

‡ Trans. Roy. Soc. Edinburgh, xxxix. 1899, p. 827 *et seq.*, and Rep. Brit. Assoc. 1900, p. 773.

§ 'Cephalaspidæ,' p. 10.

still less valid, and might be applied with equal force to any of the numerous Ganoid fishes with tuberculated bones, and surely it is a retrograde step to suggest that structures which in *Cephalaspis* have been shown to be posterior extensions of the head-shield may after all be pectoral fins.

In fact, the evidence that the Coccosteidæ are Teleostomi, that the Asterolepidæ are allied to the Coccosteidæ, and that the Cephalaspidæ have been derived—through the Tremataspidæ—from the Asterolepidæ, is so clear, that I am compelled to regard the Ateleaspid structure as a modification of that of the Cephalaspid.

Teleostei.

The reasons for regarding the Teleostei and Chondrostei as distinct orders and for including the Holostei with the former are apparent in the diagnoses given above. The Holostei may then be regarded as the first Teleostean suborder *, distinguished from the Malacopterygii by their well-developed splenial and by one or more of the pectoral baseosts being attached to the metapterygium. Whether certain features of resemblance between *Polypterus* and the Holostei, of which the articulation of the operculum to a posterior process of the hyomandibular is the most important, are to be interpreted as derived from a common ancestor or as due to convergence is not yet clear.

The Palæontological Evidence.

It may be said that the conclusions as to the evolution of the Teleostomi expressed above are not in accordance with the palæontological evidence; but to this I reply that they are in accordance with the morphological evidence, which is clear and sufficiently complete, whilst the geological record is, and must be from the nature of the case, very incomplete. The Teleostomi probably originated from Pleuropterygian Elasmobranchii in the Lower Silurian, and the Crossopterygii, with their specialized offshoots the Dipneusti and Placodermi, must have rapidly evolved, since all are well represented in the Lower Devonian, and the highly specialized Cephalaspidæ are found in the Upper Silurian. In the same way that generalized Reptilia gave rise to the host of forms which

* Provisionally, for I am inclined to think that none of the characters which have been used to distinguish between Holostei and Malacopterygii will prove satisfactory.

were characteristic of the Secondary period, including the highly specialized Ichthyosauria and Pterosauria, which declined and were replaced by a new race, the Mammalia, derived also from the same generalized stock, so must we conceive the primitive Teleostomi as giving rise to the Crossopterygii, with their specialized offshoots the Dipneusti and Placodermi, and remaining dormant to develope later on into the typical Chondrostei. There is no justification for regarding the Crossopterygii as less specialized than the Chondrostei because they were the earlier dominant group. The non-recognition of the true position of *Cephalaspis* as a specialized Asterolepid seems to have been due to its occurrence in the Upper Silurian; but when we consider that, in spite of the imperfect geological record, we know that types so divergent as *Cheirolepis*, *Tristichopterus*, *Holoptychius*, *Dipterus*, *Coccosteus*, *Homosteus*, *Pterichthys*, and *Cephalaspis* were already in being in the Lower Devonian, we may feel assured that some of these, and numerous annectent forms also, must have existed long before.

Summary and Conclusions.

The main results of the foregoing paper may be stated as follows:—

(1) The Chondrostei are the most generalized Teleostomi.

(2) The Crossopterygii differ from them
- (*a*) in the lobate pectoral fin;
- (*b*) in the larger paired gular plates.

(3) The Placodermi (Coccosteidæ, Asterolepidæ, Cephalaspidæ) are a natural group, not related to the Heterostraci, which are Chondropterygii. They may probably be regarded as armoured *primitive* Crossopterygii, this view being most in accordance with
- (*a*) the arrangement of the cranial roof-bones in *Coccosteus*;
- (*b*) the structure of the ventral fin in *Coccosteus*;
- (*c*) the structure of the pectoral limb of the Asterolepidæ.

(4) The Dipneusti probably originated from more specialized Crossopterygii, *e. g.* from the neighbourhood of the Holoptychiidæ.

(5) The Teleostei differ in so many respects from the Chondrostei that they should rank as an order, in which the Holostei are included.

In the Teleostomi and the Chondropterygii * the evolution of the paired fins has proceeded independently, but sometimes on parallel lines, from the earliest stages. The median fins of the Teleostomi also tend to undergo the same modifications as the paired ones, but this comparison must not be pushed too far. The most primitive condition is that which we have seen in the anal and ventral fins of *Psephurus*: (1) dermal rays much more numerous than the baseosts, which form a well-developed series, attached internally to a series of axonosts, the anterior of which show a tendency to fusion. From this stage is easily derived that which is seen in the anal fin of *Eusthenopteron*, or in the ventral of *Polypterus* or ? *Coccosteus*, *i. e.* (2) dermal rays more numerous than the baseosts, which are attached to a single cartilage or bone formed by the fusion of the axonosts. The third stage (3), in which the baseosts are rudimentary or absent and the dermal rays are attached direct to the axonostal bone, is exemplified in the anterior dorsal of the Cœlacanthidæ and the ventrals of the Teleostei.

Two conditions met with in the median fins are not paralleled in the paired ones. The first is a modification of stage (1) described above, and is that seen in the Teleostei, baseosts small or wanting, dermal rays equal in number to the axonosts. The second is derived from stage (2), and is that seen in the posterior dorsal of *Holoptychius*, in which there is a single axonostal cartilage, whilst the baseosts are numerous, crowded, and apparently subdivided, some being attached to others instead of to the axonost.

Similarly the paired fins undergo modifications which

* Thacher (Tr. Conn. Ac. iii. & iv. 1877) deduced the theory of the similar origin of median and paired fins from their similar structure in the Elasmobranchii and Chondrostei. Balfour, from a study of Elasmobranch development, also deduced the similar origin of median and paired fins. He concluded that in modern Elasmobranchii the ventral fin retains in all essential respects its primitive arrangement, and that the pectoral metapterygium represents the pelvic basipterygium. He also wrote: "I should be much more inclined to hold that the fin of *Ceratodus* has been derived from a fin like that of the Elasmobranchii by a series of steps similar to those which Huxley supposes to have led to the establishment of the Elasmobranch fin, but in exactly the reverse direction."

I prefer these conclusions to the more recent ones of Cope and Smith Woodward, who regard the fins of modern Elasmobranchii and Chondrostei as highly specialized, and I would point out that the Ichthyotome pectoral must have been derived from the Pleuropterygian type in the same way as the paired fins of the Dipneusti from those of the Chondrostei, the axis, or metapterygium, representing the series of axonosts, and not being derived from an elongate baseost.

cannot be paralleled in the median ones, when the axonosts form the axis of a lobate fin, and these have already been discussed in treating of the order Crossopterygii.

EXPLANATION OF PLATE VII.

Fig. 1. Anal (A.), ventral (V.), and pectoral (P.) fins of *Psephurus gladius*, the two last from the ventral or inner aspect.

Fig. 2. The same, dissected to show the supporting cartilages. *cor.*, coraco-scapular; *mt.*, metapterygium; *a.*, axonosts; *r.*, baseosts (radials); *m.*, marginals.

XL.—*Rhynchotal Notes.*—XXIII. By W. L. Distant.

Heteroptera from the Transvaal.

The British Museum has secured a set of the specimens of Rhynchota collected by the Rev. H. A. Junod at Shilouvane, Zoutpansberg, Northern Transvaal, and this paper refers to undescribed species found in the collection. The Capsidæ have already been described (*ante*, p. 196 *et seq.*), while the Homoptera, poorly represented, are reserved for future treatment. The greater part of the Zoutpansberg district possesses a subtropical climate and is much covered with bush and dwarf forest, thus being in strong contrast with the high and barren veld which constitutes so large a portion of the Transvaal landscape. I was therefore not greatly surprised to find both many new species and others known in entomological record, which I had neither seen nor secured during four years' collecting in other parts of the Transvaal. Two genera, *Geomorpha* and *Phonolibes*, both hitherto represented only by a single West-African species, are now found to have each a representative species in North Transvaal.

All the types are contained in the National Collection.

Fam. **Pentatomidæ.**

Subfam. *Cydninæ.*

Gnathoconus elongatus, sp. n.

Elongate; black; lateral margins of pronotum, basal half of lateral margins of corium, second and base of third joints of antennæ, tibiæ (excluding apical third), lateral margins of the fourth, fifth, and sixth abdominal segments, and the apical margin of anal segment to the abdomen pale ochraceous; a large discal spot to corium creamy white; lateral lobes of the head very thickly finely punctate; pronotum (excluding the transverse callose area and lateral margins), scutellum, and corium somewhat coarsely punctate; membrane pale bronzy.

Allied to *G. tibialis*, Stål, also found in the Transvaal, but much more elongate; pronotum with the lateral margins continuously narrowly ochraceous, but basal margin concolorous; apex of scutellum concolorous, &c.

Long. 5 mm.

Geomorpha Junodi, sp. n.

Fuscous brown; head, anterior area of pronotum, and legs testaceous; a narrow, transverse, callose fascia to pronotum at about one third from anterior margin, and central fused spots to fourth and fifth abdominal segments, ochraceous; connexivum piceous, the marginal tubercles ochraceous; membrane obscure brownish ochraceous, with piceous suffusions; head moderately long, profoundly sinuate in front of eyes, lateral lobes longer than central lobe, a little outwardly and upwardly dilated at their apices, which do not quite meet; antennæ mutilated in typical specimen; pronotum strongly and somewhat transversely rugose behind the pale transverse callose fascia, the anterior area with some very coarse punctures, the lateral angles very broad, obtusely angularly prominent; scutellum short, broad, its base triangularly elevate, continued in a central carination to apex, its surface strongly rugose, with four small obscure ochraceous spots on basal area; corium opaque, coarsely punctate, its lateral margin about as long as, and its inner margin only extending a little beyond middle of, scutellum; membrane reticulate, not quite reaching apex of abdomen; body beneath considerably suffused with ochraceous.

Long. 10; exp. pronot. angl. $7\frac{1}{2}$ mm.

Fam. **Coreidæ.**

Subfam. *Coreinæ.*

Division Petascelaria.

Carlisis serrabilis, sp. n.

Head above and antennæ black; basal annulations to second and third joints of antennæ, a central fascia to head beneath, and rostrum (excluding apex) ochraceous; pronotum either piceous suffused with ochraceous, or ochraceous suffused with piceous, extreme anterior area piceous, beyond which is a transverse ochraceous line, three abbreviated longitudinal ochraceous lines at base, the lateral margins always black or piceous; scutellum black, its central lateral margins, apex, and a central longitudinal line more or less obscurely ochraceous; corium ochraceous, much suffused with piceous or black; membrane black; connexivum black, spotted with ochraceous, the spots bifid above; body beneath and legs black, opaque; anterior and anterior lateral margins and a central fascia to prosternum, a central fascia to mesosternum, a broad central spot to metasternum, and lateral margins of corium as seen beneath, ochraceous; anterior and intermediate femora (excluding apices), an obscure central annulation to tibiæ, and the second joint of tarsi testaceous. First and fourth joints of antennæ subequal in length, second and third joints longer and almost subequal; pronotum sparingly punctate, with its lateral margins very coarsely serrate for their whole length; scutellum transversely wrinkled; corium very sparingly punctate; anterior and intermediate femora denticulate beneath near apex, posterior femora incrassate, obtusely convexly dilated at about middle of inner margin; anterior lateral margins of corium blackly granulate.

Long., ♂ ♀, 26–28 mm.

Division Gonoceraria.

Plinachtus trilineatus, sp. n.

Head ochraceous, obscurely punctate, with three longitudinal black lines—one central, the other two from near base of antennæ to ocelli; antennæ with the first, second, and third joints castaneous, fourth pale fuscous, with its base ochraceous; pronotum ochraceous, thickly brownly punctate, extreme lateral margins and the posterior lateral angles castaneous; scutellum ochraceous (excluding margins and apex), blackly punctate; clavus stramineous, blackly punctate; corium subroseus, blackly punctate; membrane dark bronzy brown; body beneath and legs ochraceous; a spot on each side of pro-, meso-, and metasterna, and three basal spots on each side of second, third, fourth, and fifth abdominal segments black; first, third, and fourth joints of antennæ subequal in length, second longest; rostrum reaching the intermediate coxæ; lateral pronotal angles acutely spinous, their apices directed a little forward.

Long. 17 mm.

Subfam. *Alydinæ.*

Mirperus nigrofasciatus, sp. n.

Ochraceous, coarsely punctate; a lateral fascia on each side of head, two discal longitudinal fasciæ to pronotum (not reaching anterior margin), a large central spot and narrow sublateral fascia to mesonotum, two longitudinal fasciæ to abdomen and between them on basal area two narrower and ill-defined fasciæ, black; legs piceous, with ochraceous suffusions; corium with the punctures thickly black towards apical area and the lateral margins stramineous; membrane pale piceous, its apical margin pale hyaline; antennæ with the first, second, and third joints brownish ochraceous, fourth joint mutilated, first and second joints subequal in length, third longest; rostrum piceous above and reaching intermediate coxæ; the punctuation very coarse and strong on pronotum, more finely punctate on scutellum and corium; head finely granulate; posterior femora in male incrassate and spined beneath, two subapical spines longest; posterior tibiæ strongly curved, almost as long as femora.

Long. 9½ mm.

Mirperus robustus, sp. n.

Dull ochraceous, darkly punctate; head and anterior area of pronotum thickly greyishly pilose; membrane greyish brown, with scattered small piceous spots; head beneath, disk of sternum and two oblique fasciæ on its apical areas, a central and a waved fascia on each side of abdomen beneath, apex of rostrum, and the femora black; an oblique line and a small basal spot on each side of head beneath, tibiæ, and antennæ dull ochraceous; annulations to anterior and intermediate tibiæ, bases and apices of posterior tibiæ, and apices of tarsi black; basal joint of antennæ shorter than head, about equal in length to second joint; rostrum reaching the intermediate coxæ; connexivum ochraceous, spotted with black.

Long. 9 mm.

Fam. Lygæidæ.

Division Orsillaria.

Nysius rubromaculatus, sp. n.

Head, anterior area of pronotum, and scutellum testaceous, pronotum (excluding anterior area) ochraceous; a spot on head near each ocellus, centre of anterior margin and a subbasal line to pronotum, and basal margin of scutellum black; corium pale hyaline, its apical angle broadly reddish testaceous; membrane pale hyaline, its apical area suffused with testaceous and piceous; body beneath testaceous; legs stramineous, apices of femora and tibiæ a little darker; antennæ ochraceous, basal joint and apex of second a little darker, second, third, and fourth joints subequal in length, basal joint shortest, not reaching apex of head; head strongly attenuated and laterally sinuate in front of eyes; pronotum very coarsely punctate; scutellum with a subbasal transverse carination, which is centrally continued to apex.

Long. $4\frac{1}{2}$ mm.

Division Aphanaria.

Aphanus atomarius, sp. n.

Ochraceous, thickly punctured with brown; head reddish ochraceous, lateral margins and apex, margins of central lobe, two large basal spots, and eyes black; pronotum with black lines enclosing an irregular transverse space on anterior area, the lateral margins moderately laminately reflexed; scutellum with a black line occupying nearly centres of lateral margins and two longitudinal black lines at apex; corium with the apical angle black; legs ochraceous; abdomen beneath castaneous; head beneath, disk of sternum, a central longitudinal fascia to abdomen, anterior femora (excluding apices), apices of intermediate and posterior femora, and apices of tibiæ and tarsi black. Antennæ mutilated in the six specimens now before me.

Long. 5–$5\frac{1}{2}$ mm.

Allied to *A. orientalis*, Dist., from British India.

Fam. **Reduviidæ.**

Subfam. *Stenopodinæ.*

Dithmarus, gen. nov.

Body moderately elongate, a little posteriorly widened; head subcylindrical, not narrowed anteriorly and between antennæ armed with two porrect spines, eyes inserted at about one third from base, behind and between which the surface is transversely tuberculate and there contains the ocelli, extreme base narrowly pedunculate; antennæ strongly pilose, first joint nearly as long as head, second twice as long as first;

rostrum reaching the anterior coxæ, first and second joints subequal in length; pronotum rather more than twice as broad at base as at anterior margin, transversely constricted at middle, centrally longitudinally broadly excavated, lateral margins sinuate, posterior angles acutely prominent, anterior angles shortly subtuberculously prominent; apex of scutellum produced in a somewhat long semierect spine; hemelytra reaching apex of abdomen, the last with its margins a little dilated; abdomen beneath flatly depressed, but with a very strong central longitudinal ridge; anterior angles of prosternum shortly spinous; legs of moderate length, anterior femora strongly incrassate and shortly spinous beneath.

Allied to *Argolis* by the two anterior spines to head, but differing by the incrassate and spinous anterior femora.

Dithmarus atromaculatus, sp. n.

Cinnamon-brown; antennæ and legs stramineous; clavus and anterior area of corium of a creamy hue; membrane slaty grey; an elongate spot to clavus, a broken discal spot and a larger apical spot to corium, and a very small basal and a large discal spot to membrane black; connexivum spotted with creamy white; anterior femora beneath moderately suffused with piceous; the tarsi and apices of tibiæ ochraceous.

Long. 17 mm.

Subfam. *Harpactorinæ.*

Phonolibes bimaculatus, sp. n.

Black, greyishly pilose; base and apex of head, two rounded discal spots and margins of lateral angular areas to pronotum, margins and central carina to scutellum, connexivum, posterior margin to prosternum, lateral margins of meso- and metasterna, coxæ, trochanters, and abdomen beneath sanguineous; lateral areas of abdominal segmental incisures and anal abdominal segment black; first joint of antennæ about as long as head and subequal in length to third, second short, about half the length of third.

Long. $9\frac{1}{2}$ mm.

Allied to the West-African *P. venustus*, Stål, from which it differs by its smaller size and altogether different markings; the pronotum is also narrower and much less profoundly longitudinally impressed.

Harpactor femoralis, sp. n.

Black; legs and lateral margins of abdomen testaceous; apices of femora, bases and apices of tibiæ, and the tarsi black; first joint of antennæ about as long as head; anterior lobe of pronotum broadly centrally sulcate towards its base, posterior lobe obscurely granulate; scutellum foveate at base, its apex robustly porrectly produced; legs longly pilose; first joint of rostrum about reaching eyes, second joint about twice as long as first.

Long. $12\frac{1}{2}$ mm.

Sphedanolestes corallinus, sp. n.

Coral-red; corium and anterior and intermediate tibiæ dull ochraceous; antennæ, eyes, apex of head, ocelli and a short line behind them, outer area of corium, posterior tibiæ, apices of anterior and intermediate tibiæ, and the tarsi black; membrane pale hyaline; first joint of antennæ about as long as pronotum and scutellum together; both lobes of pronotum centrally longitudinally sulcate; membrane passing apex of abdomen; femora moderately nodulose.

Long. 8 mm.

Endochus cinnamopterus, sp. n.

Cinnamon-brown; body beneath, connexivum, rostrum, and legs pale ochraceous; lateral pronotal angles black; head almost as long as pronotum, transversely constricted between the eyes, first joint of antennæ bright castaneous and about as long as anterior femora, its apex and the second and third joints ochraceous; rostrum with the first and second joints almost subequal in length; pronotum transversely constricted before middle, the anterior area a little sculptured and medially impressed, the posterior area sparingly ochraceously pilose, posterior margin truncate, the lateral posterior angles shortly, laterally, spinously produced; membrane pale bronzy; apices of femora and the whole of anterior and intermediate tibiæ cinnamon-brown; abdomen not angularly dilated, beneath with lateral series of small black spots, one on each segment; head on each side behind base of antennæ tuberculate, but not spinous.

Long. 21–22 mm.

Endochus straminipes, sp. n.

Fuscous brown; body beneath and legs stramineous; head slightly shorter than pronotum, with a rather long semierect spine a little behind the base of each antenna; first joint of rostrum distinctly longer than the second; first joint of antennæ stramineous, about as long as anterior femora, remaining joints mutilated; pronotum elongate, finely transversely constricted before middle, the posterior lobe finely granulate, posterior lateral angles longly, spinously, laterally produced; corium a little darker in hue and finely greyishly pilose; membrane bronzy; abdomen moderately angularly dilated on each side at the junction of the fifth and sixth segments; legs somewhat longly pilose.

Long. 13½ mm.

XLI.—*The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.*

IV. *On the Lepidoptera Rhopalocera collected by W. J. Burchell in Brazil*, 1825–1830. By Cora B. Sanders, of Lady Margaret Hall, Oxford.

[Concluded from p. 323.]

II. *Danainæ.*

Anosia erippus, Cram.

Bz. 122. I. 15. 8. 25. ♂ = **140.** Rio de Janeiro. "In a cross-lane about halfway between the Gloria Hill and Botafogo Bay. All found on plants." "*Papilio.*"

10. 1. 26. ♂ = **141.** Rio de Janeiro. Práia Gránde and S. João de Carahý.

27. 1. 26. ♀ = **142.** Rio de Janeiro.

31. 1. 26. ♂ = **143.** Rio de Janeiro. (As **66.**)

26. 2. 26. 2 ♂ = **144, 145.** Near Fréchal and the Rio Magé. Brazilian date and later copy on **145.**

1. 3. 26. 2 ♀ = **146, 147.** (As **121.**) Brazilian date and later copy on **147.**

13. 3. 26. ♂ = **148.** Rio de Janeiro. "From Magé. A.[M.]."

13. 3. 26. ♀ = **149.** Rio de Janeiro. "A.[M.]."

1. 4. 26. ♂ = **150.** Rio de Janeiro. "In the Valley of Catumbi."

3. 4. 26. ♀ = **151.** Rio de Janeiro. "Along the Carioca Aqueduct."

23. 9. 26. 2 ♂ = **152, 153.** Santos.

Bz. 3. 11. 26. ♂ = **154.** Santos. "On Monserrat."
12. 11. 26. ♀ = **155.** Santos. "In the Forest above the Monastery of São Bento."
14. 6. 29. ♂ = **156.** Pará.
16. 6. 29. 2 ♂ = **157, 158.** Pará. Brazilian date and later copy on **157.**
23. 6. 29. ♀ = **159.** Pará.
4. 7. 29. ♂ = **160.** „
11. 7. 29. ♂ = **161.** „
1397. + 14. 7. 29. ♂ = **162.** Pará.
Bz. 1397. + 14. 7. 29. = **162** A. Pará. A ♂ Danaine pupa-case from which the butterfly had emerged. Obviously the pupa of **162.**

23. 7. 29. / *1397.* / *1398.* / 14. 7. 29. } Both dates and both numbers written thus on one label. } = **162** B, **162** C. Pará.

Two ♀ Danaine pupæ which had died. The species is probably the same as **162** A. Both are much gnawed, perhaps by parasites, perhaps at a later date by *Anthreni.* Both pupæ on a single pin, which bears an original Brazilian label with the number *1397* in addition to the later label with the two numbers and the two dates.

8. 8. 29. ♀ = **163.** Pará.

The remaining lists in this paper were not in Westwood's handwriting.

The dates agree, except that the former existence of four or, perhaps, five additional specimens is indicated; another with the data of **149,** another with those of **159,** a specimen with the number *131,* captured on 16. 8. 25 (Rio. "Above the Theresa Convent; and on the woody hill [or hills] along the Aqueduct"), and one captured on 30. 10. 25 (Minas Geraës. "In the forest. On the N.E. side of the arraial of São João de Nĕpomucéna.") The date 5. 7. 29 follows 4. 7. 29 in the list without the usual intervening mark which indicates a separate individual. Its insertion may be merely a copyist's error. If, however, this is not the case, the additional specimen was captured at Pará. The only name given in the list is *Danais.*

Beyond this point no reference to sex indicates that no determination is given in the list.

Tasitia gilippus, Cram.

Bz. 110. II. 15. 8. 25. ♀ = **164.** Rio de Janeiro. (As **140.**)
Bz. 900. I. + 25. 10. 25. ♂ = **165.** Minas Geraes. (As **37, 38.**)

31. 12. 25. ♂ = **166.** Rio de Janeiro. "Excursion to the Summit of the Corcovado; from Catéte and up the valley of Laranjeiros."
26. 1. 26. ♂ = **167.** Rio de Janeiro. "In a botanical and entomological excursion to the Barra Vermelha, Morro de Ladeira and Catombi."
27. 1. 26. ♀ = **168.** Rio de Janeiro.
1. 3. 26. ♂ = **169.** Magé. (As **121.**)
7. 3. 26. ♀ = **170.** Rio de Janeiro. "At Catombí."
9. 3. 26. ♀ = **171.** " "
13. 3. 26. ♀ = **172.** " " "A.[M.]."
24. 12. 26. ♀ = **173.** Cubatão. "At Rio das Pedras and Cubatão."
20. 8. 27. ♀ = **174.** N.W. of Mogy Mirim. "Urisánga to Itupéba."
Bz. 3. 12. 28. ♀ = **175.** Porto Real [Nacional].
29. 1. 29. 2 ♂ = **176, 177.** Porto Real [Nacional].
Bz. 1309.+ 11. 2. 29. ♂ = **178.** Porto Real [Nacional]. "*Papilio.* The flight of this is remarkable, for it does not always hover by a constant motion of wings, but frequently sails with wings half extended, without moving them at all; nor is it very visible by what movement it sails along."
27. 2. 29. ♀ = **179.** Porto Real [Nacional].
17. 3. 29. 2 ♂ = **180, 181.** " "
22. 3. 29. 2 ♂ = **182, 183.** " " Brazilian date and later copy on **182.**
Bz.+ 23. 3. 29. ♀ = **184.** " "
24. 3. 29. ♂ = **185.** " " "Mánga."
28. 3. 29. 2 ♂ = **186, 187.** " " Brazilian date and later copy on **187.**

The dates in Westwood's list agree, except that the former existence of three additional specimens is shown, viz. another of the same date as **164**, another with the date of **180, 181,** and a specimen captured 2. 3. 29 (Porto Real=Nacional). The fact that Burchell captured two specimens on 15. 8. 25 is also shown by his note-book. The only name given is *Danais.*

[I was extremely interested to read Burchell's note on specimen no. **178,** inasmuch as it exactly describes a common mode of flight in the allied Danaine *Anosia plexippus.* I was much struck with it in the Northern United States in the summer of 1897, for I had never seen a butterfly sail in the same manner before. The appearance produced by the half-extended wings was singularly boat-like, the resemblance being much increased by a continual oscillation from side to side, like the roll of a vessel. The underside of these Danainæ is even more conspicuous than the upperside, and it occurred to me that the significance of the peculiar attitude and movement was to display the underside during flight. The method adopted is probably the only means by which this end could be achieved.—E. B. P.]

Lycorea halia, Hew.

10. 11. 25. = **188.** Minas Geraes.
31. 12. 25. = **189.** Rio de Janeiro. (As **166.**)
Bz.+ 1. 3. 26. = **190.** Magé. (As **121.**)
Bz. 10. 3. 26. = **191.** Rio de Janeiro.
Bz. 19. 3. 26. = **192.** „ "In the Valley of Catombí."
1. 4. 26. = **193.** „ "In the Valley of Catumbi."
30. 10. 27. = **194.** E. of Goyaz. On road from Meia Ponte. "Conceicão."
24. 12. 27. ♂ = **195.** Goyaz.

Name and dates agree with Westwood's list, except that he refers to a ninth specimen captured on 8. 2. 26, "Organ Mountains (in a ride to the Cattle Pounds and the Milho Roça)."

[These specimens may afford a deeply interesting instance of change in something under three quarters of a century, or, on the other hand, the results may be merely due to a deepening in the tint of a yellowish pigment owing to age.

Lycorea halia is an outlying member of Blandford's Group 3, "East Brazilian Type," Division (*a*), having "the apical spots on the fore wing yellow." This important group was shown by Mr. W. F. H. Blandford to the Entomological Society in 1897 (see Proc. Ent. Soc. Lond., May 5, 1897). It is mainly characterized by a bright yellow horizontal band traversing the hind wing parallel with the inner margin of the fore wing. The *Lycorea*, being an outlying member of the group, has a pale yellowish band, which is very different from the bright tint of the more centrally placed members, such as the species of *Heliconius*. Now Burchell's specimens are far more removed from the group than those of recent date, inasmuch as the band is but slightly paler than the tawny ground-colour of the wing. In favour of the view that a change has actually occurred and is here registered are the following facts:—(1) the specimens are, as a whole, singularly perfect; (2) one specimen is lighter than the rest, its band being of a shade common in recent specimens; (3) the yellow band, the characteristic feature of the group, is a very special and peculiar one among the numerous patterns and colour combinations of Neotropical synaposematic groups; (4) that a butterfly which is outlying to-day should be still more outlying seventy-five years ago is not surprising. Rapid change is more probable in a case of this kind than perhaps in any other. On the other side it must be remembered:—(1) that the yellow tints of some butterflies are very apt to darken; (2) that similar dark forms of *Lycorea halia* are to be found in collections of much less age, or even occasionally in recent consignments.

The latter argument, of course, supports both sides of the case.

It is not too much to hope that the question may be settled by intentional exposure or other experiments upon the yellow pigment of recent specimens, as well as by the investigation of all available material.

Miss Sanders and I have already carefully compared the Burchell specimens with the series at Oxford, in the British Museum, and in the Godman-Salvin Collection, and there can be no doubt about the existence of a marked difference between the bands of the Burchell specimens as a whole and those of more recently captured individuals of *L. halia.*

When in the later pages of this memoir the Heliconiinæ belonging to the same group are recorded, it will be convenient to reproduce typical examples of as many members as possible by the best photographic processes which we can command. I think that the differences of shade can be accurately rendered in this manner and made available in a half-tone plate.—E. B. P.]

Ituna ilione, Cram.

Bz. 12. 11. 26. = **196.** Santos. "Forest by S. Bento." Date and name as in Westwood's list.

III. *Satyrinæ.*

Pierella lamia, Sulz.

13. 5. 29. 2 ♂ = **197, 198.** Rio Tocantins, Carolina. "Boa Vista in Sylva densa" on **197.** There are two Brazilian labels on **198**: "Sylva densa" on one, "13. 5. 29 Boa Esper" on the other.

Date as in Westwood's list, where, however, only one specimen is mentioned. **198,** a very poor specimen, was found among duplicates and recognized by Burchell's handwriting on the label. The printed "Burchell Collection" label affixed to the specimens at Oxford was wanting.

When the name is not referred to, it is to be understood that none is given in Westwood's list.

Pierella nereis, Drury.

14. 1. 26. ♀ = **199.** Rio de Janeiro. (As **29.**)
14. 2. 26. ♀ = **200.** Organ Mountains. Near R. Pacaqué.
Dates as in Westwood's list.

Pierella astyoche, Erich.

7. 8. 29. ♀ = **201.** Pará.
Date as in Westwood's list.

Pierella lena, Linn.

Bz.+ 19. 5. 29. ♀ = **202.** Descent of Rio Tocantins. Rio Araguay.
Date as in Westwood's list.

Pierella dracontis, Hübn.

Bz.+ 24. 7. 29. ♀ = **203.** Pará.
4. 12. 29. ♂ = **204.** Pará, S. José.
Dates as in Westwood's list.

Anchiphlebia archæa, Hübn.

12. 3. 26. ♂ = **205.** Rio de Janeiro. "Carioca Aqueduct."

Westwood's list includes another specimen captured on 22. 3. 26 (Rio. "Along the Aqueduct to the head of the Valley of Laranjeiros").

Euptychia ocirrhoe, Fabr.

Bz. 190. I. 8. 9. 25. ♀ = **206.** Rio de Janeiro. "Along the Aqueduct. *Papilio.*"
31. 12. 25. ♂ = **207.** Rio de Janeiro. (As **166.**)
Bz.+ 7. 3. 26. ♂ = **208.** Rio de Janeiro. "At Catombí."
9. 3. 26. 2 ♂ = **209, 210,** ♀ = **211.** Rio de Janeiro. Brazilian date on **209.**
10. 3. 26. ♂ = **212.** Rio de Janeiro.
12. 3. 26. ♀ = **213.** „ "Carioca Aqueduct."
15. 3. 26. ♂ = **214.** „ "Catombi. In plantis."
16. 3. 26. ♂ = **215.** „ "In the upper part

of the Valley of Catombi, and along the road thence to Rio Comprido and Matto Porcos."

17. 3. 26. 2 ♂ = **216, 217.** Rio de Janeiro. "Along the Carioca Aqueduct, and descending the high hill mentioned (31. 1. 26) into the valley of Catombi. But they were mostly along the Aqueduct, and only a few on the hill." Brazilian date on **217.**

18. 3. 26. ♀ = **218.** Rio de Janeiro. Along the Carioca Aqueduct.

Bz. 20. 3. 26. ♀ = **219.** Rio de Janeiro. Along the Carioca Aqueduct.

Bz. 21. 3. 26. 2 ♂ ♀ = **220, 221.** Rio de Janeiro. Along the Carioca Aqueduct.

22. 3. 26. ♂ = **222.** Rio de Janeiro. Along the Carioca Aqueduct.

1. 4. 26. ♂ = **223.** Rio de Janeiro. (As **193.**)

19. 5. 29. 2 ♂ ♀ = **224, 225.** R. Tocantins. (As **202.**)

7. 6. 29. ♀ = **226.** R. Tocantins. Near Pará. "Sta. Anna."

1. 8. 29. ♂ = **227.** Pará.

18. 9. 29. ♂ = **228.** Pará, S. José. "In umbrosis Silvæ."

24. 10. 29. ♂ = **229.** „ „ "In Sylva."

15. 11. 29. ♂ = **230.** „ „ "Caminho de Chamónte."

Bz. 5. 1. 30. ♂ = **231.** Pará.

All the twenty-six specimens here recorded agree with Westwood's list, but the latter also contains thirteen individuals which cannot now be found. Of these, five were captured on dates unrepresented by existing specimens, viz.:—one taken 7. 11. 25 towards the end of the expedition into Minas Geraes, three taken at Rio on 13. 3. 26, 19. 3. 26, 3. 4. 26, and one taken at Goyaz (Caminho de Carreira) on 10. 4. 28 respectively. The remaining eight specimens are made up as follows:—One more individual captured on 7. 3. 26, one more (viz. No. *1056*) on 17. 3. 26, two more on 9. 3. 26, one more on 16. 3. 26, one more on 18. 3. 26, two more on 20. 3. 26.

Although unnamed in the list, specimen **227** bears a label with the name "*Euptychia ocirrhoe*" written by Westwood.

Euptychia mollina, Hübn.

1. 8. 29. 2 ♀ = **232, 233.** Pará. Brazilian date and later copy on **233.**

4. 8. 29. ♀ = **234.** Pará.

5. 8. 29. ♀ = **235.** „

8. 8. 29. ♀ = **236.** Pará.
Bz. 15. 11. 29. 2 ♀ = **237, 238.** Pará. (As **230.**)

Westwood's list agrees, except that it mentions three additional individuals captured at Pará,—one on 4. 7. 29 and two on 4. 12. 29. The name given is *Neonympha mollina.*

Euptychia herse, Cram.

Bz. + 23. 7. 29. ♂ = **239.** Pará. "Between my house and the city."

Westwood's list agrees.

Euptychia chloris, Cram.

31. 5. 29. ♂ = **240.** R. Tocantins, near Pará. "Baião; P. [M.]."

Westwood's list agrees.

Euptychia cosmophila, Hübn.

20. 3. 26. = **241.** Rio de Janeiro. Along the Carioca Aqueduct.

This specimen was submitted to Dr. F. D. Godman, who confirmed the identification.

Westwood's list agrees.

Euptychia cluena, Drury.

10. 3. 26. 2 = **242, 243.** Rio de Janeiro.
1055. II. 17. 3. 26. 2 = **244, 245.** Rio de Janeiro. (As **216, 217.**) "Both these caught in deep woods, as the preceding." The latter refers to **351,** and indicates capture "in the forest down the hill."
18. 3. 26. 2 = **246, 247.** Rio de Janeiro. Along the Carioca Aqueduct. Brazilian date on **246.**
20. 3. 26. 3 = **248–250.** Rio de Janeiro. Along the Carioca Aqueduct. Brazilian date on **248.**
3. 4. 26. = **251.** Rio de Janeiro. Along the Carioca Aqueduct.

245 is probably the only female.

Westwood's list agrees, except that the date 10. 2. 26 is substituted for 10. 3. 26. This is almost certainly a mistake of the copyist. It may be mentioned, however, that on the former date Burchell was in the Organ Mountains.

Euptychia myncea, Cram.

10. 8. 29. = **252.** Pará.
30. 11. 29. = **253.** Pará, S. José.

Euptychia penelope, Fabr.,=*clarissa*, Cram.

Bz. 1332.+ 2. 3. 29. = **254.** Porto Real [Nacional]. "*Papilio.* In woody places among the bushes. This and its congeners fly in a very hovering zigzag manner low among the bushes and herbage."
Bz. 15. 3. 29. = **255.** Porto Real [Nacional].
7. 6. 29. = **256.** R. Tocantins. (As **226.**)
27. 7. 29. = **257.** Pará.
15. 11. 29. = **258.** Pará, S. José. (As **230.**)

It is probable that the individuals of *myncea* and *penelope* are considered together in Westwood's list. The dates here recorded agree, except that 10. 8. 29 (**252**) is replaced by 10. 2. 29, probably a clerical error. The list furthermore includes individuals captured on 29. 12. 28 (Porto Real) and 18. 6. 29 (Pará).

Euptychia sp.

28. 5. 28. 2 ♂ = **259** (Pl. VI. fig. 8), **260.** Goyaz. "Peak near Cánta Gállo." "In summitate montis." Burchell's label, written in England, is reproduced to the right of and below figure 8.

These specimens were submitted to Dr. F. D. Godman, who is unable to name them. Mr. F. A. Heron considers that the markings best agree with *E. similis* (Butl.), but he points out that the eyes of the latter are hairy, while those of **259, 260** are naked. In the character of the distal end of the cell of the fore wing these specimens also best agree with *similis* and its allies. The marked development of the ocelli on both wings is peculiar, together with the extent to which they appear on the upper surface. The fore wing is especially remarkable in these respects. The species is almost certainly new and both striking and distinct; but the specimens are unfortunately in such poor condition that it is impossible to make either of them types. As the locality and time of year are precise, it is to be hoped that some naturalist in Brazil will capture examples which may be described, and named after the great traveller and observer.

Westwood's list agrees.

Euptychia electra, Butl.

Bz. 1306.+ 8. 2. 29. 2 = **261** (Pl. VI. fig. 9, showing underside), **262** (fig. 10). Porto Real [Nacional]. "Boracão."

"This genus is entirely sylvan, and delights to hover low among the herbage and thicker foliage. This was caught in the Carasco, or thicker campo-woods ; and another afterwards caught in the back yard."

The two labels affixed to each specimen are reproduced on the Plate to the right side of the respective figures. The lower number, written less carefully and with thicker lines, is in each case an original Brazilian label. The upper number and date, written by Burchell after his return, are upon a separate piece of paper, although the overlapping upper edge of the older label is in each case invisible.

Bz. 10. 2. 29. = **263.** Porto Real [Nacional].

These three specimens were submitted to Dr. F. D. Godman, who writes (Feb. 27, 1904) :—"Your specimens, which exactly resemble six I have from Chapada, have the four ocelli on the hind margin of the underside of the fore wings strongly marked, whereas in Butler's type [of *electra*], which is from Bahia, they are obsolete; but I have specimens showing all intermediate gradations from Brazil. These ocelli in the Satyridæ generally vary much both in size and distinctness, and are not a very good character for distinguishing a species."

The ocelli mentioned by Dr. Godman are well seen in fig. 9 of the accompanying Plate VI.

Westwood's list agrees.

Euptychia armilla, Butl.

8. 11. 28. 6= **264–269.** Near Porto Real [Nacional]. "Corrego Raiz." Brazilian dates on **266**, **268**, and **269.**

No data. = **270.**

These specimens were kindly named for us by Dr. F. D. Godman, F.R.S.

Agrees with Westwood's list, except that the latter includes a seventh individual captured 8. 11. 28, a second without data, and an individual captured 10. 2. 29 (Porto Reál).

Euptychia liturata, Butl.

26. 9. 26. = **271.** Santos. "In a walk to the Chapel on Montserrát."

Bz. 30. 8. 28. = **272.** Near Jaragua. "Estiva."

1250.+ 11. 9. 28. 2= **273, 274.** Between Jaragua and Cavalcanti. "Trahíras, R. Vendinha." "*Papilio.* Flying low among grass in woods or margin of woods, in considerable numbers. They have the same habits and hovering mode of flight as their congeners at the Cape of Good Hope." Brazilian label and later copy on **274.**

These specimens were also named for us by Dr. F. D. Godman.

Westwood's list probably agrees, except that an additional ndividual captured 11. 9. 28 is mentioned. Another individual, captured 26. 11. 26, is probably **297**, accidentally associated with *liturata* instead of *camerta*.

Euptychia acmenis, Hübn.

10. 3. 26. 2 = **275, 276.** Rio de Janeiro. Along the Carioca Aqueduct.
18. 3. 26. 2 = **277, 278.** Rio de Janeiro. Along the Carioca Aqueduct. Brazilian date on **278.**
21. 3. 26. = **279.** Rio de Janeiro. Along the Carioca Aqueduct.
3. 4. 26. = **280.** Rio de Janeiro. Along the Carioca Aqueduct.

Westwood's list agrees.

Euptychia camerta, Cram.

Bz. 350. II. 15. 10. 25. 2 = **281, 282.** Minas Geraes. "At the Discoberto do Antonio Velho; *P*[*apilio*]."
Bz. 470. I. 16. 10. 25. = **283.** Minas Geraes. Discoberto. "*Papilio.*"
Bz. 829. I. + 23. 10. 25. = **284.** Minas Geraes. Discoberto. "*Pap*[*ilio*]."
914. II. 25. 10. 25. 2 = **285, 286.** Minas Geraes. "*P*[*apilio*]. At Discoberto, near João Pedro's house." Brazilian label and later copy on **285.**
Bz. 1002. I. + 27. 10. 25. = **287.** Minas Geraes. "At São João de Nepomucena and on the road from Discoberto. *Pap*[*ilio*]."
28. 10. 25. 2 = **288, 289.** Minas Geraes. (As **72.**)
4. 11. 25. 3 = **290–292.** „ (As **19.**)
Bz. + 6. 11. 25. = **293.** Minas Geraes. "At Capitão Leite's." Near Nepomucena.
9. 2. 26. = **294.** Organ Mountains. "By the River Pacaqué."
Bz. 17. 3. 26. = **295.** Rio de Janeiro. (As **216, 217.**)
Bz. 20. 3. 26. = **296.** „ Along the Carioca Aqueduct.
26. 11. 26. = **297.** Santos. (As **8.**)
7. 3. 27. 3 = **298–300.** Near S. Paulo. "Morumby. Walk to Porto." "In Silva" on **299**, "Sylva" and date on Brazilian label on **300.**

21. 3. 27. = **301.** Near S. Paulo. "On Road W. beyond Práça da Aleyria."
8. 4. 27. = **302.** Near S. Paulo.
23. 4. 27. = **303.** " "
10. 5. 27. 2 = **304, 305.** Near S. Paulo. "About the Tiete and near Sta. Anna."
18. 6. 27. = **306.** Near S. Paulo.
22. 3. 28. = **307.** Near Goyaz.
1. 4. 28. = **308.** " "
19. 4. 28. = **309.** " "
Bz. 30. 4. 28. = **310.** Near Goyaz.
Bz. 12. 6. 28. = **311.** " "
Bz. 1303. I. + 4. 2. 29. = **312.** Porto Real [Nacional]. "*Papilio.* Caught in the back yard, and perhaps only a weather-worn variety."
5. 2. 29. = **313.** Porto Real [Nacional].
Bz. 6. 3. 29. = **314.** Porto Real [Nacional].
Bz. 9. 3. 29. = **315.** " "
15. 3. 29. = **316.** " "
Bz. + 17. 3. 29. = **317.** " "
Bz. + 9. 4. 29. = **318.** " "
22. 4. 29. = **319.** Porto Real [Nacional]. "Various" [? places].
Bz. + 19. 5. 29. = **320.** On R. Tocantins. R. Araguay.
26. 5. 29. = **321.** R. Tocantins, N. of Itaboca. Near Falls of Guariba.
26. 6. 29. 2 = **322, 323.** Pará. "Near my house (Pomba Roçinha)." Brazilian date and later copy on **323.**
6. 7. 29. = **324.** Pará.
27. 7. 29. = **325.** "
10. 9. 29. = **326.** Pará, S. José.
17. 10. 29. = **327.** " "
8. 11. 29. 2 = **328, 329.** Pará, South of S. José.
15. 11. 29. = **330.** Pará, S, José. "Caminho de Chamonte."
8. 12. 29. = **331.** Pará, S. José. "Suburbanæ."

Westwood's list agrees in a remarkable manner with this long series of specimens. He separated the individuals into four sets (unnamed), apparently influenced by the development of the eye-spots upon the underside. The only difference is the substitution in his list of 22. 4. 28 for 22. 4. 29, probably a mistake in copying, and the omission of **297.** The latter was probably included with the individuals of *liturata.*

Euptychia quantius, Godt.

9. 2. 26. ♂ = **332.** Organ Mountains. "By the River Pacaqué."

This specimen has been submitted to Dr. F. D. Godman, who considers that the species is probably *quantius*.

Westwood's list agrees.

Euptychia renata, Cram.

27. 8. 28. ♂ = **333.** Near Jaragua. Goiaveira. "All these Lepidoptera were caught at the ford of the rivulet at Goiaveira, at 5 P.M."

26. 5. 29. ♀ = **334.** On R. Tocantins. (As **321.**) "Silva."

Westwood's list agrees, except that 26. 8. 29 is substituted for 26. 5. 29, probably a copyist's error.

Euptychia marmorata, Butl.

Bz. + 14. 2. 26. = **335.** Organ Mountains. Near R. Pacaqué.

13. 4. 27. = **336.** Near S. Paulo.

Bz. 10. 5. 27. = **337.** Near S. Paulo. "About the Tiete and near Sta. Anna."

14. 6. 27. = **338.** Near S. Paulo.

Westwood's list agrees.

Euptyche libye.

31. 5. 29. = **339.** R. Tocantins. Baião. "P.[M.]."

17. 9. 29. = **340.** Pará, S. José.

17. 11. 29. 2 = **341, 342.** Pará, S. José.

7. 1. 30. = **343.** Pará.

Westwood's list agrees, except for an additional specimen captured 10. 8. 29 (Pará).

Taygetis valentina, Cram., form *euptychidia*, Butl.

12. 5. 28. = **344.** Goyaz. "Caught in the woodhouse."

We owe this determination to the kindness of Mr. F. A. Heron.

In Westwood's list 15. 5. 28 is substituted for 12. 5. 28. The words "Caught in the woodhouse" are present, proving that the discrepancy is merely a copyist's error.

Taygetis Andromeda, Cram.

9. 3. 26. = **345.** Rio de Janeiro.

Bz. 10. 3. 26. = **346.** Rio de Janeiro.
Bz. 19. 3. 26. = **347.** " "In the Valley of Catombí."

Westwood's list agrees. **346** was separated as another form.

Taygetis virgilia, Cram.

Bz. 197. I. 8. 9. 25. = **348.** Rio de Janeiro. Along the Aqueduct. "*Papilio.* In sylvâ; in crepusculo volitans."

10. 3. 26. = **349** (Pl. VI. fig. 12; Burchell's manuscript label is reproduced below the figure). Rio de Janeiro.

Bz. 1054. II. 17. 3. 26. = **350.** Rio de Janeiro. (As **216, 217.**) "Both these Papiliones were caught in the forest down the hill." The Brazilian number and later copy without date on **350.**

1248.+ 7. 9. 28. 2 = **351, 352** (fig. 11; Burchell's reference number and date are reproduced to the right of the figure). Between Jaragua and Cavalcanti; near Rio Maranhão. Fe Guárda Môr. "At twilight in deep shady wood, where we slept this night. Has a hovering motion and settles on the ground. P.M." Brazilian label and later copy on **351.**

Westwood's list agrees. He separated out **351, 352,** evidently on account of the character described below.

The Burchell specimens from Rio Maranhão (**351** and **352**) show a rufous border on hind wing altogether absent from the long series of this species in the Hope Collection. This character becomes common in Central America. Thus we read in the Rhopalocera of the 'Biologia Centrali-Americana' (vol. i. p. 97):—"The rufous margin, however, is more commonly seen in specimens from northern localities." The occurrence of the character in a pronounced form in both specimens from a locality near the opposite end of the range of the species may therefore indicate a local change or replacement of form in seventy-five years. It is much to be hoped that a traveller who has the opportunity of retraversing this part of Burchell's route may enable us to compare the two 1828 specimens with a good series from the same locality.

The striking difference as regards the hind marginal border of the hind wings between **351, 352,** and the specimens from Rio (**348–350**) is well shown in figs. 11 and 12 on Plate VI.

Taygetis echo, Cram.

Bz. 16. 4. 28. = **353.** Goyaz. "Morro de Canta Gallo." "In horto proprio."

Compared with Godman-Salvin Coll. (6 L. Amazons, 1 N. Brazil, 1 no locality.) The Burchell specimen has a broader brighter yellow band on fore wing than these, or six Hope Coll. specimens (not Brazilian).

Westwood's list agrees.

Pedaliodes phanias, Hew.

9. 2. 26. ♂ = **354.** Organ Mountains. "By the River Pacaqué."

Westwood's list agrees.

In addition to the individuals which Westwood's list shows to be missing from certain of the above-mentioned species, three small categories separated out in the list have not been traced at all. They are as follows:—

Hipparchia V. Two individuals—14. 6. 27 and *1399*. 24. 7. 29.
" XXVII. One individual—27. 8. 28.
" XXXV. Four individuals—*118*. 15. 7. 25, one without data, and the two following, which are certainly erroneous: *137*, shown by the note-book to be a *Cicada*; *153*, which is similarly found to be a *Cassida*.

EXPLANATION OF PLATE VI.

The Plate has been printed from a half-tone block prepared from a beautiful photograph of the actual specimens taken in the Oxford University Museum by Mr. Alfred Robinson. All the figures are the natural size.

Fig. 1. *Leucothyris phenomoe*, Dbl. & Hew., n. subsp. *Burchelli*. A representation of specimen **64**, the type of the subspecies. The heavier black markings which are characteristic of *Burchelli* as compared with *phenomoe* are at once apparent when figs. 1 and 2 are contrasted with 3 and 4. Burchell's label, written in England, is reproduced to the right of the figure.

Fig. 2. Another example of the form shown in fig. 1. A representation of **65**. Burchell's label, written in England, is reproduced to the right of the figure.

Figs. 3 & 4. Two examples of *Leucothyris phenomoe*, Dbl. & Hew. Representations of specimens **60** and **61** respectively. Burchell's labels, written in England, are reproduced to the right of the figures to which they respectively refer.

Fig. 5. *Dircenna dero*, Hübn. A representation of specimen **74**. The black markings are far less heavy than in figs. 6 and 7. On the other hand, it must be remembered that **74** is a male, while **68** and **72**, the specimens represented in figs. 6 and 7, are females. **74** is also more worn than the other two, and this tends to diminish the depth of the black markings. But, making all allowances, **74** must always have been much less heavily marked than **68** and **72**. Burchell's label, written in England, is reproduced to the right of the figure.

Fig. 6. *Dircenna dero*, Hübn., form *rhoëo*, Feld. A representation of specimen **68.** H. W. Bates believed that this form is replaced by typical *dero* in S.E. Brazil, and yet six out of Burchell's eight specimens from this very locality are *rhoëo.* Burchell's label, written in Brazil, is reproduced to the right of the figure.

Fig. 7. *Dircenna dero*, Hübn., form *rhoëo*, Feld. A representation of specimen **72**, another heavily marked form, although the median nervures of the hind wing are much less suffused with black than in the specimen shown in fig. 6, which is peculiar in this respect among all Burchell's captures. Burchell's label, written in England, is reproduced to the right of the figure. The figure appears to represent a butterfly with shorter broader wings than those of the originals of figs. 5 and 6. This is merely the effect of fore-shortening, the wings of the former having drooped after resetting. The obvious difference in the figures is a convincing demonstration of the false impression of form conveyed by the old British mode of setting with sloping wings.

Fig. 8. *Euptychia* sp. A representation of specimen **259.** Burchell's label, written in England, is reproduced to the right of and below the figure.

Fig. 9. *Euptychia electra*, Butl. A representation of the underside of specimen **261.** The four small submarginal ocelli on the fore wing, which are so distinctly shown in the figure, are obsolete in the type of *electra*, from Bahia. Burchell's two labels are reproduced to the right of and rather below the figure. The lower number, which is really on a separate label, was written in Brazil, the upper number and the date in England.

Fig. 10. *Euptychia electra*, Butl. A representation of the upperside of specimen **262.** Burchell's two labels are reproduced to the right of the figure. They were written as described in fig. 9.

Fig. 11. *Taygetis virgilia*, Cram. A representation of specimen **352.** The label, written by Burchell in England, is reproduced on the right side. The rufous hind marginal border of the hind wings is well indicated. This feature, which is characteristic of Central-American specimens, is here found in both of Burchell's captures (7. 9. 28) from the Maranhão River, to the N.E. of Goyaz.

Fig. 12. *Taygetis virgilia*, Cram. A representation of specimen **349.** The label, written by Burchell in England, is reproduced below the figure. The pale brown border of the hind wings is seen to be very different from that of fig. 11. The appearance here shown is common to all three specimens from Rio (**348–350**), just as that of fig. 11 is common to the two from the Rio Maranhão.

XLII.—*Notes on* Phasmidæ *in the Collection of the British Museum (Natural History), South Kensington, with Descriptions of new Species.*—No. I. By W. F. Kirby, F.L.S., F.E.S.

The Phasmidæ have been less studied than any other family of Orthoptera, and the classification is still in a rather unsatisfactory state. Many genera are at present somewhat isolated, owing probably to the incompleteness of our collections, and many others include discordant sections which require new names. Nor do we appear to possess sufficient material to enable us to judge of the real value of even such important characters for defining natural groups as the length and structure of the antennæ and of the median cell, and the presence or absence of the areole at the end of the tibiæ beneath. I would suggest that the shape of the median segment may perhaps be found to be of great importance, especially whether it is pointed, rounded, or truncated in front.

As I find myself unable to adopt Brunner von Wattenwyl's arrangement of 1893 in its entirety, I have drafted out the following provisional arrangement of subfamilies:—1. Lonchodinæ; 2. Bacteriinæ; 3. Bacillinæ (including Bacillidæ and Clitumnidæ of Brunner); 4. Diaphomerinæ; 5. Bacteriinæ; 6. Phryganistriinæ; 7. Palophinæ; 8. Necrosciinæ; 9. Acrophyllinæ; 10. Eurycanthinæ; 11. Heteropteryginæ; 12. Anisomorphinæ; 13. Prisopinæ; 14. Pseudophasminæ; 15. Aschiphasminæ; 16. Phylliinæ.

Subfam. I. *Lonchodinæ.*

Lonchodidæ, Brunner (pt.).

Includes Old-World species with long antennæ and a short median segment. Most of the genera are apterous, but one or two (*Oxyartes*, Stål, for instance) have rudimentary wings.

Genus Stælonchodes, Kirb., n. n.

Lonchodes, pt., Gray (nec sect. typ.); Stål (restr.).

Type, *L. geniculatus*, Gray.

This is Gray's second species, but his own description actually contradicts the characters of the genus *Lonchodes*; yet Stål has selected it as the type, an utterly unwarrantable action. A considerable number of species may be temporarily included in *Stælonchodes*, but the genus will probably be soon subdivided.

Stælonchodes gracillimus, sp. n.

Long. corp. 100–116 mm.

Male.—Long and slender, rufous or rufous-brown, more or less varied with blackish bronze or olive-green; antennæ bronzed; head and pronotum rufous; mesonotum, metanotum, and median segment bronzy brown, except at their extremities, which are rufous; one specimen, however, is uniform olive-green over nearly the whole of these parts; abdomen either bronzy black, with tawny bands at the extremities of the segments, or rufous as far as the sixth or seventh segment and black beyond, with or without two white spots at the end of segments 8 and 9; legs very long and slender, the middle legs somewhat shorter than the others; all the femora rufous nearly to the extremity; the rest of the legs bronzy black above and somewhat paler below; middle and hind femora finely serrated beneath towards the extremities, hind femora extending beyond the base of the sixth segment of the abdomen.

Hab. Tonkin (Than Moi), June and July (*Fruhstorfer*).

Allied to *S. praon* and *stomphax*, Westw., but larger. The very long and slender legs, with red femora, are very characteristic.

Genus Lonchodes, Gray et auct.

Dixippus, Stål.

Gray's description of this genus and of his first species, *L. longipes*, clearly indicates that as the type.

Lonchodes (?) *viridis*, sp. n.

Female.—Bright green, with the following exceptions:—antennæ, except towards the base, a square spot at the extremity of the first four segments of the abdomen (reckoning the median segment as the first), and a dot on the sides of each corresponding suture black or blackish; and a salmon-coloured streak on the sides of the meso- and metanotum, separated below by a green line from a salmon-coloured line, bordered below by a yellow one. Legs short, of nearly equal length; femora thick, straight, except for the usual curve at the base of the front femora, and with a semicircular lobe at the extremity of each lower carina, those on the front femora small, those on the others conspicuous. First joint of front tibiæ lobate above and nearly as long as the remaining joints. Head and body unarmed, but with a fine carina running down the whole length, and thickly but finely granulated, especially on the thoracic segments, which causes them to appear very finely denticulated on the sides. Prothorax with a raised carina in front and a central transverse sulcus. Abdominal segments 2–7 at least twice as long as broad, the eighth to tenth strongly carinated, the ninth shortest and transverse, the others only slightly longer than broad; the tenth indented in the middle, to expose the small but strongly carinated eleventh; operculum boat-shaped, strongly carinated on its hinder half, and not excavated at the extremity, which extends as far as the tenth segment.

Hab. Tonkin (Than Moi), June and July (*Fruhstorfer*).

Described from two specimens.

This interesting species will probably become the type of a new genus when the Lonchodinæ are revised.

Dimensions.

	mm.
Long. corporis	105–118
„ capitis	7
„ pronoti	$4\frac{1}{2}$
„ mesonoti	19–21
„ metanoti, cum segm. med.	18–19
„ fem. ant.	19–20
„ „ med.	14–16
„ „ post.	17–19

Genus Oxyartes, Stål.

Oxyartes lamellatus, sp. n.

Male.—Rather slender, brown; head with six tubercles on the hinder edge; antennæ pubescent, greenish brown, darker towards the ends of the joints, nearly as long as the body, and composed of about sixty joints, irregularly longer and shorter; pronotum with two erect spines near together in front, and two longer ones (wider apart) behind the first lobe; mesonotum smooth, inclining to greenish, with a pair of strong spines near together in front and five pairs behind (one pair on each side of the median line, one pair in front of these, separated by the median line, and one pair on each side before the base of the almost obsolete tegulæ), there is also a lateral row of shorter spines, followed by a lower row of tubercles; metanotum with two spines between the bases of the wings and three larger ones on the metapleura; wings black, paler at the base and on the costa, narrowly oval, and extending as far as the middle of the median segment; meso- and metapectus studded with black tubercles, a distinct tubercle on the median line above towards the extremity of each abdominal segment. Legs pubescent, carinated; femora with two or three small teeth on each side beneath before the extremity.

Female.—Larger and stouter than the male and darker brown, but inclining to grey on the head, pronotum, antennæ, and legs; antennæ spotted with brown on most of the joints; head with four short and broad tubercles on the hinder edge, two central and two lateral; mesonotum rugose, covered with tubercles and laterally with short spines, continued on the meso- and metapleura; mesonotum with two strong spines near the middle in front, the left-hand one with a smaller spine adjoining it; there are also two strong spines, wider apart, towards the hinder extremity, and at the hinder edge itself three or four close together on each side; metanotum and abdomen rugose and more or less granulated, two short spines on the latter between the wings, which are blackish and broader than in the male; abdomen with a short tooth near the extremity of each segment in the median line, and from the sixth segment to the extremity strongly carinated, the carina on the seventh segment rising into a large lamella for the greater part of the segment, preceded by a smaller one on the sixth.

Hab. Tonkin (Than Moi), June and July (*Fruhstorfer*).

Described from one male and two females.

Allied to *O. despectus*, Westw., but larger, and with stronger and differently arranged spines.

Dimensions.

	♂.	♀.
	mm.	mm.
Long. corporis	84	102–125
„ capitis	8	7–9
„ pronoti	5	7–9
„ mesonoti	19	20–29
„ metanoti, cum segm. med.	11	13–15
„ segm. med.	6	8–9
„ fem. ant.	25	21–25
„ „ med.	19	18–21
„ „ post.	31	21–25
„ al.	6	8–9
Lat. al.	$1\frac{1}{2}$	3–4

Genus Promachus, Stål.

Promachus (?) *lætus*, sp. n.

Apora læta, Brunner, MS.

Long. corp. 65–82 mm.

Male.—Green; rather slender, front and hind legs of nearly equal length, the latter extending nearly to the extremity of the fifth segment of the abdomen; middle legs shorter than the others. Face varied with whitish, and base of the antennæ shading from green into blue. Pronotum with a transverse sulcus just before the middle; mesonotum with four or five large asymmetrical black spines, thickened at the base, and with a row of concolorous denticulations on the sides, followed by a black spine before the base of the four hinder legs; hind femora slightly denticulated beneath at the extremity; median segment about two fifths of the length of the metanotum, rounded in front; segments 2–6 of the abdomen with a small terminal tooth on the median line; all the segments of the abdomen longer than broad, except the tenth, which is carinated, but scarcely indented at the tip; operculum boat-shaped, scarcely longer than the ninth segment; cerci short, stout, slightly incurved.

Female (long. corp. 110 mm.).—Bright green; rather stout, but tapering towards both the head and tail; a brownish line running along the lateral borders of the thorax and abdomen; mesonotum with some small scattered black tubercles, or, rather, granules; meso- and metapleuræ spinose on the dark lateral line already referred to; abdomen with some more or less complete double carinations on the median line of the hinder segment, and with a single slightly undulating carina on each side; there is a small tubercle or spine at the end of the first seven segments, including the median segment; on segments 2–7 stand two or three green tubercles above the lateral line; the tenth segment is twice suddenly contracted at the sides and terminates in an obtuse triangle above; the double median carina on the ninth coalesces into a single steep carina, which continues to the extremity of the tenth; operculum pointed and channelled, extending beyond the tenth segment to more than twice the length of the latter.

Hab. Tonkin (Matton Mountains, 2000–3000 metres), April and May (*Fruhstorfer*).

The male of this species is closely allied to *P. Wallacei*, Westw., from Aru, the type of the genus, but is easily distinguished by the spineless head and the black spines on the mesonotum. The female, however, like that of the following species, wants the long, projecting, spear-like process above the operculum, so conspicuous in that of *P. Wallacei*. The specimens were received under the MS. name of *Apora læta*, Brunn. The specific name I have of course retained, but the generic name is preoccupied in Polyzoa, and is therefore inadmissible.

Promachus (?) *bicolor*, sp. n.

Long. corp. 55–57 mm.

Male.—Rufous; the antennæ, spines, a broad band down the middle of the body, bisected by the rufous carina, an interrupted lateral line, and the legs beyond the apical fourth of the femora black or blackish. Head with two pairs of spines near the back; pronotum deeply sulcated before the middle, with a pair of long spines on the front lobe and small lateral ones at the front angles, and two pairs of spines (the first longest) on the second lobe. Mesonotum with five pairs of spines (the last pair approximating) on the central region, and a row of six spines on each side on the lateral black line; metanotum, median segment, and several of the basal segments of the abdomen with a pair of central spines, diminishing in size hindwards; there are also two strong lateral spines on the metanotum and two on the meso- and metapleuræ. Segments of the abdomen hardly twice as long as broad; hind legs rather longer than the others, extending as far as the extremity of the seventh segment of the abdomen.

Female (?).—Larger and stouter; testaceous, mottled with blackish; the spines arranged nearly as in the male; legs shorter, stouter, and carinated; hind femora extending rather beyond the fifth segment of the abdomen; abdomen with a sinuous carina on the sides of the segments, segment 10 tripartite at the extremity; except the front lobe of the pronotum, the whole median line of the thorax and abdomen is traversed by a very strong raised carina. Abdomen without terminal spine; operculum not projecting beyond the last segment.

Hab. Tonkin (Than Moi), June and July (*Fruhstorfer*).

XLIII.—*On the Genus* Ortmannia, *Rathb., and the Mutations of certain Atyids.* By E. L. Bouvier *.

The shrimps of the family Atyidæ belong exclusively to fresh water. Despite their adaptation to this special medium and the strange aspect of their most typical forms, they attach themselves by a series of genera to the most primitive of the marine shrimps. From *Xiphocaris*, of which the chelæ are normal and are furnished with exopodites on all the feet, one passes to *Atyœphyra*, in which the exopodites have disappeared on the three posterior pairs of feet, to *Caridina*, which have no expodites and whose anterior

* Translated from the 'Comptes Rendus,' t. cxxxviii. p. 446.

chelæ are alone modified, then to *Ortmannia*, M. Rathbun (*Atyoida*, Ortmann), in which the modifications take place in the chelæ of the first two pairs of feet, and at last one comes to the terminal forms of the family, the *Atyæ*, of which the very curious chelæ are split right down to the base and in consequence are devoid of a palmar region. Further, in the genus *Atya* itself it is possible to establish a series of species which progressively depart from *Ortmannia*. By its small size and its rostrum, subtriangular and toothed below, *A. serrata* presents some resemblance to *Ortmannia mexicana*, Sauss. (*O. potimirim*, F. Müller), whilst *A. gabonensis*, Giebel, *A. robusta*, A. Milne-Edwards, and many other forms stand out at first sight by their very marked adaptive characters: large size, rostrum laterally serrated, feet of the third pair singularly strong and robust, &c.

It appears that *Ortmannia* is separated from all species of *Atya* by two very constant characters: on the one hand, the form of the chelæ, which are normal, with a relatively short mobile digit and a well-differentiated palmar region; on the other, the development of the carpus, which is longer than wide, at least in the feet of the second pair. These two characters are of the first importance; they bring together *Ortmannia*, *Caridina*, and *Atyæphyra*, whilst they separate them considerably from the *Atyæ*.

In studying the Atyidæ in the collection of the Museum, a batch of shrimps, collected at Honolulu by M. Ballieu, particularly attracted my attention. These shrimps were Atyidæ of small size, all adult, and in other respects very much alike; but some presented all the characters of *Atya bisulcata*, Sp. Bate, whilst others belonged very clearly to the genus *Ortmannia*.

In 1901, Miss Mary Rathbun made an analogous observation on the Atyidæ collected on the Sandwich Islands by Mr. Henshaw; she grouped in the species of Sp. Bate all the examples with short carpi and chelæ split down to the base; the others she regarded as types of a new *Ortmannia*, *O. Henshawi*. I found myself confronted by the same forms, but I was led to regard them quite differently from Miss Rathbun.

Setting aside the generic characters affecting the carpi and chelæ, these two forms resemble one another in all respects: same structure of rostrum, antennæ, buccal appendages, same tegumentary ornaments, everywhere the most absolute identity—somewhat strange in species belonging to different generic types. More than this, the two forms have that similarity of appearance which characterizes all the representatives of a single species, and which, in the determination of species, is a more rapid and sometimes a surer guide than the examination of morphological characters. In my opinion, *Ortmannia Henshawi* is neither more nor less than a form of *Atya bisulcata*, a form which has the curious character of recalling the immediate ancestral form of *Atya*. We have not here to deal with an ordinary dimorphism, sexual, produced by season or locality: the specimens of M. Ballieu were collected in the month of May, 1877, in the vicinity of Honolulu, perhaps with one stroke of the net; in both forms there are the same variations of size and sex. Some females of *Atya bisulcata* are charged with ova, whilst the females of the *Henshawi* variation have none; but in another consignment, also made by M. Ballieu, the females of this variation carry a remarkably large charge of ova.

I should not perhaps have hazarded the foregoing conclusion if the Museum material had not permitted me to extend it to other quarters of the globe.

In 1890, M. Alluaud collected in a torrent on the Amber Mountain, in Madagascar, a small shrimp which presented all the characters of the genus *Ortmannia*, but differed from the modification *Henshawi* by specific characters; latterly the Museum has received from Sainte Marie, in Madagascar, a small batch of shrimps *, in which examples of *Atya* and *Ortmannia* absolutely resembling one another (setting aside generic characters) were mixed. The specimens of the first form appeared to me to be classifiable as *Atya serrata*, Sp. Bate: those of the second resembled that from the Amber Mountain; they have all the specific characters of *Atya serrata*, and represent certainly, in my opinion, a modification of this species. This will be, if desired, the modification *Alluaudi* of *A. serrata*.

A. serrata exists also in the island of Bourbon, where Maillard, about 1854, obtained three specimens, which are now in the Museum. The modification *Alluaudi* of this species was found, in 1893, by M. Alluaud in the ravines of the mountains of Salasie and Helbour. Another specimen was taken by M. Alluaud, in 1890, in Mauritius; the typical *A. serrata* has not yet been noted in this island, but one cannot doubt its existence there as well as in Réunion.

These modifications are of great interest, because they put in evidence one of the mechanisms by which new types are produced and definitely established through more primitive types which may persist or disappear.

* These shrimps were captured in a little rivulet near Sainte Marie in October 1895, and were presented to the Museum by M. Edouard Chevreux.

In face of these modifications, one cannot doubt but that the *Atyæ* are the direct descendants of *Ortmannia*, and that, in the case of certain species, this derivation is not yet a definitely accomplished fact. It is naturally among the small forms, nearer than any others to the primitive Atyidæ, that this condition of unstable equilibrium is seen still to exist, in which the same creature may indifferently present the form of the past or of the future: *Atya bisulcata* and *Atya serrata* are still in this stage. In *Ortmannia americana* the primitive form alone exists; either it has persisted after having produced the *Atya*, or it is in a state of evolution towards the production of this kind, which is more probable. In *Atya brevifrons*, de Man, on the contrary, the primitive form seems to have disappeared, bequeathing a very marked stamp to its descendant, which is small like the *Ortmannia* and provided as it is with locomotor feet of small power. *A. brevifrons* is a common species in the islands of the Pacific; it has never been noticed under the form *Ortmannia*, but it is possible that in some island it persists still in that state.

It goes without saying that in the most typical *Atyæ* (*A. robusta*, *A. scabra*, &c.), which are greatly modified and of large size, one would not expect to find specimens having the *Ortmannia* form.

Here, then, manifestly are *mutations by atavism* which show us how new types are formed and old types persist. Actually, *Atya bisulcata* and *A. serrata* are represented by individuals of two kinds—the one with chelæ split down to the base, the other with normal chelæ. If these species were social, the individuals of each type might be called upon to play a different *rôle* in the colony, and to a certainty the characters which distinguish them would go on exaggerating themselves in consequence.

May we not explain in the same way the mysterious presence of polymorphic individuals in the societies of ants and termites? and the starting-point of the polymorphism of these forms, would it not be an atavic mutation similar to that of the *Atyæ*?

I return to the domain of pure systematics. The genus *Ortmannia* should persist, but it comprises up to the present time, it appears, only a single independent species—*O. mexicana*, of Tropical America. The modification *Henshawi* of *Atya bisulcata* and the modification *Alluaudi* of *Atya serrata* are clearly *Ortmannia*; but they represent species in course of evolution, which, according to circumstances, may persist or disappear as *Ortmannia*; it is useful to look upon them no longer as independent species, but as the atavic form of the species of *Atya* which issued from it. It is easy to verify upon the spot the exactness of the views expressed in this note. Those who do not accept them may always regard the two modifications described above as distinct species of *Ortmannia* *.

XLIV.—*Notes on a new Species of* Acis. By W. D. Henderson, M.A., B.Sc., Zoological Laboratory, the University, Aberdeen.

While working along with Prof. J. Arthur Thomson over a collection of Indian-Ocean Alcyonarians I recognized the new species here described. It was included in a collection made by Prof. W. A. Herdman in Ceylon.

The colony is large and fan-shaped, rising to a height of 149 mm. and having a maximum width of 167 mm.

From a conical base, which has a flat spreading margin and is attached to a mass of worm-tubes, the short main stem arises. At a distance of 14 mm. from its origin, where it has a diameter of 3·5 mm., it divides into two principal branches.

The branching is for the most part confined to one plane, but several of the smaller branches and twigs arise at right angles to the principal plane of branching. The branching is very profuse and at several points shows anastomosis of the branches, but this is by no means common. The branches are cylindrical, but there are traces of slight flattening in the plane of branching. The twigs arise usually at right angles to the branches, and their tips as well as those of the branches are slightly clavate.

The polyps are small and are scattered over the whole surface of the stem and branches. In no place can it be said that they are confined to three surfaces, nor can any attempt at lateral arrangement be seen. The verrucæ are very small and the polyps can be completely retracted within them. The edges of the verrucæ show a variable number of spines which project above the slightly conical operculum formed by the tentacular spicules when the polyps are withdrawn.

The superficial cœnenchyma of the stem and the branches presents a striking appearance, due to the arrangement of the large flat whitish spicules and to their being outlined against the darker ground-colour of the stem and branches.

The spicules of the general cœnenchyma are flat and multituberculate, varying very much in size and shape. The

* M. Ortmann regards *Atya bisulcata*, Spence Bate, as an *Ortmannia* (*Atyoida*), although the examples studied by the English author had the true Atyan chelæ; I may add that M. Ortmann does not appear to have observed the curious variations of this species.

tubercles are low and rough and very numerous. Many of the larger spicules extend the whole distance between two adjacent polyps, and sometimes even exceed this length. They fall into three groups, fairly distinct in shape:—(*a*) large modified fusiform spicules, which taper more or less towards the ends and measure from ·9–3 mm. in length by ·25–·45 mm. in breadth; (*b*) squamous or scale-like spicules, often with slightly lobed margins, which measure from ·8–1·1 mm. in length by ·4–·6 mm. in breadth; and (*c*) large modified squamous spicules, consisting of a flattened tuberculate basal portion and of a projecting part which forms the projecting spine of the verrucæ. They measure, in length by breadth in millimetres, as follows:—·7 × ·5, ·6 × ·4, ·5 × ·3.

In the polyps there are slender spindle-shaped and club-shaped spicules. They are often slightly curved and either taper to both ends or are blunt and rounded at one end and pointed at the other. Many of these exhibit fairly prominent spines towards the thicker end. They vary considerably in size, being from ·3–·5 mm. in length and from ·02–·06 mm. in breadth. They are found chiefly in the tentacles, where they form an operculum to the retracted polyp; but an incomplete and irregular crown or collar is formed by them at the base of the tentacles.

In colour the spicules vary from white to semitransparent, while the whole colony has a whitish-brown appearance.

This species differs from *Acis pustulata* in not having violet-coloured opercular spicules and in the branches not being compressed in the plane of branching. It also differs from *Acis orientalis* in having the polyps on all sides of the stem and branches and in the branching not being confined to one plane.

From the fact that it was collected in Ceylon waters I propose to name it *Acis indica*, to mark it as distinct from *Acis orientalis*.

Hab. Deep water off Galle, Ceylon.

XLV.—*A new Bat from the United States, representing the European* Myotis (Leuconoe) Daubentoni. By Oldfield Thomas.

The subgenus *Leuconoe* * has not been hitherto recognized as occurring in North America, but *Myotis yumanensis* should probably be regarded as a member of the group, although not a strongly marked example of it.

* Type, *Myotis Daubentoni*, the "Wasser-Fledermaus."

Now, however, I am able to record that *Leuconoe* in its most typical form does occur in that continent; for Mr. J. ffolliott Darling, a naturalist already known to zoologists for his work in Mashonaland, has recently presented to the British Museum a bat, obtained in the Yellowstone Park, which is evidently closely allied to the typical species of the subgenus, *M. Daubentoni*.

Thanks to the kindness and generosity of the authorities of the United States National Museum, I have had for comparison with Mr. Darling's bat a complete series of North-American *Myotis*, as worked out in Mr. G. S. Miller's fine monograph of the group. None of the bats there described can be confused with it, nor have any species been described since.

It may be called

Myotis (Leuconoe) carissima, sp. n.

Closely allied to the European *M. Daubentoni*, which it evidently represents in North America.

General characters and proportions as in *Daubentoni*. Sides of muzzle heavily whiskered. Ears narrow, of medium length; laid forward in the spirit-specimen they just reach to the tip of the nostrils; their inner margin evenly convex below, slightly concave before the tip, which is narrowly rounded off; outer margin excavated above, slightly convex below; basal lobe well marked, rounded. Tragus rather short, with straight inner margin, narrowly rounded tip, sloping outer margin, and well-defined basal lobe.

Feet very large, their length more than two thirds that of the tibia; claws medium.

Wings attached to the side of the metatarsus. Calcars very long, more than double the length of the free portion of the uropatagium, their tips forming prominent lobules exactly as in *Daubentoni*; no postcalcareal lobules. Tail scarcely projecting from membrane. Wings hairy for about half an inch on each side of the body, above and below; base of uropatagium thinly haired, its free edge quite without fringe. Toes with tufts of hair overhanging the claws.

Colour above and below (in spirit) uniformly smoky blackish, the tips of the hairs indistinctly buffy or pale brown. Ears, wing-membranes, and feet also blackish.

Anterior premolar about twice the size of the second, decidedly drawn inwards, but in older specimens it might take its place in the general line.

Dimensions of the type (measured on the spirit-specimen):—

Forearm 38 mm.

Head and body 45; tail 36; head 17; ear 13 × 8; tragus on inner edge 5·5; thumb 8; third finger, metacarpus 33, first phalanx 11·5, second phalanx 10·5, third phalanx 7·2; fifth finger, metacarpus 31, first phalanx 9, second phalanx 9; tibia 16; hind foot (c. u.) 11; calcar 16; free border of uropatagium 6.

Hab. Yellowstone Lake, Yellowstone Park, N.W. Wyoming. Alt. 8000 feet.

Type. Female (just adult). B.M. no. 4. 4. 25. 1. Collected September 1903; presented by J. ffolliott Darling, Esq.

"Caught flying about the Lake Hotel, although the weather was snowy."

This bat is very closely allied to *M. Daubentoni*, but has a more strongly whiskered muzzle, rather larger ears, a less projecting tail-tip, and appears to be darker in colour throughout.

My own inclination would still, however, be to regard it as a subspecies of *M. Daubentoni*; but as I am not writing a general monograph of the group, it seems better in the case of a United States bat to conform to the ideas about nomenclature prevalent in that country.

From *M. yumanensis saturatus*, Miller, apparently its nearest American ally, *M. carissima* is readily distinguishable by its much longer forearm and still larger feet. *M. subulatus*, Say, of similar size, has conspicuously smaller feet and broader ears.

The British Museum also contains another bat, from Lake Winnipeg, collected by Sir John Richardson, which appears to be referable to *M. carissima*, but is unfortunately in too bad a condition for certain determination. It was referred by Dobson to *M. lucifugus*, but is certainly not that species. Allowing for the great altitude of Lake Yellowstone, the occurrence of the same species at Lake Winnipeg, considerably further north, would be quite natural.

In the Old World *M. Daubentoni* occurs in Scandinavia, and, as Dobson says, "attains the most northerly range of all the species of the genus."

XLVI.—*Three new Bats, African and Asiatic.* By Oldfield Thomas.

Hipposideros Commersoni and its subspecies.

The bats currently referred to *H. Commersoni* fall into four groups, divisible by size, by the number of supplementary nose-leaves, and by colour.

The common mainland form is the largest, with a forearm measurement of 95 mm. and upwards, and with the lower tooth-row (front of canine to back of m_3) about 15 mm. It has four well-developed supplementary leaflets, and often the rudiment of a fifth. In coloration it has the brown and white markings described by Peters well defined and distinct, except in such individuals as have the reddish suffusion so often found in members of this genus.

Its synonymy appears to be as follows:—

Hipposideros Commersoni gigas, Wagn.

Rhinolophus gigas, Wagn. Syn. *Phyllorhina vittata*, Peters, and *Phyllorhina Commersoni*, var. *marungensis*, Noack.

In Madagascar the typical *H. Commersoni*, Geoff., is found: small (forearm about 80–90 mm.; lower tooth-row about 13); supplementary leaflets three, the rudiment of a fourth being occasionally present; coloration dull greyish, with but little indication of the characteristic dark dorsal markings.

In the island of San Thomé, on the opposite side of Africa, is found a somewhat similar form, *H. Commersoni thomensis*, Bocage, which agrees with true *Commersoni* in essential characters, but is even darker, and has a prominent whitish spot on each shoulder at the insertion of the antebrachial membrane.

Finally, in British East Africa and Zanzibar there occurs a form agreeing with *Commersoni* and *thomensis* in size, but with the four leaflets of *gigas* and well-defined colour-markings. It may be briefly diagnosed as follows:—

Hipposideros Commersoni mostellum, subsp. n.

Size small, as in *Commersoni*. Supplementary leaflets four, with rudiment of a fifth. General colour whitish, the brown Y-shaped marking of the back well defined; under surface creamy whitish, a brown line across each shoulder separating off a white patch at the insertion of the antebrachial membranes.

Skull and teeth as in true *Commersoni*, the cheek-teeth conspicuously smaller than in *gigas*.

Dimensions of the type (measured in skin):—

Forearm 92 mm.

Skull: length from cingulum of canine to back of occipital crest 32; basal length to cingulum of canine 26·5; zygomatic breadth 18; mastoid breadth 15; upper cheek-teeth, front of p^4 to back of m^3 8·4; front of lower canine to back of m_3 13.

Hab. (of type). Tana R., British East Africa. Other specimens from Zanzibar.

Type. Male. B.M. no. 89. 3. 8. 3. Presented by H. C. V. Hunter, Esq.

Rhinolophus Denti, sp. n.

Allied to the European *R. euryale*, but smaller.

Size very small, among the smallest species of the genus. Leading characters (in the order used in Dobson's synopsis): posterior upper premolar separated from the canine, though not very widely, the small anterior premolar in the tooth-row, towards its outer side; horizontal portion of the sella not widely expanded, though (allowing for shrinkage in the dried skin) it would appear to be more so than is usual in the allied species; upper margin of the posterior connecting process forming a marked projection, rounded terminally, rising considerably above the summit of the front of the sella; sides of the vertical process of the sella parallel, summit broadly rounded off; antitragal notch shallow.

Horseshoe large, covering most of the muzzle, circular, its anterior edge sharply notched in the centre; lancet short, conical, its sides evenly convergent upwards, thickly covered with fine fur, similar in colour and quality to that of the head. Ears of medium size, their inner margin evenly convex, tip sharply pointed, upper half of outer margin slightly concave; antitragal notch not deep and the lobe itself comparatively little convex. Hind limbs slender and delicate. Wings from the lower third of the tibiæ. Interfemoral membrane finely fringed posteriorly.

Fur close and fine, about 7 mm. long on the back. General colour above pale grey, the individual hairs dull whitish, with dark brown tips. Under surface nearly white. Membranes brown, the plagiopatagium and interfemoral inconspicuously edged with white.

Skull with the nasal convexity more developed than in *R. euryale*, less than is figured in Peters's *R. lobatus* *. Palate ending opposite the posterior edge of the internal lobe of m^2.

Dimensions of the type (those in inverted commas taken by the collector in the flesh):—

Forearm 42 mm.

"Head and body 41"; "tail 21"; "ear 20"; nose-leaf (dry) $9{\cdot}2 \times 6{\cdot}3$; lower leg and foot (c. u.) 25·5.

* Reise Mossamb., Saug. pl. xiii. fig. 17.

Skull: greatest length 17; basal length to front of canines 13·2; breadth of brain-case 7·6; palatal bridge 1·9; front of upper canine to back of m^3 5·9; front of lower canine to back of m_3 6·6.

Hab. Kuruman, Bechuanaland. Alt. 1300 m.

Type. Male. B.M. no. 4. 4. 8. 2. Original number 7. Collected 24th January, 1904, by R. E. Dent. Two specimens.

"Caught in a house."

This species, the smallest of South-African *Rhinolophi*, seems to represent *R. euryale*, but may be readily distinguished from that, as from all others, by its proportions, its pale colour, the high attachment of its wing-membranes, and its unusually hairy lancet.

Pipistrellus raptor, sp. n.

A rather large species, with long head, proportionally short forearms and tibiæ, and with a bone in the very large penis.

Size rather large, form clumsy. Head long, half the length of the forearm, almost equally broad in front and behind. Muzzle swollen, smooth and rounded; the nostrils small, their edges not projecting; middle line above more deeply grooved between the glands. Ears rather small; base of inner edge with a very narrow hem; inner margin straight, tip narrowly rounded off, outer margin evenly but slightly convex to the shallow emargination separating the low basal lobule. Tragus short, broad, broadest opposite the lower third of the inner edge, the latter straight or slightly concave, tip rounded, outer margin evenly convex, basal lobule distinct, triangular. Wings to the base of the toes. Hind limbs short, feet stout and heavy. Calcar reaching about halfway towards the tip of the tail, its end marked with a projecting lobule; post-calcareal lobe short, but very broad and distinct, supported by a well-marked supplementary cartilage. Tail rather short, of seven vertebræ and a terminal rudiment, involved in the membrane practically to its tip. Penis enormous, as long as or longer than the tibia, the development being mainly in the lengthening of the glans (which is slender and contains a long *os penis*) and the prepuce; the latter is club-shaped, well-haired, grooved above terminally.

Fur extending on to the wing-membranes for about one third of an inch on each side of the body and for a similar distance on the interfemoral; below, a slightly wider area is hairy. Scattered hairs present on ears, the external basal lobe thickly hairy externally.

General colour above dark bistre brown, the ends of the hairs prominently lighter, buffy brown. Below, similar but lighter. Hinder aspect of pubis buffy to base of hairs.

Skull long and low, with a very deep nasal notch. Teeth on the whole like those of *P. ceylonicus* (*P. indicus*, Dobs.). Inner incisors long, their secondary cusp well developed, postero-external; outer incisors just equalling in length the secondary cusp on the inner ones and with an indistinct, low, postero-internal, basal cusp, and a posterior hollow for the tips of the lower canines, as in *P. ceylonicus*. Large premolar close to back of canine; the well-developed small premolar visible with difficulty from without. Lower incisors slender, scarcely overlapping. Lower canines with a broad cingulum, making its section circular. Anterior lower premolar three fourths the height of the second.

Dimensions of the type (measured in spirit):—

Foream 37 mm. (range 36–39).

Head and body 51; tail 36; head 18; ear 13·5; third finger 65; tibia 12; hind foot (c. u.) 9; penis 15, its terminal portion (with the bone) 11.

Skull: greatest length 14·5; upper length in middle line 12; basal length in middle line 10·9; zygomatic breadth 10·6; interorbital breadth 6·1; constriction 4; mastoid breadth 8·6; length of brain-case 5·7; front of canine to back of m^3 6; front of lower canine to back of m_3 6·1.

Hab. Tonkin.

Type. Adult male in British Museum. Collected by Mr. H. Fruhstorfer. Six specimens examined.

This species may be readily distinguished from all its allies by the enormous size of the penis and the presence of a bone in that organ. From Dobson's "*Vesperugo affinis*," only known from a female, it may be separated by its shorter and fewer-jointed tail, stouter feet, shorter tibiæ, and other characters. *P. brachypterus*, Temm., of which I have not seen a specimen, has shorter outer incisors and the wing-membrane arises from the tarsus; described originally from an old male in spirit, no mention is made of the penis.

XLVII.—*Notes and Descriptions of some new Species and Subspecies of* Mustelidæ. By G. E. H. Barrett-Hamilton.

In working through the Mustelidæ in the British Museum of Natural History I find several forms which seem to me to be worthy of recognition mainly because they are either distinguishable as local races of well-known species, or, as in the case of the Greenland stoat, are sufficiently differentiated to claim a title to full specific rank.

Firstly, as regards the pine-marten, I find a tendency to deeper coloration and a brighter throat-patch in the southern representatives of the species. I propose for these the subspecific name *Mustela martes latinorum*, and I take as type of the subspecies a male (no. 95. 4. 16. 1) from the Nurri Mountains, Sardinia, presented by Mr. E. N. Buxton.

In this specimen the general colour is between "seal-brown" * or "mummy-brown," darkest on the tail, limbs, and, to a less degree, the central dorsal region. The yellowish-brown underfur, yellower than in British martens, frequently shows through the long outer hairs. The ears are edged and faced with dirty brownish-white hairs. The extensive throat-patch is rich "orange-buff," deepest near its centre. It reaches from the "interramia" †, where it sends forward a small central projection, to slightly behind the region of attachment of the fore limbs, near which it is interrupted by one or two detached areas of the brown colour. Its edges are sinuous.

No dimensions taken from the animal whilst in the flesh accompany the specimen; but it was evidently an adult male, having a hind foot and ear measuring 41 and 35 mm. respectively in the dried skin.

The dimensions of the skull are :—Greatest length 90 mm.; basal length 84; palatal length 43; zygomatic breadth 51.

I have also examined examples of this form obtained by Messrs. Oldfield Thomas and R. I. Pocock in Majorca and Minorca.

Amongst the polecats, I find in the south a tendency to assume yellow underfur and face-markings, while in Central Europe the face-markings are more extensive, and both they and the underfur are whiter.

As type of the former subspecies, which may be known as *Putorius putorius aureolus*, I take no. 94. 3. 12. 1 (a female), killed at Ferrol, Spain, on the 23rd of June, 1893, and presented by Dr. V. L. Seoane.

The colour, above and below, is deep seal-brown, especially dark upon the limbs and chest. The ears are edged with dirty yellowish white, and the cheeks, upper lip, interramia, and a band running up from the latter between the eye and

* Names of colours in inverted commas are from Mr. R. Ridgway's 'Nomenclature of Colors,' 1886.

† I adopt this term from a suggestion of Mr. Oldfield Thomas.

ear on each side, but not extending to the crown of the head, are of the same colour. The underfur is yellowish buff.

The dimensions of the hind foot and ear, taken from the dried skin, are 61·5 and 19 mm. respectively.

The dimensions of the skull are :—Greatest length 66 mm.; basal length 60; palatal length 31; zygomatic breadth 44.

The Central-European polecat, on the other hand, has a nearly white underfur, and the long outer hairs are nearly black. The facial markings also are nearly white and the two bands between the eyes and ears are carried upwards until they meet and form a **V**-shaped mark, with the blunt point of the **V** lying on the forehead between the eyes pointing anteriorly.

This subspecies may be known as *P. putorius manium.* I take as the type no. 2. 8. 4. 24 (a male), procured by Mr. Zollikofer at Teufin, Apfenzell, Switzerland.

The dimensions are :—Head and body 408 mm.; tail (without end-hairs) 145; hind foot 62; ear 25.

It seems probable that a paper by M. Drion, Jun.*, in which he distinguishes a yellow and a black race of polecat, both existing in Belgium, but with different habits, habitat, and character, was based upon the overlapping and intergrading of these or other continental races. M. Drion states that in both of his races he found the male about one third larger and stouter than the female, and the young dark in colour and hardly assignable to either form.

The large weasel named by Pallas *Mustela sibirica*, and which has a wide range in Siberia, seems to be divisible into a number of subspecies. In this animal there is probably a considerable difference between the summer and winter coats, the former being some shade of brown, the latter of yellow. I find two forms which cannot be identified with any previously published description of any known subspecies. These are :—

Putorius sibiricus noctis, subsp. n.

Form as in *P. sibiricus typicus.*

Coloration. Above near "vandyke-brown," shading gradually without line of demarcation into a tint between "russet" and "tawny olive" beneath; the tail a shade lighter than the brown of the upper surface, but with the tip darker. Anterior

* Bull. Acad. Roy. Sci. Lett. Beaux-Arts Belg. sér. 3, t. xiv. pp. 365–368; translated in 'Zoologist,' 1895, pp. 366–369.

half of interramia, edges of lower lips, angles of mouth, and a sprinkling of hairs about the nose white.

Dimensions: from label, "length 20 inches"; hind foot (measured in dried skin) without claws 54 mm.; tail (ditto) including end-hairs about 170; ear about 15.

The *skull* is not perfect, but presents the following dimensions:—palatal length 25 mm.; zygomatic breadth 31. The mesopterygoid fossa is attenuated anteriorly; the incisive foramina are ample and elongated.

Type (an almost mature male), no. 99. 3. 1. 11, from San-yen-tze, China, 5th August, 1896; procured by Mr. F. W. Styan.

Putorius sibiricus noctis is clearly separated by its dull coloration from all its allies of the Asiatic mainland. The type is evidently in summer coat.

Putorius sibiricus miles, subsp. n.

Form as in *P. sibiricus typicus*.

Coloration. Above between "russet" and "cinnamon-rufous," shading into "orange-rufous" or "ochraceous rufous" on the underside, and becoming darker on the upper surface of the head. Upper surfaces of the feet, interramia, upper lips, and a spot behind each nostril dirty white, shading into ochraceous tints on the throat.

Dimensions from the dried skin:—Hind foot 45 mm.; ear 15.

There is no *skull*.

Type. No. 74. 1. 16. 2, from Dauria, Eastern Siberia; received from Professor Taczanowski.

The bright underside of this weasel renders it distinguishable at a glance from all other described forms.

Turning to the true weasels, I may remark here that the subspecific name *Putorius nivalis italicus* proposed by me for the Italian weasel is preoccupied by Achille Costa's name "var. *meridionalis*" *, of which it must accordingly stand as a synonym. The type locality of *P. nivalis meridionalis* is "in Italia *meridionali continentali*."

Amongst the ermines or stoats I find the following forms. Firstly, a specimen from British North America does not agree with any description by American naturalists of the

* Ann. del Museo Zool. della R. Univ. di Napoli, anno 1865, p. 40 (dated 1869).

various forms which inhabit that continent. It may be known as

Putorius arcticus imperii, subsp. n.

Form as in *P. ermineus* or *arcticus*, but smaller and with the tail longer than that of the latter.

Coloration of type specimen. Upperside (with exceptions to follow) golden brown (between "tawny olive," "raw umber," and "mars brown"), the crown of the head darker. Dorsal borders of ears, a tuft of hairs at their anterior angle on each side, upper lips, chin, interramia, and upper throat white. Underside (except as above) deep "primrose-yellow," including the inner and posterior surfaces of the fore legs, the whole of the fore feet, the distal half and inner side of the hind feet, and the under surface of the tail nearly to the dark pencil. Line of demarcation well defined and straight, the brown colour not encroaching on the underside. Tail with conspicuous dark terminal pencil.

The *skull* corresponds with Dr. Hart Merriam's description of that of *P. arcticus*.

Dimensions of the type (taken from the dried skin):—Hind foot 38 mm.; ear 20; tail (including terminal hairs) 129; tail-pencil 71.

The somewhat damaged skull has:—Zygomatic breadth 25 mm.; palatal length 17; length of upper molar series 11, of lower molar series 12.

Type. No. 63. 10. 28. 1, from Fort Simpson, British Columbia; received from Mr. B. R. Ross.

P. arcticus imperii appears to be a smaller race of *P. arcticus*, from which it differs also in the possession of white ear-borders and upper lips, a less deeply yellow underside, and a longer tail.

Secondly, the specimens long since brought home by Mr. H. C. Hart from Greenland show that there are in that country two forms of stoat. Of these the first is a well-defined species, apparently not very clearly related to its allies either of the Old World or of the New. It may be known as

Putorius audax, sp. n.

General characters.—*Size* moderate; tail short, with well-developed dark pencil; colours of upperside not encroaching upon underside.

Coloration. Above between "wood-brown" and "mars brown," the line of demarcation straight and decided. Below white, tinged with yellow on the flanks, neck, and near the legs, the white colour including also the upper lips, fore and hind feet (but not conspicuously), the inner and anterior surfaces of the limbs, but not the under surface of the tail, which is barely lighter than the upper surface. Tail with dark pencil commencing at about the middle point. Underfur of upper surface near white.

The *skull*, as compared with that of American stoats, is characterized by its broad, somewhat massive, and depressed rostrum and moderately conspicuous postorbital processes. It is shorter and far less massive than that of *P. ermineus*; the posterior region has a peculiar rounded appearance when viewed from above, which is characteristic, but difficult to describe. The audital bullæ are shortened as compared with those of *P. ermineus*.

Dimensions of the type (taken from the dried skin):—Hind foot (without claws) 40 mm.; tail (including terminal hairs) 196; tail-pencil 63.

The somewhat damaged skull has a zygomatic breadth of about 25 mm.; palatal length 18; length of upper molar series 10·50, of lower molar series 12.

Type. No. 78. 6. 26. 5; secured by Mr. H. C. Hart at Discovery Bay, North Greenland.

A second skin was brought home by Mr. Hart from latitude 82° N., longitude 59° 20′ W., in Hall Land, in the very far north of Greenland. This specimen appears to me to be a form of *P. arcticus*, Merriam, and I accordingly propose for it the subspecific name

Putorius arcticus polaris, subsp. n.

Form and general characters as in *P. arcticus*, Merriam.

Coloration. Above golden brown, the underfur near white; upper lips, interramia, and upper throat white; remainder of underside deep "primrose-yellow," this colour running in a slightly lighter shade to the underside of the tail (except the terminal pencil) and the fore feet. Line of demarcation direct and as in *P. audax*.

There were no *dimensions* or *skull* with this specimen. In the dried skin the hind foot measures about 38 mm. and the tail (including terminal hairs) 105, with a pencil of 62.

Type. No. 78. 6. 19. 11; locality as above.

Lastly, I find that true *P. ermineus* of Scandinavia * may be distinguished from its southern representatives, such as those of Britain, by the fact that it has the underside of the tail (except the distal part occupied by the terminal pencil) of the same colour as the underside generally, whereas in British stoats the tail (except in cases of winter whitening) is unicoloured all round. A second, and, to my mind (since it is of deep physiological significance), far more important distinction is the absence of winter whitening in southern stoats. Southern examples may therefore be distinguished subspecifically under the name of

Putorius ermineus stabilis, subsp. n.,

with no. 98. 5. 13. 2 (a female, dated the 18th of February, 1895), from Blandford, Dorset, presented by Mr. J. C. Mansel-Pleydell, as the *type*.

I add a description of the British stoat, not taken from the type, but from a series:—

Coloration. Entire upper surface of both sexes (except the end of the tail) in summer with the long outer hairs between "mummy brown" and "mars brown," the underfur lighter and near "isabella colour," usually concealed, but in specimens in old faded coat showing through the thin outer hairs. Under surface (except that of the tail) white, with a strong wash of yellow which about reaches "primrose-yellow" in extreme, but by no means rare, cases at all seasons, the white colour extending to the upper lips and the inner surfaces of all four legs to the ankles and wrists, but not to the tail. Line of demarcation definite and decided, the brown colour not encroaching upon the underside. Tail with the hairs

* The nomenclature of the northern stoats must be regarded as entirely provisional. Dr. Merriam clearly emphasizes the close relationship between his *arcticus* and true *ermineus* by the remark that the former, "though specifically distinct, is strictly the American representative of the Old-World *erminea*" ('North-American Fauna,' no. 11, p. 16, 1896). Remembering, then, what different conceptions are prevalent between naturalists of the Old and New World in regard to the uses of specific and subspecific names, that Baird's *Putorius Kaneii* ('Mammals of North America &c.,' pp. 172–3, 1859) of Chukchi-Land and Bering's Straits (Arikamtchitchi Island) is a small yet "perfect miniature" of *ermineus*, and that Dr. Allen cannot find any tangible characters whereby to separate stoats from North-eastern Siberia and Europe (Bull. Amer. Mus. N. Hist. vol. xix. art. iv. pp. 174–176, March 31, 1903), we may look forward to the strong possibility that both *Kaneii* and *arcticus* with all its subforms may eventually find their true status as subspecies of *ermineus*.

beginning to lengthen and deepen in colour at a point about halfway from the extremity until they form a large black terminal tuft or pencil, having a variable length, but often reaching 100 mm. Feet often, but variably, white, either partially or wholly. In *winter* the white of the under surface may extend upwards, according to locality, until the animal becomes completely white or white washed with yellow, the black tuft of the tail alone retaining its dark colour. The margins of the ears, being amongst the first to whiten, show this colour to a variable extent in many specimens otherwise apparently in full summer coat; for a similar reason the feet may be partially white at all seasons of the year.

The average dimensions (in millimetres) of a series are (approximately):—

	Skin.				Skull.			
	Head and body.	Tail.	Hind foot.	Ear.	Greatest length.	Basal length.	Palatal length.	Zygomatic breadth.
Males ..	269	111	48	22	51	47	30	22
Females .	244	90	42	20	46	42	25	19

BIBLIOGRAPHICAL NOTICES.

Mostly Mammals. By R. Lydekker. Pp. 383; 16 plates. London: Hutchinson & Co. 1903.

To a very large number of readers the essays in this volume will be right heartily welcomed as old friends finally united under peculiarly happy circumstances. By a careful process of gleaning from the pages of 'Knowledge,' 'Nature,' 'The Field,' and 'The Asian,' Mr. Lydekker has produced a really delightful volume. Full of matter for thoughtful consideration, it will be cherished as guide, philosopher, and friend by those who live in the country, or are called away into wild places far from the haunts of men, where books are not, save those that are carried for their own intrinsic worth.

Perhaps the most fascinating chapters in the volume are those referring to the coloration of animals. Save the chapter on cowrie-shells, mammals only are dealt with under this head, but, as many will know already, these chapters are strikingly original and suggestive.

To the traveller the chapters on "Celebes: a Problem in Distribution" and "Deserts and their Inhabitants" will serve as incentives to observation, no less than those on coloration; whilst the stay-at-home naturalist will find equally helpful studies in the essays on domesticated animals. But these are by no means the only subjects treated of in this volume. Extinct animals, armour-clad whales, monkey finger-prints, frogs and toads, and scorpions are amongst the other subjects noticed, and all alike are of extreme interest.

The book is well printed, tastefully got up, and well illustrated, there being no less than sixteen full-page plates, the most remarkable of which is a photograph showing giraffes in covert. The volume would make a handsome gift-book.

Catalogue of the Lepidoptera Phalænæ in the British Museum. Volume IV. *Catalogue of the* Noctuidæ *in the Collection of the British Museum.* By Sir GEORGE F. HAMPSON, Bart. London: Printed by Order of the Trustees, 1903. 8vo. Pp. xx, 689. Plates lv.–lxxvii.

WE congratulate Sir George Hampson and the authorities of the British Museum on the publication of the fourth volume of the great Catalogue of the Moths of the world, which has been appearing at intervals during the last six years. With Volume IV. the great family of *Noctuidæ* is commenced, with one of the largest and most important of the subfamilies, the *Agrotinæ*, of which no less than 1126 species are described, by far the larger proportion of which have only been made known within the last few years. To the entomologists of the present day, the wonderful increase in our knowledge of insects and the large collections now in existence appear marvellous. So did Hewitson's collection of Exotic Butterflies to the older generation of naturalists who were his contemporaries; but hundreds of the most beautiful butterflies in the world, which are now to be found in every first-rate collection, were either unique and unattainable, or undiscovered in his time, and he did not live to see them. Our knowledge of moths has also very largely increased, though it cannot be supposed to be so forward as in the case of butterflies, for three reasons: firstly, because they are much more numerous; secondly, because many of them are less brightly coloured, and thus less attractive, and are therefore less assiduously collected; and, thirdly, because many are nocturnal insects and are therefore really more difficult to collect. But nothing is more likely to encourage and extend the knowledge of moths than comprehensive and well-illustrated works like Sir George Hampson's.

In addition to the coloured plates, there are 125 text illustrations, representing structural details. Many larvæ are described, those of North-American species by Dr. Harrison G. Dyar; but there are no illustrations of larvæ, which the character of the book would perhaps hardly admit of. Very full tables of species are given under genera, or, in the case of the larger genera, under sections; and we are glad to notice that when a number of generic names are included under a more comprehensive one (as in the case of *Euxoa*, Hübn., p. 153) the types of the various names are indicated. This will be very useful for future reference.

At the end of the volume we find a list of unrecognized species, some of which will probably be identified and referred to their proper position at some future time.

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.—*Rhynchota.* Vol. II. Part 1 (*Heteroptera*). By W. L. Distant. London, 1903. Pp. x, 242; figs. 167.

As we are informed that the next part of this work, completing the second volume, will appear very shortly, we will defer our detailed notice until then, and confine ourselves for the present to recording the publication of the present instalment, which extends from Fam. 4. Lygæidæ to the commencement of Fam. 12. Reduviidæ.

Memoirs of the Geological Survey.—Palæontologia Indica. Series IX. *The Jurassic Fauna of Cutch.* Vol. III. Part 2. *The Lamellibranchiata.* No. I. *Genus* Trigonia. By F. L. Kitchin, M.A., Ph.D., Geol. Survey England. 122 pages, Fol. Plates I.–X. Calcutta, London, and Berlin, 1903.

The *Trigoniæ* of Cutch here figured and described have been selected from among the Lamellibranchs collected by Wynne, Tedden, Stoliczka, and Blanford, and entrusted to Dr. Kitchin, of London, for examination and description. The strata from which they came are known as the following groups:—I. The Oomia group, probably combining the Cretaceous, Neocomian, partly the Portlandian; II. The Katrol, probably combining the Kimmeridgian and Oxfordian, and constituting the Upper Jurassic of Cutch; III. The Charee, probably representing the Kelloway strata, Middle Jurassic of Cutch; IV. The Patchum, probably representing the Bath Oolite group. These are enumerated in the second edition of the 'Manual of the Geology of India,' 1893, p. 217.

The classification of the known fossil *Trigoniæ* into sections, groups, and genera is carefully considered and clearly explained. In some cases these serial divisions and subdivisions of recognized forms are separated from their several allies by gaps variable in extent and value, but evidently reducible by better knowledge of the types. The most reliable observers and authors concerned in this classification have been:—Agassiz, 1840; d'Orbigny, 1843; Pictet, 1866; Stoliczka, 1871; Lycett, 1872–1883; Bayle, 1878; Choffat, 1885; and Bigot, 1892. Their methods and results are succinctly stated at pages 7–9.

The differences due to the progress of growth in individuals (as in growth-stages) are taken into consideration on the lines more or less definitely indicated by Hyatt, 1888; Jackson, 1890; and by Buckman and Bather, 1895, for other kinds of Mollusca.

A strict comparison of the species from Cutch with those at present known from other parts of the world is made throughout. The *Distribution* of the fossil *Trigoniæ* in Cutch is thus given at pages 12 and 120:—

a. (i) *Costatæ* (Section).		
1. Trigonia tumida, nov.		
2. T. prora, n.		
3. T. chariensis, n.		
4. T. propinqua, n.		
5. T. brevicostata, n.		Patchum Group.
6. T. distincta, n.	... 12 ...	Charee Group.
7. T. acuta, n.		Oomia Group.
8. T. dhosaënsis, n.		
9. T. nitida, n.		
10. T. sp.		
11. T. tenuis, n.		
12. T. parva, n.		
(ii) Derivatives of *Costatæ* (Section).		
13. Trigonia Smeei, *J. de C. Sowerby*.		
14. T. crassa, n.		
15. T. cardiniiformis, n.	... 5 ...	Oomia Group.
16. T. trapeziformis, n.		
17. T. retrorsa, n.		
b. *Gibbosæ* (Group).		
18. Trigonia spinicostata, n.	... 1 ...	Oomia Group.
c. Group of *Trigonia v-scripta* (Group).		
19. Trigonia dubia, n.		
20. T. v-scripta, n.	... 3 ...	Oomia Group.
21. T. recurva, n.		
d. *Undulatæ* (Section).		
22. Trigonia remota, n.	... 1 ...	Oomia Group.
e. *Scaphoideæ* (Section). (*Sensu latiore.*)		
23. Trigonia kutchensis, n.		
24. T. exortiva, n.		Patchum Group.
25. T. hispida, n.	... 5 ...	Charee Group.
26. T. jumarensis, n.		
27. T. gracilis, n.		
f. *Pseudo-quadratæ* (Group).		
28. Trigonia mamillata, n.	... 1 ...	Oomia group.
g. *Scabræ* (Section).		
29. Trigonia ventricosa, *F. Krauss*, sp.	... 2 ...	Oomia Group.
30. T. pulchra, n.		

I. Nos. 1, 2, 25, 26 occur in the Upper Patchum beds.

II. Nos. 1, 3, 4, 5, 6, 7, 8, 9, 10, 23, 24, 27 occur in the Charee group.

III. None in the Katrol group.

IV. Nos. 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 28, 29, 30 occur in the Oomia group.

Of these thirty species only two were determined as occurring in Cutch previously, namely *Trigonia Smeei* and *T. ventricosa.* The former has long been known as an Indian species, and the latter also in India as well as in the Uitenhage strata of South-east Africa, and lately it has been found in German East Africa.

In the Appendix at page 121 Dr. Kitchin refers to the Mesozoic Mollusca collected during W. Bornhardt's Journey in German East Africa (1895–97), and described by Dr. G. Müller in 1900, who regards two of the species as Jurassic; but two of the others he considers to be of Lower Neocomian age, namely *T. ventricosa*, Krauss, and its associate *T. Beyschleyi*, Müller. *T. Kuehni*, Müller, is said to be of Upper Neocomian age. It is evidently certain that there is a resemblance (Dr. Kitchin says) of the German East-African fossils to those of the Oomia group and those of Uitenhage, as far as the lamellibranchs bear evidence at present (pages 2, 115, 121, &c.).

The numerous figures of *Trigoniæ* in the ten lithographic plates are excellently well drawn, of natural size, by Miss G. M. Woodward, of London.

Circulars on Agricultural Economic Entomology. Issued by the Trustees, Indian Museum.

We have received the following numbers of these useful publications, which are accompanied with good recognizable uncoloured illustrations, and are issued at the price of 3 or 4 annas per dozen, for general circulation in India.

No. 1. The Rice Sapper (*Leptocorisa acuta*).
2. The Bengal Rice Hispa (*Hispa ænescens*).
3. The Sugar-cane Borer (*Chilo simplex*).
4. The Rhinoceros or Date-Palm Beetle (*Oryctes rhinoceros*).
5. The North-west or Migratory Locust (*Acridium peregrinum*).
6. The Cut-Worm (*Agrotis ypsilon*).

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 20th, 1904.—Sir Archibald Geikie, D.C.L., D.Sc., Sec.R.S., Vice-President, in the Chair.

The following communication was read:—

'On the Jaws of *Ptychodus* from the Chalk.' By Arthur Smith Woodward, LL.D., F.R.S , F.L.S., F.G.S.

Hitherto no traces of the cartilaginous jaws of this fish have been found in association with the dentition; but Mr. Henry Willett has recently found a specimen of *Ptychodus decurrens*, in the zone of *Holaster subglobosus* of the Lower Chalk at Glynde (Sussex). Fragmentary remains of both jaws are seen in the specimen, each bearing many of the characteristic teeth arranged in natural order. There are four series, and one small displaced tooth (probably belonging to the fifth series), on the left of the large median series in the lower jaw; while in the upper jaw the teeth are clearly arranged in six paired series. The specimen proves that the peculiarly effective disposition characteristic of the living Myliobatidæ had not been assumed, but that *Ptychodus* more nearly resembled the Trygonidæ in its jaws. The probable explanation of the new discovery is, that in the Cretaceous Period, the great Rays of the 'families' Myliobatidæ and Trygonidæ had not become fully differentiated. Prof. Jækel has already arrived at a similar conclusion from general considerations, and has proposed to place all these fishes in one comprehensive family, termed Centrobatidæ. If this arrangement be adopted, *Ptychodus* represents a primitive sub-family, which still awaits definition from lack of complete specimens; while the Trygoninæ, Myliobatinæ, and Ceratopterinæ are equivalent sub-families which survive at the present day.

April 13th, 1904.—J. E. Marr, Sc.D., F.R.S., President, in the Chair.

The following communication was read:—

'The Discovery of Human Remains under the Stalagmite-Floor of Gough's Cavern, near Cheddar.' By Henry Nathaniel Davies, Esq., F.G.S.

Gough's Cavern opens at the base of the cliffs on the south side of Cheddar Gorge. Various human and animal remains have been discovered at different times in the clearing-out of parts of the main cavern. The principal deposits are a stalagmite-like travertine overlying cave-earth, and the latter at one place encloses a tabular limestone-block surrounded with flint-chips. During drainage-operations it was found necessary to excavate part of a fissure running northward out of the vestibule of the cavern, when a human skeleton was discovered, associated with flakes, scrapers, and borers of flint, embedded in cave-earth, which overlay a lower bed of stalagmite and was overlain by a second bed 5 inches thick. The skeleton was nearer the top than the bottom of the deposit, and the remains excavated comprise the skull, the bones of an arm, a leg, and part of the pelvic girdle. The other bones were allowed to remain *in situ*, and may now be seen. The position of the skeleton was that which would have been assumed by a drowned man. Interment is out of the question, because of the narrow and steep shape of the fissure, which was choked up with undisturbed débris and calcareous deposits. The stature of the man was 5 feet 5 inches;

he was of muscular build, with prognathous jaws, a straight thigh, an extremely platycnemic tibia, and a thick dolichocephalic skull. The animal-remains found in the cave-earth of other parts of the Cavern, and held by the Author to be contemporaneous with that in the fissure, are those of mid- and late Pleistocene age; and this evidence, together with that derived from the position of the skeleton, the shape of the cranium, and the form and workmanship of the flakes, points to a period towards the close of the Palæolithic or the opening of the Neolithic Age.

MISCELLANEOUS.

The Action of Human Serum on certain Pathogenic Trypanosomes; Action of Arsenious Acid upon Trypanosoma gambiense. By A. Laveran.

In previous notes (1st April, 1902, and 6th July, 1903) I have shown that human serum injected in sufficient doses into mice or rats affected with Nagana, Mal de Caderas, or Surra, caused the Trypanosomes to disappear, at least temporarily, from the greater circulation.

A mouse weighing 20–25 grammes required 0·5 to 1 c.c. of human serum; a rat of 200 grm., 2–3 c.c. of serum or 0·20–0·30 grm. of dry serum in powder.

The Trypanosomes disappear in 24 or 36 hours from the larger circulation, but reappear in general at the end of a few days. Sometimes their disappearance is definitive. The most frequently repeated injections of human serum do nothing more than prolong the life of the animals.

In the month of November, 1903, Drs. Dutton and Todd sent me through Dr. Annett two rats, one infected with *Trypanosoma gambiense*, the other with a *Trypanosoma* of horses from the Gambia. It appeared demonstrated that *Tr. gambiense*, discovered by Forde and Dutton in Gambia, is identical with the *Trypanosoma* described by Castellaini under the name of *Tr. ugandense*, as the pathogenic agent in the disease called "sleeping sickness." The study of this parasite is therefore, from the medical point of view, of great interest.

One might think, *à priori*, that *Tr. gambiense*, which is developed in the blood of man, as in that of many other mammals, would not be influenced by human serum, contrary to that which takes place in the case of the Trypanosomes of Nagana, Surra, and Caderas, diseases against which man is naturally immune. This is precisely the result of my observations. Human serum injected in doses of 0·20–0·30 grm. of the powder, in the case of rats weighing 170 to 200 grm. infected with *Tr. gambiense*, proved entirely inactive.

At the beginning of the infection of rats with *Tr. gambiense*, the Trypanosomes are very rare in the blood, and it happens that after examinations giving positive results, subsequent examinations yield negative results; but at the end of a month or six weeks the Trypanosomes have established themselves in the blood, and their number is, in general, large enough to enable the action of medicaments to be readily observed; and this is the time to be chosen for experiments with drugs and serums.

Fresh serum of guinea-pig, sheep, and horse proved without action upon *Tr. gambiense*, like human serum; this was to be expected, because the guinea-pig, sheep, and horse can alike be infected with *Tr. gambiense*.

P. Manson tried the treatment of a case of injection by *Trypanosoma* with injections of horse serum, but failed (Brit. Med. Journ. 30 May, 1903); the result might have been foreseen, the horse not being refractory to infection by *Tr. gambiense* (Dutton and Todd, 1st Rep. of the Trypanosomiasis Exped. to Senegambia, 1902, Liverpool, 1903, exper. 87, pl. x.).

This Trypanosome develops unfortunately in the blood of most mammals. I ought, however, to say that the serum of a *Cynocephalus*, apparently naturally immune against *Tr. gambiense*, showed itself as little active as the serum of animals having an admitted susceptibility to this Trypanosome.

It will be well to experiment with the serum of animals with acquired immunity against *Tr. gambiense* and that of animals made hyper-immune, but the results of previous researches in this direction with other pathogenic Trypanosomes (Laveran and Mesnil, "Recherches sur le traitement et la prévention du Nagana," Ann. de l'Instit. Pasteur, Nov. 1902), and of some trials of the curative power of serum of animals with acquired immunity against *Tr. gambiense* itself, leave but small hope of a definitive result of such experiments.

Human serum, inactive against *Tr. gambiense*, has, on the contrary, an evident though feeble action on the *Trypanosoma* of horses in the Gambia. It is now demonstrated that this latter Trypanosome must be completely separated from *Tr. gambiense*, from which it is distinguished by its morphological characters, as well as by its pathogenic action on animals; but at the outset of their researches Dutton and Todd have placed the question of the identity or non-identity of these parasites observed in the same region. Their different reaction with human serum provides a fresh proof in support of their differentiation. Human serum injected in sufficiently large doses into mice and rats having a fair number of the Gambia horse Trypanosomes in their blood, generally causes these Trypanosomes to disappear in 36 or 48 hours; but the parasites do not fail to return.

In the cases where the Trypanosomes are numerous, the injection of human serum can only have for result a diminution of their number. The activity of human serum is, in short, real but more feeble than in the case of Nagana, Surra, and Caderas.

Arsenious acid is the only drug which has given any favourable results in the treatment of Surra and Nagana (*op. cit.*, Ann. de l'Inst. Pasteur, Nov. 1902); it was therefore of interest to experiment on its efficacy against *Tr. gambiense.*

It results from experiments which I have made on rats that arsenious acid, given in sufficient doses, causes the *Tr. gambiense* to disappear from the greater circulation, at least in a temporary manner, and that it can hasten the cure of Trypanosomiasis in these animals. The efficacious dose is 0·1 mgr. of arsenious acid for every 20 grm. of animal, *i. e.* 1 mgr. for a rat of 200 grm.; below this dose the results are nil or incomplete.

(*Note.*—This is also the efficacious dose in Nagana, Surra, and Caderas. The solution employed for hypodermic injection has the following composition:—Arsenious acid 1 grm., carbonate of soda 1 grm., distilled water 500 grm.—Laveran and Mesnil, *op. cit.*)

In human Trypanosomiasis arsenical compounds have been often tried and have yielded only a passing amelioration, but in general the doses prescribed have been too feeble. Judging by the results of experiments on animals, one may say that the method which consists in giving small daily doses of arsenious acid (the method most frequently adopted in the treatment of human Trypanosomiasis) is bad, and that it is preferable to administer large doses at longer intervals.

Writers are all agreed that human Trypanosomiasis is always fatal as soon as the nervous symptoms declare themselves, but before the appearance of these symptoms there is a period, more or less long, during which the Trypanosomes, in small number in the blood, produce but few morbid troubles. In this first phase it is probable that the infection produced by *Tr. gambiense* is curable in the human subject as it is in many species of animals, and that arsenious acid may contribute to a cure.

Good hygienic conditions and abundant food are also important factors in the treatment of Trypanosomiasis; in Africa the "sleeping sickness" rages with a peculiar intensity among the miserable Negro labourers, overworked and ill-fed. (*Note*—Christy, Rep. of the Sleeping Sickness Comm., Nov. 1903: in Uganda the epidemic of Trypanosomiasis has been greatly aggravated by famine.) The same thing is observed among animals, those that have some defect or some cause of enfeeblement are more strongly infected than those which are in good condition and are supplied with abundant food.—*Comptes Rendus*, tome cxxxviii. p. 450 (22 Feb., 1904).

Relations between the Development of the Tracheal Apparatus and the Metamorphoses of Insects. By Jules Anglas.

The phenomena of internal metamorphosis have in Insects a strict relation to the development of the respiratory apparatus.

The metamorphoses properly so-called, characterized by the phenomena of histolysis followed by histogenesis, bear, moreover, even among the Holometabolids, only on the middle portion of the intestine, the muscles, and sometimes on the tracheal apparatus itself.

In the Hymenoptera that I have studied (Wasps, Bees) these phenomena always correspond with the centripetal tracheal growths. Shortly after the hatching of the larva a first growth of tracheal tubes makes its appearance towards the mid-intestine. At this moment, at the base of the epithelial cells of that organ, appear the elements of future substitution. A careful study of sections shows that the substitution-cells communicate with the ultimate and very delicate prolongations of the tracheal tubes. They may therefore be regarded as tracheal cells analogous to those seen along the course or at the extremities of the tracheal tubes.

The elements of substitution are in a state of rest all through the life of the larva; but from the beginning of nymphosis a renewal of activity sets in: they proliferate actively, join one another and constitute the definite digestive epithelium, whilst the larval tissue enters into histolysis and is thrown off. A fresh tracheal growth appears at this moment; the calibre and arrangement of the respiratory apparatus are modified. At the same time fine tracheoles proceed in great number towards the peri-intestinal muscular layer and penetrate it; the same occurs in the other muscles of the thorax and abdomen.

The terminal tracheal cells, or even the cells of the wall of the tracheal trunks, insinuate themselves into the sarcoplasm of the muscular fibres, there multiply actively and form long linear threads; so that the larval fibre is cut up into little columns, broken up and profoundly altered in form. In the muscular histolysis, whether partial or total, the tracheal cells play an important *rôle* by a mechanical process, and probably also chemical, but without the phenomena of phagocytosis.

Many of the tracheal cells become free in the general cavity and then disappear on the spot; others furnish the tracheoles of the muscles of the imago, these latter turning out the corresponding larval elements (larval muscular fibres and nuclei).

An American observer, Robert S. Breed*, has described analogous processes in the muscles of a Coleopter (*Thymalus*). One is inclined to ask with him if it would not be well, in considering the tracheal elements, thus far too much neglected, to again take up the study of the Diptera, in which it is classic to describe an intense phagocytosis during the metamorphosis.

In the Hymenoptera the metamorphosis which has just been sketched is completed by the histolysis and total disappearance (without phagocytosis) of the primitive Malpighian tubes and the salivary glands. In short, a burst of ectodermic activity realizes the completion of the following organs, momentarily retarded in the larva: teguments, appendages, œsophagus, rectum (formation of fresh Malpighian tubes), nervous system, and sense-organs.

The tracheal growth is itself a manifestation of this ectodemic activity. It is to be remarked that it corresponds with a period during which Bataillon has noted asphyxial respiratory troubles in *Bombyx mori*.—*Comptes Rendus*, tome cxxxviii. p. 300 (1 Feb., 1904).

* R. S. Breed, "The Changes which occur in the Muscles of a Beetle" (Bull. Mus. Comp. Zool. Harvard Coll. vol. xl. no. 7, Oct. 1903).

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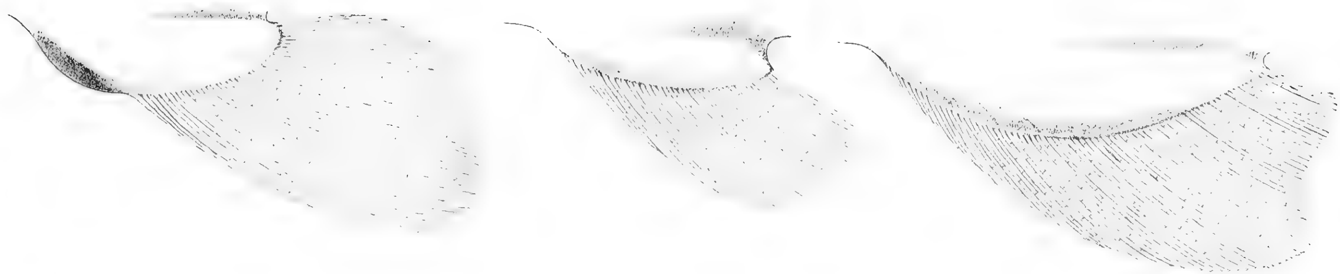

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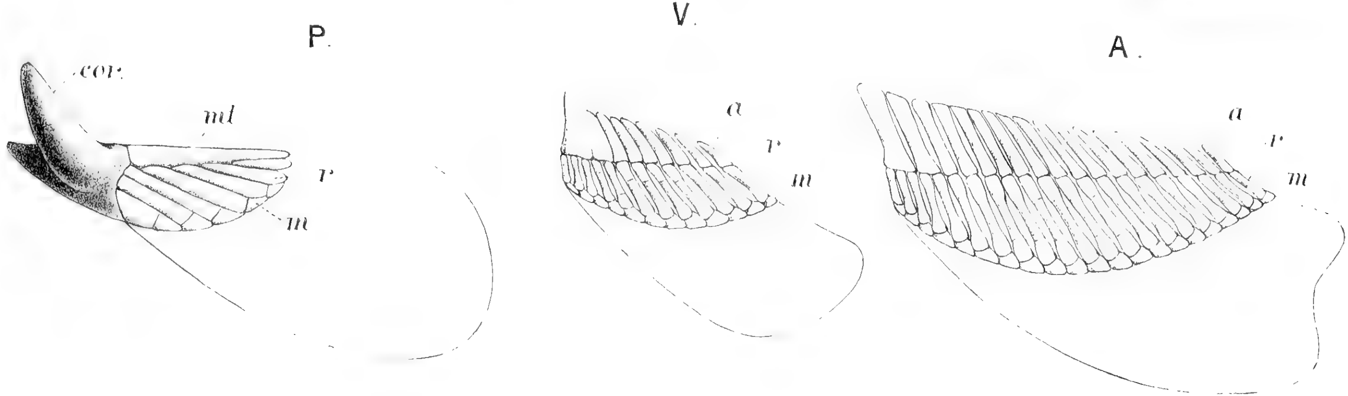


J. Green del. et lith.

Mintern Bros. imp.

PSEPHURUS GLADIUS.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 78. JUNE 1904.

XLVIII.—*On Mammals from Northern Angola collected by Dr. W. J. Ansorge.* By OLDFIELD THOMAS.

DURING 1903 the well-known collector Dr. W. J. Ansorge, to whom the British Museum is already indebted for series of specimens from British East Africa, Uganda, and Nigeria, made a collecting-trip to Northern Angola, and obtained about two hundred specimens belonging to forty-six species, and of these a complete set has been acquired for the Museum.

The mammalogy of Angola has hitherto remained almost entirely in the hands of the Portuguese, as represented—most admirably—by Prof. Barboza du Bocage in Lisbon and by M. Anchieta and other collectors in the country under consideration. Thanks to the enlightened generosity of Prof. Bocage many institutions, and notably the British Museum, had received specimens representing the species discovered in Angola by the Portuguese naturalists, and on these specimens such comments on the Angolan fauna as have been made by Gray, de Winton, myself, and others have been based.

But these specimens, valuable as they have proved to be, have been all preserved in spirit, and the freshly made skins obtained by Dr. Ansorge are therefore of very great interest for comparison with similarly made specimens from other regions of Africa.

Complete as have been Prof. Bocage's researches on the subject, the present collection contains a fair number of species not included in his lists, while, owing to my having been able to compare the remainder directly with typical specimens from other localities, I have found it necessary to describe several of those he mentions as local species or subspecies.

Dr. Ansorge has therefore to be congratulated on the considerable number of new and interesting forms which his collection has enabled me to discriminate.

1. *Miopithecus talapoin*, Erxl.

♂. 200. Canhoca.

2. *Rousettus collaris*, Ill.

♂. 40. Pungo Andongo.
This specimen has a small third upper molar on each side.

3. *Epomophorus pusillus*, Peters.

♂. 195, 196. Canhoca.

4. *Epomophorus* sp.

♂. 70. Pungo Andongo.
♀. 143. Braganza.

5. *Epomophorus* sp.

♂. 69; ♀. 68, 124. Pungo Andongo.
♀. 138. Braganza.

6. *Hipposideros caffer*, Sund.

♀. 5. Ambaca.

7. *Hipposideros Commersoni gigas*, Wagn.

♀. 201. Canhoca.
A note on the subspecies of *H. Commersoni* has been recently published *.

8. *Nycteris* sp.

♀. 58. Pungo Andongo.
Closely similar, both in size and colour, to the type of *N. æthiopica luteola*, Thos., from British East Africa, but from the single skin I do not venture definitely to assign it to that form.

* Ann. & Mag. Nat. Hist., May 1904, p. 384.

9. *Pipistrellus nanus*, Pet.

♂. 71, 72; ♀. 73, 74, 84. Pungo Andongo.
♂. 139; ♀. 145. Braganza.

10. *Myotis Bocagei*, Peters.

♂. 140, 148; ♀. 146, 147. Braganza.

These specimens, actual topotypes, are of a far brighter colour than those from the Cameroons, which, in the absence of Angolan examples, we had hitherto treated as the true *Bocagei*.

The Cameroon form would appear to represent a special subspecies, as follows:—

Myotis Bocagei cupreolus, subsp. n.

Essential characters as in true *M. Bocagei*, but the colour much darker, owing to only the terminal millimetre instead of 2–3 mm. of the dorsal hairs being reddish; the reddish is also of a more coppery tone. A blackish patch at the base of each humerus. Under surface dark smoky brown, the hairs being dark smoky with brownish tips; inguinal region not or scarcely lighter. In true *Bocagei* the under surface is pale buffy brown.

Dimensions of the type:—

Forearm 39 mm.

"Head and body 60"; "tail 40"; "ear 15."

Skull: greatest length 15.

Hab. Efulen, Bulu Country, Cameroons.

Type. Male. B.M. no. 3. 2. 4. 6. Collected 14th August, 1901, by Mr. G. L. Bates.

11. *Miniopterus Schreibersi*, Kuhl.

♀. 202, 203. Golungo Alto.

12. *Nyctinomus limbatus*, Pet.

♂. 215. Cunga.
♀ (in spirit). 2. Loanda.

13. *Taphozous mauritianus*, Geoff.

♀. 1. Loanda.

14. *Crocidura* (*Croc.*) sp.

♂. 20; ♀. 17. Pungo Andongo.
♀. 156. Braganza.

15. *Viverra civetta*, Schr.

204. Golungo Alto.
♀. 124. Pungo Andongo.

16. *Genetta* sp.

♀ (young). 180. Braganza.
♀ (young). 210. Golungo Alto.

17. *Nandinia binotata*, Gray.

205. Golungo Alto.

18. *Herpestes galera*, Erxl.

209. Golungo Alto.

19. *Herpestes albicaudus loandæ*, subsp. n.

♀. 23. Pungo Andongo.
"Caught by native hunting dogs." "Native name *mabeku*."—*W. J. A.*

The animals usually referred to *H. albicaudus*, ranging from Senegal to Natal, are very uniform in colour, with the striking exception of the condition of the tail, which may be either black or white in the same locality. Broadly speaking, the forms from N.E. Africa and Arabia, representing *leucurus*, Hempr. & Ehr. (syn. *albescens*, Geoff., *abu-wudan*, Fitz.), are paler and more buffy, while those from West Africa, East Africa, and further south are more heavily blackened. The skulls show the former to be rather smaller than the latter.

But in the dimensions and structure of the last lower molar there are such striking and yet locally constant differences that it is impossible to regard as identical all

a *b*

a. Last lower molar, left side, of *Herpestes albicaudus leucurus*.
b. Ditto of *H. a. loandæ*.

the forms hitherto referred to the one species *H. albicaudus*. Treating them for the present as subspecies, the animal I should call *H. a. leucurus* has the tooth small and narrow

($6 \times 3{\cdot}7$ mm.), low (height of hinder side of main antero-internal cusp 3·2 mm.), and simple, the antero-internal cusp not or scarcely divided into its constituent paraconid and metaconid, the hinder rim of the talon little developed, and with but one low cusp on the centre of the talon (see fig. *a*).

The opposite extreme to this is shown by my *Herpestes grandis* (figured P. Z. S. 1889, pl. lxii.), where the tooth is very large ($8{\cdot}1 \times 4{\cdot}7$ mm.), high, and complicated, the anterior trefoil well developed, and the talon with a high posterior rim subdivided into cusps behind, and with two cusps on the talon, one on its outer edge and one in its centre.

East-African specimens have the tooth large ($7{\cdot}4 \times 4{\cdot}5$ mm.), but lower than in *grandis*, the paraconid and metaconid distinct, the rim of the talon well defined, but not divided into cusps posteriorly, and with one large cusp on the antero-external part of the talon. This form I would propose to call *H. a. ibeanus* *.

In specimens from Guinea, representing *loempo*, Temm., and perhaps the original Senegalese *albicaudus*, m_2 is of medium size ($7 \times 4{\cdot}2$ mm.), low, with the metaconid distinct but lower than the paraconid, the median outer cusp high, nearly equal to the low protoconid, the posterior rim of the talon high and irregularly notched.

Finally, in the North-Angolan form (*H. a. loandæ*, subsp. n.) the tooth is large ($7{\cdot}5 \times 4{\cdot}8$ mm.), but its cusps and crenulations are remarkably low and indistinct, the paraconid practically coalesced with the metaconid, the median outer cusp low and rounded, continuous with a low transverse crest running transversely across the tooth, posterior part of talon narrow, its rim formed of two low cusps (fig. *b*).

The skull of this mungoose is large, and all the teeth are heavy and well developed; but in the single example there

* Subsp. n. Colour intermediate between the pale North-eastern and darker Western forms, though nearest the latter, the general tone of the fur, apart from the dorsal black hairs, greyish isabella. Tail white in the type.

Dimensions of an adult skull (not the type), collected by Dr. J. W. Gregory at Kibwezi, Kikuyu:—

Basal length 100 mm.; zygomatic breadth 51; front of canine to back of m^2 42; breadth of palate outside m^2 33.

Dimensions of teeth in the type: greatest diameter of p^4 10, m^2 8·4, p_4 7·9, m_1 8·3, m_2 7·4.

Hab. East Africa. *Type* from Athi-ya-Maui, Mombasa–Uganda Railway.

Type. Immature male. B.M. no. 99. 10. 14. 2. Presented by C. S. Betton, Esq.

The object of selecting an immature specimen as the type is to have one with the diagnostic tooth unworn.

is no trace on either side of the small anterior lower premolar, a peculiarity not occurring in any other specimen of the group.

The general colour is dark grizzled grey, with black limbs and white tail.

Dimensions of the type (measured in the flesh):—

Head and body 620 mm.; tail 506; hind foot 135; ear 47.

Skull: nasals 26 (in middle line) ×10; interorbital breadth 23; breadth of palate across outer corners of m^1 35·5; front of canine to back of m^2 41; greatest horizontal diameter of p^4 10, m^2 8·3, p_4 8·2, m_1 8·9, m_2 7·5.

Hab. Pungo Andongo, 1200 m.

Type. Subadult female. B.M. no. 4. 4. 9. 37. Original number 23. Collected 6th June, 1903.

The above division into "subspecies" is, of course, only provisional, until such time as sufficient material is available for the true relations of the different forms to be made out. Probably the north-eastern type, paler in colour, rather smaller, and with very small m_2, should in any case be looked upon as a distinct species. Whether it overlaps the larger and darker animal remains to be seen.

20. *Pœcilogale albinucha*, Gray.

178. Marimba, Jinga Country.
♂. 179. Bange, Ngola, Jinga Country.

21. *Sciurus Nordhoffi*, Du Chaillu.

♂. 199. Canhoca.
206. Golungo Alto.

22. *Sciurus annulatus*, Desm.

♂. 198. Canhoca.

23. *Funisciurus congicus*, Kuhl.

♂. 197. Canhoca.

24. *Funisciurus congicus olivellus*, subsp. n.

♂. 214. Cunga.

In his classical paper on the mammals of Angola, Prof. du Bocage stated that the squirrels he referred to *Sciurus congicus*, Kuhl, presented several different types of coloration, and I am inclined to think that these are so different as to deserve recognition by name. For the moment I shall treat them as subspecies of *congicus*, though I think it probable that when more localized specimens are brought together some of their ranges will be found to overlap without intergradation taking place, in which case they will have to be considered as species.

The three forms I recognize may be briefly indexed as follows:—

Colour dark olivaceous, lateral lines blackish. Tail dull brownish .... *congicus.*
Colour light yellowish olivaceous, lateral lines scarcely darkened. Tail-hairs ringed with black and yellowish. *olivellus.*
Colour dull fulvous, the white stripes very broad. Tail-hairs orange at their bases .... *flavinus.*

The Canhoca specimen of Dr. Ansorge agrees closely in its general dull tone and the blackness of the outer dark line with Kuhl's type, still in the British Museum collection. A specimen received from the Lisbon Museum, and labelled as from Caconda, is also similar.

Funisciurus congicus olivellus, subsp. n.

General colour clear yellowish olivaceous, almost approaching Ridgway's "olive-yellow." This colour is yellower on the sides of the nape and on the rump, darker on the back. White stripe well defined, but narrow, the body-colour on each side of it scarcely darkened. Flanks abruptly lighter. Belly white, not sharply defined laterally. Cheeks light, an indistinct darker line running through the eye. Limbs externally like flanks, internally like belly; upper surface of hands and feet yellow. Tail-hairs ringed with pale yellow and black, the bases, middles, and tips of the former colour separated by two rings of black.

Dimensions of the type (measured in the flesh):—

Head and body 165 mm.; tail 180; hind foot 36; ear 14.

Hab. (of type). Cunga.

Type. Adult male. B.M. no. 4. 4. 9. 45. Original number 214. Collected 1st February, 1904.

The Museum contains another example of this form labelled as from the Quanza River.

Funisciurus congicus flavinus, subsp. n.

S. congicus, var. *flavivittis*, Bocage (not *S. flavivittis*, Peters).

General colour strongly flavescent, approaching orange on the sides of the neck and on the rump. White stripes very broad and prominent, the dorsal colour between them suffused with blackish; lateral lines outside them well marked, blackish. Under surface buffy yellow, as are also the inner sides of the limbs; upper surface of hands and feet orange-yellow. Sides of head and edges of ears dull buffy whitish, a faint darker line running backwards from the whiskers and another through the eyes. Tail-hairs deep orange for their basal half, then with a broad subterminal bar of black, their tips buffy yellow; terminal hairs of tail tipped with black.

Dimensions of the type (measured in spirit before skinning):—

Head and body 168 mm.; tail 141; hind foot 39; ear 14.

Skull: greatest length 40; basilar length 31; palate length 16; length of upper molar series (excluding minute anterior premolar) 6·2.

Hab. (of type). Capangombi, southern plateau of Angola.

Type. Male. B.M. no. 92. 1. 9. 6. Received in exchange from the Lisbon Museum.

Two specimens from "Angola," collected by Mr. Monteiro, and some imperfect skins from the Cunene River, collected by C. J. Andersson, may be referred to this form.

25. *Otomys irroratus*, Bts.

♂. 29. Pungo Andongo.
♀. 163. Braganza.

26. *Tatera valida*, Bocage.

♂. 184, 193. Braganza.
♂. 105, 125, 126, 127. Pungo Andongo.

27. *Cricetomys Ansorgei*, sp. n.

♂. 39; ♀. 18, 22. Pungo Andongo.
♂. 211; ♀. 212. Golungo Alto.

Size even larger than in *C. gambianus*. General colour drab-brown, paler than in true *gambianus*, darker than in the southern form of that animal. Under surface of a similar colour, but little paler than above, the throat and inguinal region alone more whitish. Young specimens, however, have their belly whitish. Cheeks paler than body, "wood-brown," muzzle and orbital rings darker brown, an irregular whitish patch at the base of the whiskers. Arms and legs like body; metacarpals blackish brown mesially, digits and outer edge of metacarpals whitish; ankles and metatarsals blackish brown, toes lighter, but not conspicuously contrasted white. Tail black for its proximal, white for its terminal half, the contrast more marked than is usual in *gambianus*.

Skull similar to that of *C. gambianus*, but larger throughout, and with heavier molars.

Dimensions of the type (measured in the flesh):—

Head and body 400 mm.; tail 469; hind foot 78; ear 47.

Skull: greatest length 82; basilar length 67; zygomatic breadth 38; nasals 34 × 11·8; interorbital breadth 12; brain-case, breadth 26; palate length 40; diastema 25; palatal foramina 8·2; length of upper molar series 12·1.

Typical locality. Pungo Andongo.

Type. Old male. B.M. no. 4. 4. 9. 91. Original number 39. Collected 9th June, 1903.

In its large size, unwhitened belly, and dark metacarpals this huge rat differs from any of the forms of the widely spread *C. gambianus*, and seems to represent a special Angolan species. The two forms of the group, no doubt synonymous with each other, from Landana described by Rochebrune * are both far smaller and have their bellies "albo-cinereis."

A comparison of the specimens of *C. gambianus* in the Museum shows that the typical form occurs from the Gambia down through the forest-region of West Africa to the Congo, and eastwards to Monbuttu. It is chocolate-brown along the dorsal area, paler on the sides, and with a sharply defined white belly. Further south, from the lake-region to Portuguese South-east Africa, it is replaced by a paler form, which may be called

Cricetomys gambianus viator, subsp. n.

Size and general characters as in *Mus gambianus*, but body-colour much paler, the back "wood-brown," scarcely darker along the spine. Under surface white, not quite so sharply defined as in *gambianus*. Tip of muzzle and orbital rings dark brown; edges of upper lip white; cheeks like flanks. Upper surface of hands white, the brown of the forearm ending on the wrists. Centre of metatarsals dark brown, the toes prominently contrasted white. Tail half blackish, half white, the two colours hardly so strongly contrasted as in *C. Ansorgei*.

Dimensions of the type (measured in skin):—

Head and body (stretched) 415 mm.; tail 370; hind foot 68; ear 44.

Skull: greatest length 73; basilar length 62; zygomatic breadth 35; nasals 31 × 11; interorbital breadth 11·3; palatal foramina 8·7; length of upper molar series 10·5.

* *Cricetomys dissimilis* and *Mus tephrus*, Bull. Soc. Philom. (7) ix. pp. 86, 87 (1885).

Hab. (of type). Likangala, Nyasaland.

Type. Old male. B.M. no. 2. 1. 6. 33. Collected June 1901 and presented by Sir Alfred Sharpe, C.B.

28. *Arvicanthis dorsalis griselda*, subsp. n.

♂. 174; ♀. 175. Muene Coshi, Jinga Country.

Like the true southern *A. dorsalis* in all essential respects, but the colour is paler throughout, with less ferruginous suffusion; sides of head and flanks pale lined greyish with scarcely a tinge of buffy. Orbital rings and sides of muzzle pale yellowish, not ferruginous. Belly white.

Molars rather smaller than in the typical subspecies.

Dimensions of type (measured in flesh):—

Head and body 121 mm.; tail 135; hind foot 28; ear 14.

Skull: greatest length 31; basilar length 25; breadth of brain-case 12·5; palatal foramina 6·1; length of upper molar series 6·1; breadth of m^1 2·1.

Type. Adult, but not old, female. B.M. no. 4. 4. 9. 95. Original number 175. Collected 26th September, 1903.

The present is the furthest towards the north-west that *A. dorsalis* has been recorded, and, considering the great distance from the Cape, it is not surprising that there should be a difference in colour worthy of subspecific recognition.

On the eastern side of Africa *A. dorsalis* goes slightly farther north, but there, instead of being more pallid, the colours are intensified, while the reduction in the size of the molars is carried to an extreme. This eastern form may be called

Arvicanthis dorsalis rosalia, subsp. n.

Essential characters of true *dorsalis*, but the colours strong and dark, a large proportion of the rump strong ferruginous; sides of muzzle, orbital rings, and ears rich rusty.

Skull small and narrow, the molars conspicuously weaker than in the typical form.

Dimensions of the type:—

Head and body (in skin) 119 mm.; hind foot (wet) 28; ear (wet) 15.

Skull: back of interparietal to tip of nasals 31; zygomatic breadth 14·2; interorbital breadth 4·4; brain-case, breadth 12·7; palatal foramina 6·5; length of upper molar series 5·6; breadth of m^1 1·7.

Hab. Monda, Nguru Mountains, German East Africa.

Type. Adult female. B.M. no. 90. 6. 8. 28. Presented by Emin Pasha.

29. *Arvicanthis pulchellus*, Gray.

♂. 63. Pungo Andongo.
♂. 157, 185; ♀. 150, 181, 182, 186. Braganza.
♂. 177. Marimha, Jinga Country.

30. *Pelomys campanæ*, Huet.

♂. 4. Ambaca.
♂. 35, 36, 118, 119; ♀. 37, 130. Pungo Andongo.
♂. 149, 161. Braganza.
Type locality. Landana, Lower Congo.

31. *Pelomys frater*, sp. n.

♂. 168; ♀. 154, 167. Braganza.

A darker-bellied form than *P. campanæ.* Molars larger.

General colour above of the usual iridescent dark yellowish olive; no dorsal stripe. Sides rather more buffy. Under surface dirty greyish buffy, the hairs dark slaty for two thirds their length, buffy at tips; line of demarcation on sides not sharply defined, the upper and lower colours passing quite gradually into each other. Head rather greyer than body; sides of muzzle and orbital rings not prominently buffy; ears dark brown, a ferruginous spot at their anterior bases. Limbs like body; upper surface of hands and feet grey, not fulvous. Tail shorter than in *P. campanæ,* black above, dull whitish below.

Skull much as in *P. campanæ,* the palatal foramina rather shorter and the bullæ larger.

Incisors thick and powerful. Molars very broad and heavy, conspicuously larger than in *P. campanæ.*

Dimensions of the type (measured in the flesh):—

Head and body 139 mm.; tail 136; hind foot 31; ear 20.

Skull: greatest length 32; basilar length 25·7; zygomatic breadth 15·5; nasals 11·7; interorbital breadth 4·7; breadth of brain-case 14; diastema 8; palatal foramina 5·8; length of upper molar series 6·8; breadth of m^1 2·5.

Hab. Braganza.

Type. Male. B.M. no. 4. 4. 9. 107. Original number 168. Collected 6th August, 1903.

It is interesting to find two forms of *Pelomys* inhabiting the same region, but there can be no question as to the distinction of *P. frater* from *P. campanæ.* Pousargues's *P. Dybowskii,* from French Congo, is a very much larger species than either (hind foot, c. u. 38; molars 8·5 mm.).

32. *Dasymys* sp. (probably *nudipes*, Pet.).

♀. 159. Braganza.

33. *Œnomys* (g. n.*) *hypoxanthus Anchietæ*, Bocage.

Mus Anchietæ, Bocage (the male only).

♂. 24. 93. 98; ♀. 25. Pungo Andongo.

The "*Mus Anchietæ*" of Bocage is clearly a member of the *hypoxanthus* group, but is separable from the Gaboon form by its rather lighter colour, in which respect it approaches my *Œ. h. unyori* †. From this latter it is distinguished by the lesser extension of the rufous over the back and the less wholly red feet.

With regard to the general position of the *hypoxanthus* group, further consideration convinces me that the molars are so peculiar that it ought not any longer to be included in *Mus*, and I therefore suggest a special generic name for it. A good account of its dentition, with figures, has been given by Tullberg ‡, and in Bocage's paper there is also a photograph of the under aspect of the skull. The characters of *Œnomys* would be as follows:—

General structure as in *Mus*, but the molars very broad, rounded, with peculiarly prominent cusps; the individual cusps separated by deep antero-posterior grooves from each other, so that the essential laminate structure of the molars is lost. M^1 and m^2 each with a large antero-internal supplementary cusp and small antero-external one. M^3 with very large antero-internal supplementary and main internal cusps, but the external ones, both supplementary and main, almost or quite obsolete.

34. *Mus Bocagei*, sp. n.

♂. 19, 30, 78, 86, 128; ♀. 21, 27, 43, 59. Pungo Andongo.

A large pale brown rat, with white belly and feet; mammæ 0—2=4.

General colour pale brown, resulting from a mixture of blackish and clay-colour; sides greyer; belly white, fairly sharply defined, the hairs slaty grey at their bases only. Head like body, orbital rings darker. Ears of medium length, brown. Outer side of limbs like body, inner like

* *Œnomys*, g. n. Type *Mus hypoxanthus*, Pucheran.

† Ann. & Mag. Nat. Hist. (7) xii. p. 343 (1903).

‡ N. Act. Upsala, (3) xvi. Art. xii. p. 26 (1893).

belly; upper surface of hands and feet pure white. Tail about the length of the head and body, practically naked, the few fine hairs about one scale in length; scales coarse, about nine rings to the centimetre; colour uniformly brown. Mammæ 0—2=4, all close together near the vulva.

Skull long, well-ridged, the ridges not sharply divergent; palatal foramina long, rather narrow, reaching back to the level of the first lamina of m^1. Bullæ of medium size, smaller than in *M. Hindei* and *Thomasi*, much larger than in *M. sebastianus*.

Teeth rather light, the molars much narrower than the palate between them.

Dimensions of the type (measured in the flesh):—

Head and body 191 mm.; tail 189; hind foot 35; ear 28.

Skull: greatest length 41; basilar length 32·2; zygomatic breadth 20; nasals 15·5; interorbital breadth 6; breadth between ridges on parietals 13; diastema 11; palatine foramina 8·7; length of bulla 7; length of upper molar series 6·2.

Hab. Pungo Andongo. Alt. 1200 m.

Type. Male. B.M. no. 4. 4. 9. 62. Original number 128. Collected 13th September, 1903.

This fine species may be readily recognized by its size, nearly naked large-scaled tail, white belly and feet, and unusual mammary formula.

An example of it seems to have been the "Femina: coloribus pallidioribus. Mammæ quatuor inguinales" of Bocage's *Mus Anchietæ*, but the male and all other parts of the description refer to an *Œnomys* (see above).

I have great pleasure in dedicating this species to my friend Prof. Barboza du Bocage, of Lisbon, to whom I am much indebted for help, and in whose many papers almost the whole of our knowledge of Angolan mammals is enshrined.

35. *Mus avunculus*, sp. n.

♂. 49. Pungo Andongo.

Like *M. angolensis*, but larger, with white belly and more hairy tail.

General colour above pale fawn-grey, about as in *M. angolensis*, but the rump distinctly redder (dull "ochraceous buff"). Under surface, from chin to anus, pure white, the hairs white to their roots. Head clearer grey, without buffy suffusion. Ears of medium size, grey. Upper surface of hands and feet pure white. Tail distinctly ringed (ten rings to the centimetre), almost naked basally, the rings there obvious, but terminally the hairs increase in length, hiding the scales on the last inch, and forming a slight pencil at the tip, where they are about 2 mm. in length; colour pale brown, rather lighter proximally below. Mammæ unknown.

Skull very like that of *M. angolensis*, but larger; anterior edge of zygomatic plate slightly concave.

Dimensions of the type (measured in skin):—

Head and body 136 mm.; tail 176; hind foot 28; ear 19.

Skull: greatest length 34; basilar length 25·5; nasals 15; interorbital breadth 4·6; diastema 8·5; palatal foramina 7·8; length of upper molar series 5·2.

Hab. Pungo Andongo. Alt. 1200 m.

Type. Old male. B.M. no. 4. 4. 9. 67. Original number 49. Collected 14th June, 1903.

This rat looks at first sight like a diminutive relative of *Mus Bocagei*, but it would seem on the whole more related to *M. angolensis*, from which it differs by its reddish rump, white belly, more hairy tail, and longer feet. If this view of its affinities is correct, its mammary formula should prove to be 3—2=10.

36. *Mus angolensis*, Boc.

♂. 47, 87; ♀. 114, 117. Pungo Andongo.

This is the Angolan representative of the widely distributed rat with 3—2=10 mammæ, otherwise so like the multimammate form. It appears to have, however, broader posterior nares than the latter.

37. *Mus* sp. (multimammate).

♂. 79, 103, 106, 116; ♀. 67, 111, 115. Pungo Andongo.

38. *Mus arborarius*, Peters.

♂. 107, 121; ♀. 90. Pungo Andongo.

39. *Mus carillus*, sp. n.

♂. 33, 50, 61, 82, 113; ♀. 26, 65, 85. Pungo Andongo.

A small buffy mouse, with long tail, similar to *M. Alleni*. Mammæ 1—2=6.

Size small, form delicate, with slender feet and long thin tail. Fur soft and fine, hairs of back about 6–7 mm. in length. General colour above buffy fawn, varying very much in tone and brightness according to age and state of development, some of the younger specimens near "cinnamon," older ones almost "ochraceous." Under surface greyish white, the hairs slaty for their basal two thirds, white terminally. Outer side of limbs like sides, inner side like belly; hands white from wrists; ankles inconspicuously brown, upperside of feet white; fifth toe reaching to the end of the second phalanx of the fourth. Tail long, slender, thinly and fairly haired, scarcely pencilled at end, uniformly pale brown; rings of scales very fine, about sixteen or seventeen to the centimetre. Mammæ 1—2=6.

Skull low and broad, with a large brain-case and small muzzle; supraorbital edges square, but not markedly beaded, the faint ridges disappearing halfway across the parietals; palatal foramina not very widely open, reaching back to the level of the front of m^1; palate ending squarely just behind m^3; bullæ small.

Dimensions of the type (measured in the flesh):—

Head and body 96 mm.; tail 146; hind foot 20; ear 16.

Skull: greatest length 26; basilar length 20; zygomatic breadth 12·5; nasals 9; interorbital breadth 4·5; breadth of brain-case 11·2; height of brain-case 7·5; palate length 11; diastema 6·6; palatal foramina 4·7; length of upper molar series 4·0.

Hab. Pungo Andongo. Alt. 1200 m.

Type. Old female. B.M. no. 4. 4. 9. 74. Original number 65. Collected 20th June, 1903.

Even apart from the number of its mammæ this pretty mouse is readily distinguishable from *Mus Alleni*, the only species with which it could be compared, by its much paler colour and its wholly white feet.

40. *Lophuromys sikapusi*, Temm.

♂. 162. Braganza.

41. *Dendromys* sp.

♂. 213. Golungo Alto.

A striped species whose identity with the southern *D. mesomelas* and *melanotis* I am at present unable either to affirm or deny.

42. *Steatomys Bocagei*, Thos.

♂. 133, 135, 137, 164, 165; ♀. 132, 155. Braganza.

43. *Georychus Mechowi*, Peters.

♂. 152, 153, 170, 178; ♀. 169. Braganza.

44. *Georychus Bocagei*, de Wint.

♂. 142, 151, 160, 189, 190, 191. Braganza.
♂. 12. Ambaca.
♂. 129. Pungo Andongo.

45. *Lepus angolensis*, sp. n.

Lepus ochropus, Bocage, nec Wagner.

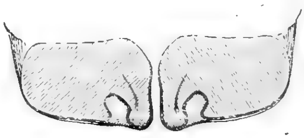
♀. 3, 7, 11. Ambaca.
♀. 15. Pungo Andongo.

A dark strongly coloured species, with rufous neck; enamel foldings of incisors peculiar.

General colour above dark, a dark clay-colour grizzled with blackish, the hairs with a subterminal band of dark buffy and black tips; sides rather paler. Centre of face dark lined buffy, a white frontal spot generally present. Sides of muzzle whitish and a narrow orbital ring of the same colour; an indistinct patch below the front of the eye blackish. Nape bright rufous, near "tawny ochraceous" of Ridgway. Ears of medium length; anterior part of external surface dark lined greyish; the fringing hairs dark buffy; tips edged with black; outer margin white basally, becoming buffy terminally. Chin and interramia white, throat dull buffy; belly white, not sharply defined laterally. Fore limbs dull cinnamon, a narrow line on the inner side of the forearms white. Hind limbs similar, their inner surfaces more broadly white. Tail of medium length, black above, white on sides and below.

Skull in its general proportions not unlike that of *L. Whytei*, Thos., of medium length, stoutly built, without noticeable peculiarities.

Incisors with the involution of the enamel about as in *L. Whytei* *, the groove practically filled up with cement.



Section of upper incisors of *Lepus angolensis*.

But, in addition to the main involution, there is a further and peculiar complexity in the presence of a fine thread (as seen in section), apparently of enamel, passing backwards and

* Figured by Forsyth Major, Tr. Linn. Soc., Zool. vii. p. 468, figs. xi & xiii. (1899).

outwards from the middle of the antero-internal peninsula towards the centre of the main dentine area of the tooth, dying away about halfway across to the hinder margin. This additional complexity of the incisive section has not been hitherto noticed in any hare.

Dimensions of the type (measured in the flesh):—

Head and body 390 mm.; tail 90; hind foot 115; ear 115.

Skull: back of parietals to tip of nasals 78; basilar suture to henselion 55; zygomatic breadth 39; nasals, length diagonally 34, greatest breadth 18; interorbital breadth 20; diastema 23; breadth of palatal bridge 7; palatal foramina 21 × 9.

Hab. (of type). Ambaca. Alt. 800 m.

Type. Adult female. B.M. no. 4. 4. 9. 140. Original number 7. Collected 29th April, 1903.

The Angolan hare was referred by Prof. Bocage to *Lepus ochropus*, Wagn., but that is the yellow-naped High Veldt representative of *L. capensis* *. Jentink's *L. salæ*, from Mossamedes, is a far paler form, with much shorter tail.

Probably *L. angolensis* is most nearly allied to the Zambesian *L. Whytei*, but differs from that as from all other species by the unusual complexity of its upper incisors.

46. *Procavia Bocagei*, Gray.

♀. 51 (imm.). Pungo Andongo.

XLIX.—*On* Felis ocreata, *better known as* Felis caligata, *and its Subspecies.* By Harold Schwann.

The first account of this cat appears in Bruce's 'Travels to Discover the Source of the Nile' †, under the name of the "Booted Lynx," and, with the exception of the exaggeration of the ear-tufts in the plate, appears to be a very accurate description.

In 1791 E. W. Cuhn published at Leipzig a German translation of the 'Travels,' with a zoological appendix by J. F. Gmelin, where the latter distinctly gives the name of *Felis ocreata* ‡ to Bruce's specimen.

F. ocreata therefore stands as being the earliest technical name of the species.

* *Cf.* Ann. & Mag. Nat. Hist. (7) xii. p. 344 (1903).
† Vol. v. p. 146 (1790).
‡ Anh. Bruce Reisen, Gmel. p. 27 (1791).

Mr. W. E. de Winton, in Anderson's 'Zoology of Egypt' *, has taken Meyer's *Felis lybica* † as representing Bruce's "Booted Lynx," not having noticed Gmelin's earlier name. It seems, however, very probable that Meyer's *F. lybica* is applicable to some form of caracal, as the first part of the description he quotes from Forster's translation of Buffon ‡ (the original describer) runs as follows:—"Corpore rufo, auriculis albis nigrobarbatis."

The names that have been applied to this group at different times are given below, with the locality where each type was collected, so far as this can be ascertained with any exactness:—

"*Booted Lynx*," Bruce, Travels Source of the Nile, vol. v. p. 146 (1790).—Ras el Feel, Abyssinia.

Felis ocreata, Gmelin, Anh. Bruce, Reisen (Rinteln und Leipzig), vol. ii. p. 27 (1791).

Felis cafra, Desm. Encycl. Méth., Mamm. Suppl. p. 540 (1822).—"Caffraria."

Felis caligata, Temm. Monogr. Mamm. no. 4, vol. i. p. 123, 1824 (1827) (ex Bruce).

Felis maniculata, Temm. *op. cit.* p. 128.—Ambukol, on the Nile.

Felis Rüppelli, Schinz, Cuv. Thier. vol. iv. p. 509 (1825).—Dongola.

Felis bubastis and *F. dongolanæ* (nom. nud.), Hemp. & Ehrenb. Symb. Phys. dec. ii. text to pl. xvii. (1832).

Felis pulchella, Gray, Charlesw. Mag. Nat. Hist. i. p. 577 (1837).—Egypt.

Felis margarita, Loche, Rev. et Mag. Zool. p. 49 (1858).—N'gouca, Algerian Sahara.

Felis cristata, Lataste, Faune des Vert. de Barbarie, p. 104 (1885).—Haïdra.

It appears very probable that *F. pulchella* ought to be considered a synonym of *F. maniculata*, Temm., but the British Museum does not at present possess sufficient North-African material to settle the question definitely.

I regard the following new forms as subspecies partly because their differences from *Felis ocreata* are not marked enough to warrant specific distinction, and also on account of the great convenience the use of trinomial nomenclature is in linking together the members of a widely distributed group.

Felis ocreata rubida, subsp. n.

Resembles *F. o. ocreata* in general proportions, but is strongly suffused with fulvous on the head, body, and feet.

General colour of the upper surface "hair-brown," the

* P. 171.

† Meyer, 'Syst. Zool. Entd. Neuholland u. Afr.' p. 101 (1793).

‡ Forster, 'Ueberf. v. Buff. Naturgesch. der vierfüssigen Thiere,' B. vi. p. 313 (1780).

median line strongly fulvous, pencilled with black; flanks covered with irregular brown spots. Individual hairs of back about 15 mm. in length; their basal third drab, middle third cinnamon-colour, subterminal ring dark brown, almost black, tip buffy. Muzzle, upper lip, ears, and sides of throat bright fulvous; a white patch above and below the eyes, nape dark brown; four indistinct brown lines extending from forehead to shoulders; interramia pure white, shading into dull buffy on the throat and chest; belly cinnamon-colour, marked with indistinct black spots; inguinal region buffy yellow. Upper surface of fore and hind limbs light brown, ringed with several indistinct brown bands; forearms partially black; feet fulvous above, black beneath; tail coloured like back, tip black, three or four subterminal black rings.

Dimensions of the type (from the dried skin):—

Head and body 575 mm.; tail 286; hind foot 127; ear 54.

Skull: basilar suture to nasion 60·5; breadth of brain-case 44·2; temporal breadth 30·6; anteorbital breadth 14·0; zygomatic breadth 62·0; outer length of upper carnassial 10·7; greatest length of auditory bulla 22·0.

Hab. Monbuttu.

Type. Male. B.M. no. 87. 12. 1. 6. Collected and presented by Dr. Emin Pasha.

A young specimen obtained by Dr. Emin from the same locality has the characteristic spots on the flanks and the fulvous coloration on the median line, but is of a rather lighter colour throughout.

Felis ocreata Mellandi, subsp. n.

Very uniformly coloured, no spots or bands on the back and sides.

General colour of the upper surface greyish buff, darker on the median line. Individual hairs of back about 35 mm. in length; basal two thirds dull buffy yellow; subterminal ring black; tip light grey. Under surface creamy buff; the hairs grey basally, middle third buff, terminal third creamy yellow. Nose and ears bright yellowish; cheeks and interramia light yellow, almost white; forehead and nape darker than back, the individual hairs black, with grey tips. Upper surface of fore and hind limbs coloured like back; under surface black, speckled with grey.

The two specimens of this subspecies in the British Museum are incomplete as to their tails, so it is impossible to say whether the usual black tip and subterminal rings are present until more material is obtained. The tail (as much as is preserved) is coloured like the median line of the back, rather darker than the flanks.

Dimensions of the type (from the dried skin):—

Head and body 210 mm.; ear 48.

Skull absent in both specimens.

Hab. Mpika, North-east Rhodesia.

Type. B.M. no. 4. 3. 11. 2. Collected and presented by F. H. Melland, Esq.

I have much pleasure in naming this cat after Mr. Melland, who has collected a number of specimens for the National Museum in the country round Mpika.

This subspecies may be readily distinguished by the sharp contrast between the bright yellow of the ears and the rest of the body as well as the entire absence of any markings on the dorsal area.

A specimen collected by Mr. Alfred Sharpe in 1893 * at Lake Mweru appears to be referable to *Mellandi*.

Felis ocreata ugandæ, subsp. n.

Similar to *F. o. ocreata*, but darker throughout.

General colour above yellowish grey, lighter on the flanks; median line of the back conspicuously darker, fulvous to dark brown; flanks transversely banded with indistinct fulvous stripes from ten to fifteen in number. Underfur of back about 15 mm. in length, proximal half smoke-grey, light buffy yellow distally; long hairs about 25 mm. in length, black, with white subterminal ring and black tip. Under surface "creamy buff," covered irregularly with brown or blackish spots. Muzzle, upper lips, and a patch above and below the eyes strongly fulvous; a line extending from the posterior margin of the orbit to the middle of the cheek dark brown; edge of the lips, lower part of the cheek, and a patch from muzzle to eyebrows yellowish white; forehead and nape darker than the back, in well-marked specimens nearly black; ears bright rufous, covered internally with long white hairs, ear-tufts black; interramia and throat white, with one or two transverse buffy yellow bands; inguinal region thickly covered with long buffy hair. Upper surface of fore and hind limbs coloured like back, with several indistinct dark bands; feet bright buffy above, black below. Tail coloured like back or greyer; two or three black subterminal rings; tip black.

Dimensions of the type (taken in the flesh):—

Head and body 584 mm.; tail 341; hind foot 131; ear 58.

* P. Z. S. 1893, p. 723.

Skull.

	Male (type).	Female.
	mm.	mm.
Greatest length	103·0	92·0
Basal length	88·0	78·5
Zygomatic breadth	73·0	63·2
Anteorbital breadth	16·5	16·0
Temporal breadth	31·2	35·6
Brain-case, breadth	45·5	45·0
Greatest length of bulla	24·0	23·0
Outer length of upper carnassial	11·0	11·0

Hab. Mulema, Uganda.

Type. Male. B.M. no. 3. 11. 7. 8. Alt. 5000 feet. Collected by Mr. W. G. Doggett and presented by Col. Delmé Radcliffe.

The comparative skull-measurements given above serve very well to show the difference in size between the sexes. The specimens from which they were taken were both fully adult and obtained in the same locality.

The colour of the female is slightly lighter throughout, agreeing in this respect with a specimen obtained by Capt. Speke at "Memissa."

Felis ocreata cafra, Desm.*

Mr. W. E. de Winton, in Anderson's 'Zoology of Egypt' †, decided that it was necessary to adopt the earlier name ‡ of *obscura* instead of *cafra* for the South-African race of *Felis ocreata*, although the name was based on a melanistic specimen. A comparison of the two descriptions with the British Museum's fine series of South-African skins seems to suggest that after all Desmarest's *F. obscura* § may be nothing more than a melanistic specimen of the domestic cat. It may be noticed that the British Museum specimens do not have the "bandes transversales entièrement noires et très-nombreuses," nor is the species so small as the domestic cat, as *F. obscura* is said to be.

It appears, therefore, so doubtful whether *F. obscura* is really referable to this species that I see no necessity at present for altering the more suitable and better known name of *cafra*.

The British Museum does not at present possess sufficient North-African material for me to decide definitely as to the status of *F. margarita*, Loche, and *F. cristata*, Lataste.

* Encycl. Méth., Mamm. Suppl. 1822, p. 540.

† P. 175.

‡ Encycl. Méth., Mamm. 1820, p. 230.

§ See Dict. des Sci. nat., F. Cuv., tom. viii. p. 222, for original description.

A synopsis of the new forms described above is added to assist in the identification of individual members of this difficult group:—

A. No fulvous suffusion on the sides, no spots on the flanks.
  a. Underfur on median line of back cinnamon-colour, forehead and nape not darker than back ...... *F. o. ocreata.*
  b. Underfur on median line dark brown or black, forehead and nape darker than back.
    a'. Forearms conspicuously ringed with black, underside of forearms deep black all over .... *F. o. cafra.*
    b'. Forearms inconspicuously ringed, underside of forearms partially black.
      a''. General colour pale, ears yellowish .... *F. o. Mellandi.*
      b''. General colour darker, ears rufous .... *F. o. ugandæ.*
B. Sides and limbs suffused with fulvous, well-marked brown spots on the flanks...................... *F. o. rubida.*

L.—*On certain African Butterflies of the Subfamily* Pierinæ. By ARTHUR G. BUTLER, Ph.D., F.L.S., &c.

I THINK every true naturalist will agree with me that fair criticism is valuable as a stimulus, and has the effect of making a good workman exert himself to avoid error as much as possible in his subsequent work. When, however, a man has spared no pains to arrive at the exact truth, has built up his facts brick by brick, until the edifice seems to be complete, and another workman, with all the facts before him, misrepresents them, it seems only right to expose the unfairness of such criticism.

In a paper by Prof. Aurivillius published in the Upsala 'Nya Tidnings Aktiebolag' last year, and entitled "Results of the Swedish Zoological Expedition to Egypt and the White Nile, 1901, under the direction of L. A. Jägerskiöld. —No. 8," the author records two forms of *Belenois* under the names *Pieris gidica*, God., var. *Westwoodi*, Wallengr., and *Pieris gidica*, God., var. (?) *abyssinica*, Lucas; and he observes, "It is very remarkable that *Westwoodi* also was taken in the dry season at nearly the same time as *abyssinica*. The relation between *P. Westwoodi* and *abyssinica* has been the subject of much discussion, and is not yet sufficiently cleared up. Butler says in 1894 (Proc. Zool. Soc. 1894, p. 579), 'I am quite satisfied that *B. gidica* and *B. abyssinica* cannot be regarded as distinct species'; and in 1898 (Trans. Ent. Soc. London, 1898, p. 436), 'I may begin by stating emphatically that *gidica* is not the wet-season form of *abyssinica.*' "

The above statement does give the impression, whether intended or not, that in 1898 I flatly contradicted the statement made by myself in 1894; but Prof. Aurivillius, with both papers before him, is perfectly well aware that the *B. gidica* of the first and second papers were entirely different species or forms.

In 1894 we knew *B. gidica* from description only, and it was supposed by all lepidopterists to be identical with the *B. Westwoodi* of Wallengren; but Godart's type came into the possession of, I believe, the Edinburgh Museum, was brought to the British Museum for comparison, and thus the fact that it was quite distinct from *B. Westwoodi* (=*B. gidica* auct. plur.) was made evident.

In 1898, in the very paper to which Prof. Aurivillius refers as evidence of the instability of my emphatic utterances, I described the true *B. gidica* as explanation of the very sentence quoted, only part of which, moreover, was quoted, since to quote the whole would have made the misrepresentation of my assumed change of front evident: what I added is, "Furthermore, there are two South-African species of the group, easily separated by anyone who has an eye for form and pattern"; and I then proceeded to describe the differences between the typical *B. gidica* and the form previously regarded as that species by lepidopterists generally.

But, to make the point still more unmistakable, I in the same paper described the seasonal forms both of *B. abyssinica* and *B. Westwoodi*, showing that they are not, as I formerly supposed, mere seasonal phases of one species, but that the wet phase of each form is well marked, and indicates at least the local distinctness of the southern and northern representatives of this type.

Now, to examine Prof. Aurivillius's statement in detail. It is *not* very remarkable that dry and wet phases should both occur during the dry season. I have repeatedly shown that, although the dry phase of a species is prevalent in the dry season, examples of the wet phase are frequently present. We do not know, and can only surmise, the cause of this fact: it is possible that the position of a chrysalis near to or far from the earth may have some effect in determining the character of the developing butterfly; in heavy dews it is conceivable that the chrysalis near the surface of the earth might be more affected by the moisture than if situated at some height above the ground.

Again, I have shown that in very dry countries a species will frequently develop all the phases characteristic of the seasons simultaneously. Prof. Aurivillius cannot understand this; therefore he says of *Teracolus daira*:—"It is very peculiar to find this form, which is coloured like a summer form, flying in the middle of the dry season together with highly developed dry-season forms of other species. I therefore do not think that *T. nouna*, Lucas, is really a dry-season form of *daira*." If the Professor had paid more attention to my argument—that the seasonal phases of species are only variations formerly coexistent which have become more or less seasonally fixed—there would be nothing peculiar to him in the existence of a wet phase in the dry season, so long as it was not as abundant then as in the wet season; nor would he have any reason for coming to the conclusion, on such evidence, that *T. nouna* could hardly be the dry phase of *T. daira*.

In the second place, I do not agree that the relation between *B. Westwoodi* and *abyssinica* has not been cleared up. I consider that, as I have described the seasonal phases of both, the only question between lepidopterists is as to whether they shall be called species or local forms—a question of absolute unimportance, which can never be cleared up so long as naturalists hold different views as to what constitutes a species.

In the same page upon which Prof. Aurivillius makes the remarks above discussed he describes and figures a very pretty little species of *Herpænia*, to which he gives the unnecessarily descriptive name "*Herpænia eriphia*, God., var. hib. extrema *straminea*, n. var." Now, in the first place, it is not *Herpænia eriphia* at all, the dry phase of which barely differs from the wet, nor is it *H. melanarge*, the dry phase of *H. iterata* (which I suspect is the species recognized by Prof. Aurivillius as *nyassæ*, Lanz), but it is my *H. lacteipennis*, described from Abyssinia, and, I believe, sunk by Aurivillius as a synonym of *H. eriphia*, probably because my friend Trimen, in his 'South African Butterflies,' vol. iii. p. 78, says he should regard *H. melanarge*, judging from the description, as the same as var. *a* (the dry phase of *H. eriphia*), and *lacteipennis* from Abyssinia, notwithstanding its unusually small size, as referable to the same variety, if it were not for the description of the hind wings. Mr. Trimen had then not seen the types of either species or local representative (whichever one may please to call these closely related forms); and, therefore, when the Professor was in London he should have carefully examined them himself, and so at least saved himself from perpetrating so terrible a synonym for a pretty little butterfly as that quoted above. It is a long time, since 1876, for my species to have remained unknown to one of the chief workers at the lepidopterous fauna of the dark continent; in twenty-seven years surely he should have gained some idea of the identity of a species the type of which he might have examined at the Museum on more than one fairly long visit to London.

LI.—*Notes on* Phasmidæ *in the Collection of the British Museum (Natural History), South Kensington, with Descriptions of new Genera and Species.*—No. II. By W. F. KIRBY, F.L.S., F.E.S.

Subfam. II. *BACTRICIINÆ.*

I am obliged to form a new subfamily for my genus *Bactricia* (=*Scaphegyna*, Karsch), which agrees with the Lonchodinæ in its long antennæ and in the short median segment, but differs entirely in the large incurved cerci of the male and in the long operculum of the female.

The two known species are from Africa, and I now add one from Singapore. (By some error the name of this subfamily has been given as Bacteriinæ in the list on p. 372 *antea*.)

Genus BACTRICIA, Kirb.

Bactricia Ridleyi, sp. n.

Male.—Greenish brown; head short, narrowed behind, and with two compressed obtuse horns between the eyes; space between the horns and the antennæ, sides of head, (probably) the propectus, and a lateral streak below the median segment white. Antennæ and legs long and slender, the latter nearly straight, and unarmed except for a sharp, flattened, curved tooth near the base of the middle femora beneath. Median segment half as long again as broad; abdominal segments 2–6 about three times as long as the median segment, the seventh about twice as long; segments 8 and 9 about as long, tenth rather shorter, concave at the extremity; cerci compressed, almost spatulate, incurved and crossed; operculum extending as far as the ninth abdominal segment.

Dimensions.

		mm.
Long.	corporis	125
„	capitis	4
„	pronoti	5
„	mesonoti	28
„	metanoti, cum segm. med.	23
„	segm. med.	$3\frac{1}{2}$
„	fem. ant.	40
„	„ med.	32
„	„ post.	41

Hab. Singapore (*Ridley*).

Allied to *B. trophinus*, Westw., from Natal, but in the male of that species the horns are much more slender and pointed, and the middle femora are unarmed.

Subfam. III. *Bacillinæ.*

Clitumnidæ et *Bacillidæ*, Brunner.

The very short median segment and the large incurved and frequently crossing cerci of the males will provisionally bring together a series of apterous Old-World species which agree with the American Diaphomerinæ in most respects, but differ in the shortness of their antennæ. With Brunner's Clitumnidæ I associate his Bacillidæ, considering them too closely related to *Phthoa* &c. to be separated from them, notwithstanding the more or less distinct excavation at the end of the tibiæ, which will, perhaps, prove to be a less important character than has been supposed. It is not nearly so distinctly marked in some genera of Phasmidæ as in others.

Another reason for removing the Clitumnidæ from the position in which they were placed by Brunner is that they come between the Necrosciinæ and Acrophyllinæ, winged Old-World subfamilies which agree in the shape of the median segment.

Subfam. IV. *Diaphomerinæ.*

Bacunculidæ, pt., Brunner.

I employ this name for a series of American genera allied to the Lonchodinæ by the very short and well-marked median segment and to the Bacillinæ by the large and generally incurved cerci of the males. *Bacunculus* and the genera following it in Brunner's arrangement appear to me to be more closely related to the Bacteriinæ.

Genus Caulonia, Stål.

‖ *Ceroys*, Sauss. (nec Serv.).

A series of utterly discordant species have been placed in this genus, the type of which is *Caulonia bifolia*, Stål, allied to *Ceroys rhabdota*, Westw.; but I have not sufficient material available to justify me in attempting to break it into natural genera. The genera including spiny Phasmidæ are in greater need of revision than any others of the family. However, judging by the description, I think that *Parobrimus*, Scudd., is probably allied to *Caulonia*, and that *Ceroys laciniatus*, Westw., may be referable to it.

Subfam. V. *Bacteriinæ.*

Bacunculidæ, pt., and *Bacteridæ*, pt., Brunner.

I employ this name provisionally for a series of apterous American genera in which the median segment is either as long as the metanotum or else, especially in the males, so closely fused with it that no division is visible. The genera *Bacunculus*, Burm., and *Dyme*, *Calynda*, *Bostra*, and *Clonistria* of Stål, included by Brunner in his Bacunculidæ, will fall into the present subfamily, and also the following genera, included by Brunner in his Bacteridæ:—*Phibalosoma*, Gray; *Phanocles*, Stål; and *Bacteria*, Latr. I include *Phibalosoma* (and some allied American genera not mentioned by Brunner) in this subfamily, although they have winged males, because they agree too closely with *Phanocles* and *Bacteria* to be referred to a distinct family. I also include the genera *Bactridium*, Sauss., and *Abrachia*, Kirb., though they are not very closely allied to the other genera; but I cannot find a better place for them. *Abrachia* has no triangular spaces at the end of the tibiæ beneath, as I have erroneously stated, but a very large one at the end of the middle femora, the carinæ of which project at the end on each side in a strong spine.

Genus Tersomia, nov.

Antennæ only one third of the length of the front femora, 23-jointed; scape flattened, twice as long as broad; second joint rather longer than broad, flattened, narrower than the scape, the rest slender, linear; third joint the longest, three times as long as broad, the fourth scarcely longer than broad, the rest gradually increasing in length to beyond the middle and then gradually shortening to the extremity. Head considerably longer than broad, narrowed behind, with a pair of short, stout, very obtuse horns on the vertex between the eyes. Legs and body long, slender, smooth, legs nearly straight; tibiæ carinated to the extremities, terminal spines of the front femora and outer side of the middle femora very slightly marked, those on the inner side of the middle femora and on both sides of the hind femora more conspicuous; first joint of tarsi at least as long as all the rest together; median segment fused with the metanotum, longer than broad; segments 2–7 of the abdomen from two to four times longer than broad; three terminal segments slightly longer than broad, carinated above, terminating in a very long operculum, trifid at the extremity.

Appears to be allied to *Clonistria*, Stål, but with much shorter antennæ and very long operculum.

Tersomia brasiliensis, sp. n.

Female.—Light brown, legs pubescent; meso- and metanotum above with a double yellowish line, head and pronotum less distinctly streaked and dotted with yellowish.

Dimensions.

	mm.
Long. corp.	151
„ antennarum	16
„ capitis	5
„ pronoti	$4\frac{1}{2}$
„ mesonoti	33
„ metanoti, cum segm. med.	26
„ operculi	17
„ fem. ant.	43
„ „ med.	31
„ „ post.	32

Hab. Iguarassu, Brazil (*Ridley*).

Subfam. VI. *Phryganistriinæ.*

Lonchodidæ, pt., et *Bacteridæ*, pt., Brunner.

I propose this subfamily to include the Eastern genera *Phryganistria*, *Sadyattes*, and *Pharnacia* of Stål, and *Tirachoides* of Brunner. The males are winged, except in *Phryganistria*. *Phryganistria* is placed by Brunner in the Lonchodidæ, but its real affinities appear to be with the other genera, which he places in his Bacteridæ. They agree with this group, as I have restricted it, in the form of the median segment, and I think it best to treat them as an independent subfamily.

With these may perhaps be associated some of the species placed by Westwood in his genus *Lopaphus*, which, except for the possession of wings, much resemble Lonchodinæ.

Genus Lopaphus, Westw.

Lopaphus, Westw. Cat. Phasm. p. 99 (1859); Wood-Mason, Journ. Asiatic Soc. Bengal, xlvi. p. 347 (1877).
Phasma, group 15, Haan, Temminck, Verhandel., Orth. p. 125 (1842).

As Westwood's genus corresponds to De Haan's group 15, one of the four species included in that group by De Haan (*Bojei*, *brachypterum*, *Macklottii*, and *galacpterum*, H.) must be regarded as the type. But Wood-Mason (*suprà*) enumerates a series of species as belonging to *Lopaphus*, among which *brachypterum* is the only one of De Haan's included; and this consequently becomes the type.

However, the other species placed by Wood-Mason in *Lopaphus* are not congeneric, but belong to *Candaules*, Stål, and other genera. *L. brachypterus* is probably allied to the following genus.

Genus Phænopharos, nov.

Antennæ nearly as long as the front legs and composed of a great number of joints; head with 4 or 5 tubercles behind, and about as long as the pronotum; mesonotum nearly one third of the whole length of the body; median segment very long, fully half as long as the metanotum; legs very long; front legs longest, middle legs shortest; first joint of front tarsi longer than the remaining joints together, and with a lamellated crest at the extremity; all the tibiæ with two spines towards the extremity on each lower carina; hind tibiæ with a small basal lamina beneath on the inner side; tegmina squamiform. Wings hardly as long as the median segment.

Type, *Lopaphus struthioneus*, Westw., from Singapore and Penang.

The three specimens of this genus in the Museum probably represent two species; but it will be better to wait for a longer series before differentiating them.

Subfam. VII. *Palophinæ.*

I have no observations to make on this subfamily.

Subfam. VIII. *Necrosciinæ.*

Genus Sosibia, Stål.

Sosibia peninsularis, sp. n.

Female.—Brown, thickly dotted with grey; antennæ black, ringed here and there with yellowish towards the extremity; front sloping above the antennæ, this portion bordered behind by a curved row of a few small tubercles, one of which on each side is black and more conspicuous than the others. The head is covered with short black spines, arranged in about four rows on each side of the median line; the row nearest the median line on each side is more regular than the others, and terminates above the frontal depression in a single central spine; towards the margins are some black tubercles among the spines. The thorax is strongly tuberculate, and the prothorax bears a double row of black spines, slightly converging hindwards, the intermediate ones longer than the others, and in front of the mesothorax are two short spines on each side close together. The front legs are testaceous, banded with brown, and the front femora expanded and flattened; the middle and hind legs are yellowish, with the extremities of the femora and tibiæ and at least the last joint of the tarsi black. The tegmina are brown, slightly bordered with yellowish, and convex; the costal area of the wings is light brown, varied with grey, and the membranous part is brown and subhyaline. The cerci are short and very thick, especially towards the extremity.

Dimensions.

	mm.
Long. corporis	81
„ capitis	7
„ pronoti	4
„ mesonoti	12
„ metanoti, cum segm. med.	$12\frac{1}{2}$
„ fem. ant.	$12\frac{1}{2}$
„ „ med.	10
„ „ post.	16
„ tegm.	7
Exp. al.	115

This species is allied to *S. nigrispina*, Stål, and *S. curtipes*, Westw. It may be the female of *S. esacus*, Westwood, but it would be unsafe to put them together without evidence.

Hab. Penang (*Flower*).

Genus Calvisia, Stål.

Calvisia maculata, sp. n.

Female.—Testaceous (green when alive?), varied with blackish. Head longer than broad; occiput convex, front sloping and slightly excavated as far as the base of the antennæ; a blackish band runs below the eyes obliquely upwards to the back of the head, and there is a shorter one above it running backwards from the eye, interrupted before reaching a transverse black mark at the back of the occiput. Antennæ marked with long black spots. Legs with indistinct brown bands and the tips of the femora and tibiæ and the terminal joints of the tarsi distinctly black. Thorax granulated. Prothorax with black markings on the sides and on the median line; this is interrupted on the front of the hinder lobe, where there is a curved black line on each side, before the black median line is continued. Mesothorax with the hinder two thirds suddenly raised, the raised part with a black spot and a curved black line on each side in front. Tegmina with a cone-shaped elevation in front and distinctly spotted with black, especially on the paler basal half. Costal area of wings testaceous brown, spotted with black on the hinder part, and more sparingly elsewhere; the membranous part of the wings greyish brown, scarcely hyaline. Hind femora reticulated with black beneath; first joint of the middle and hind femora about as long as the two following; front tarsi missing. Abdomen irregularly and indistinctly reticulated with black above.

Dimensions.

	mm.
Long. corporis	64
„ capitis	6
„ pronoti	5
„ mesonoti	10
„ metanoti, cum segm. med.	12
„ segmenti mediani	7
„ fem. ant.	11
„ tegm.	7
Exp. al.	100

Hab. Penang (*Flower*).

Seems to be most nearly allied to *C. maculicollis*, Westwood, but with the mesothorax simply raised behind instead of humped. In markings it greatly resembles *Aschipasma annulipes*, Westwood, though much less heavily spotted; but its generic characters separate it at once from that species.

Genus TRIGONOPHASMA, nov.

Size rather large; head smooth, rounded and convex behind the eyes; tegmina raised and flattened laterally, thus forming a triangular hollow cone; wings much longer than broad; front femora curved at the base; mesonotum rarely more than three times as long as the pronotum.

Allied to *Mormessoides*, Brunner.

Type, *Necroscia rubescens*, Sauss.

Genus ORTHONECROSCIA, Kirb., n. n.

‖*Necroscia*, Brunner, Ann. Mus. Genova, xxxiii. p. 84 (1893), nec. Serv.

None of the species described by Serville under *Necroscia* appear to belong to the genus as restricted by Brunner to species with the front femora not curved at the base. Neither Stål nor Brunner happen to assign any type to *Necroscia*, and I therefore rename Brunner's genus, specifying *N. filum*, Westw., as the type of *Orthoneuria*, and one of Serville's most conspicuous species, *N. roseipennis*, as the type of *Necroscia*.

Orthonecroscia pulcherrima, sp. n.

Long. corp. 90, exp. al. 116 mm.

Female.—Head green, somewhat convex above, with a medial sulcation, on each side of which are three others, converging behind. A square black spot between the antennæ and a large oval spot behind on each side. Antennæ very long and slender, green at the base and afterwards black, with several white bands. Pronotum with crossing sulci before the middle; before this green, behind black. Mesonotum yellowish and slightly granulated above and green below. Abdomen greenish (colour changed?), seventh and eighth segments yellow, with a black spot at the extremity; ninth, tenth, and anal appendages almost entirely black; operculum green, as long as the abdomen. Legs green, banded with dark brown or blackish. Tegmina strongly carinated and thickly spotted with golden yellow or, near the margin, with green. Costal area subhyaline, thickly covered with partly connected golden-yellow spots, between which are four longitudinal series of blackish spots; costa bright green. The membranous part of the wing brownish hyaline, and very strongly iridescent.

Hab. Borneo.

Closely allied to *O. filum*, Westw., but much larger and more variegated in colour.

Orthonecroscia ruficeps, sp. n.

Long. corp. 38–50, exp. al. 53–65 mm.

Black; head, base of antennæ, and incisions and three terminal segments of the abdomen sealing-wax red; in the female the legs are also varied with red. Tegmina black, paler towards the extremity in the female. Wings with the costal space black or dark brown, intersected by a fusco-hyaline line extending from the base to the tip; membranous part fusco-hyaline, with brown nervures.

Hab. Solomon Islands (Guadalcanar).

A very distinct species.

Genus Necroscia, Serv.

Necroscia, Serv. Ins. Orth. p. 250 (1839). (Type *roseipennis*, Serv.)
Sipyloidea, Brunner, Ann. Mus. Genova, xxxiii. pp. 84, 86 (1893). (Type *sipylus*, Westw.)

Necroscia tonquinensis, sp. n.

♂.—Long. corp. 72, long. capitis et pronoti 15, exp. al. 88, lat. al. 23 mm.

♀.—Long. corp. 105, long. capitis et pronoti 22, exp. al. 115, lat. al. 30 mm.

Male.—Pale brown; head rather long, oval, and raised behind, yellow; median line of head and pronotum sulcated; head with a row of small granules between the eyes, and meeting behind them in a **V**, and several other symmetrical rows of small granules adjoining and on each side of the median sulcus; below these is a brown line below the eye, continued as a black carina on the sides of the prothorax and mesothorax, and forming a raised black ridge on the tegmina, which are otherwise yellowish and obtusely rounded at the extremity. Antennæ pubescent, brown, blackish towards the base and at the joints; pro- and mesothorax thickly granulated, the former sulcated and the latter slightly carinated; abdomen with a black median line, slightly raised, on several of the segments. Legs pubescent, yellowish brown, indistinctly mottled with pale brown; femora blackish towards the extremity. Costal area of wings yellowish brown, more yellowish along the costa, and with three or four long yellow spots, partly surrounded with black, on the hinder edge; the membranous part iridescent hyaline, with yellowish nervures; those at the base red.

Female.—Brown; antennæ varied with black and pale; head yellowish, the mouth-parts black in the middle and on the sides; head and pronotum with slender black central and lateral lines; thorax granulated; tegmina with a raised central carina, marked with yellow at the base before the carina and towards the extremity behind it; costal area of wings pale brown, the nervures interrupted with blackish; rest of wings brownish hyaline, with yellowish nervures, scarcely interrupted with darker, those towards the base distinctly red. Wings in both sexes considerably broader than the length of the head and thorax together.

Hab. Tonkin (Tan Moi), June and July (*Fruhstorfer*).

Described from three (one male and two female) specimens.

The male is very distinct, but the female is very similar to *N. sipylus*, Westw., except for the breadth and red basal nervures of the wings. I should not be surprised to find that the wings of *N. tonquinensis* were more or less flushed with red, at least at the base, in perfectly fresh specimens. It is one of the largest species of the Necrosciinæ.

Subfam. IX. *Acrophyllinæ.*

Genus Acanthomima, nov.

Allied to *Acanthodyta*, Sharp; head very long; antennæ with the basal joint very large and flattened, second annular; flagellum very short, scarcely longer than the head; mesonotum granulated, with from 2 to 4 small asymmetrical spines; median segment about two fifths as long as the metanotum; front femora curved at base and with from 4 to 6 strong serrations between the curve before the middle. Tegmina and wings rudimentary.

Type, *Anophelepis rhipheus*, Westw., from Swan River.

Genus Arrhidæus, Stål.

Arrhidæus phlyctænoides.

Marmessoidea phluctainoides, Rehn, Proc. Acad. Nat. Sci. Philad. 1904, p. 73.

Long. corp. 48, long. mesonoti 10, lat. 4, long. fem. ant. 13, exp. al. 38 mm.

Female.—Bright green; head large, slightly convex, twice as long as the very small pronotum; antennæ reddish brown, with more than 30 joints; a yellow line running from the eye to the back of the head and along the borders of the pro- and mesonotum. Pronotum with crossing sulcations, the transverse one well before the middle. Mesonotum moderately broad, finely granulated, and with a slight median carina. Legs unarmed; femora moderately stout, nearly as long as the tibiæ and tarsi together, front femora much waved at the base. Tegmina almost quadrate, but with the angles rounded off; a black raised line towards the costa, before which the colour is yellowish. Wings rather short, costal area green, membranous area rose-coloured. Abdomen with the basal segments hardly so long as broad, but the four basal segments suddenly narrowed and laterally compressed.

Hab. Japan.

Described from four specimens, scarcely varying at all.

Genus Phasma, Licht.

Phasma, Lichtenstein, Cat. Mus. Zool. Hamburg, iii. p. 77 (1796); Trans. Linn. Soc. Lond. vi. p. 9 (1802); Illiger, Käf. Preuss. p. 499 (1798); Fabr. Suppl. Ent. Syst. p. 186 (1798).

Lichtenstein and Fabricius enumerate many species under this name, but fix no types. Illiger, however, mentions *gigas*, Linn., and *calamus* and *rossia*, Fabr., as the types. Latreille afterwards specified the type as *rossia*; but none of the three species mentioned by Illiger can be taken as the type, for though all three species were mentioned by Lichtenstein, he applies the name *Mantis* to them, not *Phasma*. However, the first species mentioned by Lichtenstein under the name of *Phasma* is a very close ally of *gigas*, L., figured by Stoll as *gigas* ('Spectres,' pl. i. fig. 1) and described briefly by Lichtenstein under the name of *Phasma empusa*. Consequently Illiger's mention of *P. gigas* (apart from this being the first species mentioned under *Phasma* both by Illiger and Fabricius) fixes the closely allied *P. empusa* (Lichtenstein's first species) as the type.

Genus Eurycnema, Serv.

Eurycnema magnifica, sp. n.

Long. corp. 200, exp. al. 215, long. tegm. 46, lat. tegm. 20 mm.

Female.—Yellowish green above, more or less varied with whitish (colours probably changed); mesonotum rather long, slender, and nearly smooth, transversely banded with black beneath; tegmina yellowish green, veined below with red; membrane sea-green. Wings sea-green, the opaque costal area yellowish green, almost entirely red beneath, except on the borders, the colour slightly showing through on the upperside. Legs strongly carinated, serrated, and spined, as usual in the genus.

Hab. (probably) New Guinea (Crowley Collection).

This splendid species is one of the largest of the winged Phasmidæ. It is allied to *E. versirubra*, Serv. (*herculeana*, Charp.), from Java, but is abundantly distinct by the longer, more slender, and smooth mesonotum, the much longer tegmina, not marked with white above, and the longer wings, with the costal area not distinctly red at the base above, but almost entirely red below.

Eurycnema viridissima, sp. n.

Long. corp. 186–195, exp. al. 170–175, long. tegm. 38–42, lat. tegm. 20 mm.

Female.—Green; head and pronotum mostly whitish, with three green bands on the former and two on the latter; abdomen with white incisions and a slender white line on each side; pronotum paler on the sides than in the middle, smooth, or with a few small nodules. Meso- and metapectus with a double row of dark green nodules placed on transverse spots of the same colour; metapleura with a row of spines. Tegmina bright green, streaked and spotted with white; the white spaces are veined with red beneath. Wings sea-green, costal area tinged with red at the base, and sending out a broad longitudinal white streak nearly to the margin; under surface with the red colouring occupying a corresponding space to this white streak and with most of the veins red on the basal third of the wing and along the course of the pale stripe. Legs green, somewhat irregularly banded and spotted with whitish. Eggs smooth, oval, black, and shining.

Hab. Moreton Bay and North Australia.

Differs from the North-Australian *E. versifasciata*, Serv., in the much longer wings and tegmina, and in the colour of the latter, which have only one broad longitudinal streak in *E. versifasciata*.

The Museum possesses specimens of *Eurycnema* from Timor and Timor-Laut, but not in sufficiently good condition to be determined. The only described species not represented in the Museum is *E. Beauvoisi*, Serv., from Java, in which the pronotum is stout and granulated, and the tegmina and the costal area of the wings are uniform bright green.

Subfam. X. *Eurycanthinæ*.

The genera *Karabidion*, *Eurycantha*, and *Canachus* are placed by Brunner at the end of his Clitumnidæ, but they have so little resemblance to the other genera of that family, and so much (except in the tibiæ being carinated to the tips) to the Heteropteryginæ, that I think it better to remove them to the neighbourhood of the latter insects.

Genus Eubulides, Stål.

Eubulides spuria, sp. n.

Eurycantha spuria, Westw., MS.

Long. corp. 55, long. pronoti 10, lat. 8 mm.

Male.—Pale yellowish grey, varied with reddish brown on the head above, and more or less on the sides of the body. Antennæ thick, 17-jointed, the scape and second joint paler than the rest; joints 2 and 4–6 transverse, the rest longer than broad; joints 7–11 increasing gradually in length; joint 12 as short as joint 7, the rest again gradually increasing in length, the terminal joint being the longest and slenderest. Head convex above and depressed in front; a slender yellow median line, and behind and within the level of each eye two narrow sulcations, converging behind but not meeting. Median line with a deep sulcus which extends to the extremity of the abdomen, but is interrupted on segments 4–6 of the latter. Pronotum with the transverse sulcus placed before the middle; the upper surface is widened behind, and on each side of the median line is a brown band, curving outwards, on which stand three tubercles, behind the last of which are a few smaller ones, irregularly placed; upper lateral carina convex. Mesonotum rather broader in front than behind, thickly tuberculate for two thirds of its length, and slightly denticulate on the lower lateral carina. Abdominal segments transverse, considerably broader than long, and truncated behind; all except the three terminal ones, which are narrower than the others, laterally sublobate. Cerci pale, very thick, hardly pointed at the tips, about half as long as the last segment, beyond which they project. Legs very short and stout, front and hind femora and tibiæ all about as long as the mesonotum, middle ones rather shorter; they are slightly carinated and unarmed; hind femora with several small teeth beneath on the inner carina, and two large subterminal ones on the outer, preceded by some obsolete ones; the median line beneath is also tuberculate. Last joint of tarsi very large, as long as all the rest put together, which are very short, except the first joint of the front tarsi, which is concave above and as long as joints 2–4 together; claws and arolia also very large.

Hab. Australia.

Appears to belong to Stål's genus *Eubulides*, founded on *E. alutaceus*, Stål, from the Philippines, a species I have not seen. In this, however, all the femora are dentated beneath.

Genus Eurycantha, Boisd.

Eurycantha Willeyi, sp. n.

Eurycantha horrida, Sharp, Willey, Zool. Results, p. 85, pl. viii. figs. 7–9, pl. ix. figs. 46, 46 *a*, *b* (egg) (1898), nec Boisd.

Long. corp. 120–130, lat. pron. 17–20 mm.

Male.—Black; head with two moderate-sized spines wide apart, nearly halfway between the eyes and the occiput, and two smaller ones, nearer together, rather further back; pronotum with 2 large lateral spines in front and 1 behind; mesonotum with 7 or 8 strong lateral spines, the last some distance behind the penultimate one and near the hinder edge; there are also less regular rows of smaller spines below them and on the mesopleura; metanotum and metapleura with large irregular lateral spines, the largest being two about the middle, and another above the hind coxa; segments of the abdomen (except the last) each with 3 strong lateral spines, and with one or two terminal large tubercles at a higher level; segments 7–9 with a short terminal tooth on the median line; upper surface of the body except at the sides spinulose, but with scattered granules; coxæ spined; 4 first femora thickened and with regular but rather widely separated teeth on the carinæ; 4 first tibiæ with 4 or 5 moderately large teeth on each side beneath; hind femora greatly dilated, and with 3 large teeth beneath, the last very large and curved backwards; there are also strong terminal spines on the carinæ beneath; hind tibiæ with 3 large teeth beneath, the middle one double, besides smaller ones towards the base and on each side at the extremity.

Female more ferruginous; the spines smaller, but similarly arranged; the hind femora are much less thickened, and the third spine is not much larger than the others.

Hab. New Britain.

Nearest to *E. calcarata*, Luc., but much less strongly spined. The true *E. horrida*, Boisd., differs from most of the allied forms by the lateral spines on the abdominal segments being smaller and more numerous.

Eurycantha portentosa, sp. n.

Long. corp. 170, lat. mesonoti 22–26 mm.

Female.—Black; antennæ, legs, and under surface inclining to ferruginous; spines arranged nearly as in the last species; much more strongly granulated on the upper surface, and with a transverse row of short spines before the extremity of most of the abdominal segments. There are sometimes additional small spines between the three larger ones on the sides of each abdominal segment.

Hab. Rossel Island, Louisiade Archipelago.

The largest and broadest species known.

Eurycantha sifia, sp. n.

Long. corp. 104–129, lat. mesonoti 18–20 mm.

Male.—Mahogany-brown, rather shining; head with two large spines behind and rather within the level of the eyes, and two smaller ones behind these, nearer together; sometimes a pair of tubercles nearer the front; pronotum with 2 large lateral spines in front and 1 behind; mesonotum with 2 small central spines on the front edge and about 8 moderate-sized spines on the upper lateral margin, but only 2 or 3 small ones on the mesopleura towards the hinder end; lateral spines of metanotum nearly as in *E. Willeyi*, but more numerous; abdomen with 3 lateral spines on each segment, the first placed rather higher than the others, which stand on a carina on which other rudimentary spines are often placed; upper surface of thorax and abdomen with scattered tubercles; a transverse row of small terminal spines on most of the abdominal segments, best developed on the hinder ones; a distinct median carina on the three segments before the last, rising into a strong spine at the extremity. Legs armed nearly as in *E. Willeyi*; the large spine less curved.

Female darker brown, but otherwise very like the male; mesopleura with more numerous small spines below the larger ones; spines of the metanotum smaller than in the male; abdomen with the hinder half carinated to the extremity; hind femora beneath with 4 or 5 spines (before the terminal ones) of nearly equal length.

Hab. Thursday Island.

Appears to be a common species. Belongs to the group of *E. calcarata*, Luc. Differs from *E. calcarata* in the smaller and less numerous spines, and from *E. Willeyi* (*inter alia*) by the conspicuous pair of spines in front of the mesonotum.

Subfam. XI. *Heteropteryginæ*.

Genus Heteropteryx, Gray.

The type of this genus is *Phasma dilatata*, Parkinson, the male of which is, I believe, *Phasma* (*Eurycantha*) *graciosa*, Westw. (not at present represented in the Museum), on which Stål founded his genus *Leocrates*.

Genus Haaniella, Kirb., n. n.

‖*Heteropteryx*, Haan; Stål (nec Gray).

Phasma (*Heteropteryx*) *Mülleri*, Haan, may be regarded as the type.

Subfam. XII. *Anisomorphinæ*.

I have no additions to make to this subfamily.

Subfam. XIII. *Prisopinæ*.

These peculiar insects differ much from all the others placed by Brunner in his heterogeneous family Phasmidæ, and in some cases the clefts at the end of the tibiæ beneath are very slightly marked.

Genus Acanthoclonia, Stål.

Acanthoclonia (?) *paradoxa*, sp. n.

Female.—Dark brown; antennæ, palpi, and legs clothed with a thick felty pubescence. Head with the upper part much raised, having a trilobate diverging excrescence on each side and a row of three pairs of raised tubercles between; the sides and front of the head are also set with conspicuous tubercles less regularly arranged. The anterior lobes are much larger than the others, and converge in front. Of the antennæ, which incline to reddish towards the end, twenty joints remain; they are cylindrical; the third is the longest, but the remainder increase very gradually in length after the fourth; the scape is broad and flattened, with a raised carina on each side above, and a large lobe below; the second joint is thickened, forming a broad cone. Legs short and stout; femora more or less laminate-dentate on the upper carinæ, the foliations slightly converging above; the tibiæ the same, with several elevations on the front tibiæ and one or two on the others; the outer lower carina of the middle femora is armed with three large teeth. Tibiæ beneath with large terminal triangular clefts. Tarsi with the fifth joint long, the first shorter, and the middle ones very short, decreasing in length. Tegmina rounded, rather longer than broad, extending just beyond the base of the median segment; wings not visible. Lower appendages of the abdomen yellowish.

Dimensions.

		mm.
Long.	corporis	61
„	capitis	7
„	pronoti	6
„	mesonoti	10
„	tegminum	7
„	fem. ant.	11

Hab. Santarem, Lower Amazons, March 1896. Taken in the forest by Mr. F. O. Pickard-Cambridge.

The lower carinæ of the thorax and the coxæ are distinctly tuberculate. The thorax is strongly granulated and tuberculate; the prothorax has rows of small tubercles in front, behind, and at the sides; also in the middle, where two are larger and more conspicuous than the others. The mesothorax has three broad obtuse spines on each side of the double median carina, two in front, and the other about the middle. Abdomen with irregular zigzag lines of rugosities, those on the back of the penultimate segment and the one before enclosing long oval spaces.

A very peculiar species, probably belonging to a new genus, which, however, I do not wish to found upon a single specimen, perhaps immature. It is not unlikely to possess wings when fully developed, but it differs conspicuously from *Prisopus* and its allies by the much broader and shorter tegmina.

Subfam. XIV. *Pseudophasminæ.*

Phasmidæ, pt., Brunner.

Genus Dajaca, Brunner.

Brunner proposed this genus for an undescribed Bornean species of which the Museum possesses a specimen, unfortunately in too poor condition to describe.

Genus Olcyphides, Griff.

‖ *Phocylides*, Stål (nec Pascoe).

Olcyphides iridescens, sp. n.

Long. corp. 73, long. tegm. 6, lat. 3, exp. al. 93, lat. 24 mm.

Female.—Head black below and at the sides as far as the level of the eyes; a black space between the antennæ and a black curve behind the ocelli; antennæ black, the scape greenish, the joints with narrow pale rings towards the base and at least four broad whitish or green belts beyond; head and pronotum sulcated on the median line; pronotum longer than broad, green above and black below and on the sides, transverse sulcus placed before the middle, behind it on each side is a broad black dash. Mesonotum brownish green above, with a median bright green line; sides and under surface black, the former with two longitudinal yellowish lines. Interalary space greenish; abdomen mahogany-brown, seventh segment reddish, the last three segments varied with green and brown. Abdomen brown beneath, except the operculum, which is green; cerci brown, rather short and thick; legs purplish brown, broadly belted with green. Tegmina green, with the usual hump; extremity truncated, oblique, costa shorter than inner margin. Wings with the costal area of a subhyaline rosy grey, the longitudinal nervures bright green; a purplish-brown costal stripe, narrowly bordered towards the base by yellow on the extreme costal edge, traverses the greater part of the wing. Membranous part of the wing brownish subhyaline, with a very strong coppery iridescence; the nervures green towards the base, and most of the transverse nervules greenish white.

Hab. Trinidad.

Genus Ignacia, Rehn.

Pseudophasma, Bol.

Ignacia appendiculata, sp. n.

Light brown; antennæ with the two basal joints and more or less of several of the succeeding ones reddish brown, the terminal half of the fourth blackish; head twice as long as broad, with a black band extending backwards from the antennæ, but well within the eyes, over the pro- and mesonotum; pronotum shorter than the head, the sides and the sulcations pale; mesonotum rather longer than the head and pronotum together, and with six long slender filaments rather than spines on the upper surface, black, tipped with pale in the male, and wholly pale in the female; the first pair on the front margin nearly obsolete in the male, the second rather further, and the third about the middle; tegmina brown, with a large, pointed, conical elevation directed towards the base; behind this the colour is yellowish; wings with the costal area light brown; a whitish streak towards the base of the costa, membranous portion greyish subhyaline; legs long and slender, all the femora clavate towards the extremity, and the front femora much waved.

Dimensions.

	♂.	♀.
	mm.	mm.
Long. corp.	53	71
„ tegm.	6	10
Exp. al.	64	102
Long. fem. ant.	18	22

Hab. Nauta (*Degand*).

Described from one male and one female, both in rather poor condition.

Genus Pseudophasma, Kirb.

Pseudophasma inca, sp. n.

Male.—Black; head scarcely broader than long, pronotum half as long again as broad, granulated, speckled with yellowish, and with the lateral carina narrowly yellowish; a deep oblique depression before each of the front angles; mesonotum granulated with yellowish, metanotum and base of abdomen rufous above; tegmina broadly oval, the costa greatly arched, reticulated with yellow, the intermediate space brown, and a large, black, obliquely oval spot before the extremity. Costal area of wings dark brown, yellowish, and with yellowish transverse nervures towards the base; membranous area smoky hyaline.

Female.—Upper surface of head, pro- and mesonotum brown, bounded by the black colour of the sides; tegmina with the black blotch much larger, curving round to the base; area behind uniform light brown. Costal area of wings light brown, mottled with darker; base pale; metanotum with borders and sutures varied with yellow, and basal segments of abdomen indistinctly marked with yellow. Antennæ black, banded in the female only with ferruginous towards the extremity.

Dimensions.

	♂.	♀.
	mm.	mm.
Long. corp.	47	77
„ mesonoti	5	6
Exp. al.	70	122

Hab. Palcazu, Peru.

A fine species, belonging to the same group as *P. phthisicum*, Linn.; but in that species the tegmina are much raised, and the femora are reddish at the base.

Pseudophasma Cambridgei, sp. n.

Female.—Head broader than long, testaceous, with a narrow brown carina above, expanding and ceasing in a small triangular spot between the antennæ; the sides of the head nearly to the level of the upper part of the eyes are black; face testaceous, a transverse reddish mark in front below the level of the antennæ; palpi reddish brown, the inner side and terminal joint more yellow. The antennæ are finely ciliated (18 joints remain), testaceous yellow to the eleventh joint and then black, with pale rings towards the base of the twelfth segment, and on the extremity and base of the fourteenth and fifteenth and sixteenth and seventeenth respectively, and at the tip of the eighteenth. The scape, second joint, and base of the third are thickened; the third is nearly as long as the fourth and fifth together, the fifth being the shortest, the rest gradually lengthening, though the eighteenth is a little shorter than the preceding; all the joints beyond the second are long and cylindrical. Prothorax and mesothorax testaceous above, with a median groove; the thorax, below the lateral carinæ, and the abdomen are black. The hinder two-fifths of the mesothorax is raised; the front part is bordered on the lateral carinæ with a row of short sharp spines, the flat space between being sparingly and irregularly granulated. The tegulæ are humped, strongly reticulated, and testaceous yellow inside to the summit of the hump, and black outside. The wings are dark reddish brown on the costal area and greyish brown on the membranous area. The legs are testaceous, the femora black, testaceous at the tips beneath on the first four femora, and wholly so beneath on the hind femora. The trochanters and coxæ are wholly blackish. The terminal segments of the abdomen are carinated above and provided with a deep pouch below; the cerci are short, thick, and obtuse. The legs are long and slender, the middle legs shortest.

Dimensions.

	mm.
Long. corporis	53
„ capitis	4
„ pronoti	$3\frac{1}{4}$
„ mesonoti	8
Exp. al.	57
Long. fem. ant.	20

Hab. Forest, Santarem, Lower Amazons, March 1896.

Closely allied to *Phasma putidum*, Bates (also from Santarem), but differing in the colour of the antennæ, the prickles on the thorax, &c.

A single specimen only, taken by Mr. F. O. Pickard-Cambridge.

Subfam. XV. *Aschipasminæ.*

Subfam. XVI. *Phylliinæ.*

I have no additions to make to these subfamilies. The genus *Aschipasma*, Westw., is often misspelt *Aschiphasma*.

LII.—*Diagnoses of Three new Species of* Barbus *from Lake Victoria.* By G. A. Boulenger, F.R.S.

Barbus nummifer.

D. III 8. A. III 5. L. lat. 37–39. L. tr. $\frac{5\frac{1}{2}-6\frac{1}{2}}{6\frac{1}{2}}$.

Depth of body $3\frac{1}{2}$ to 4 times in total length, length of head $4\frac{1}{3}$ to $4\frac{1}{2}$ times. Snout rounded, as long as eye, which is $3\frac{2}{3}$ to 4 times in length of head; interorbital width $2\frac{1}{3}$ to $2\frac{2}{3}$ times in length of head; lips feebly developed, interrupted on the chin; barbels 2 on each side, anterior as long as eye or a little shorter, posterior $1\frac{1}{4}$ to $1\frac{1}{2}$ diameters of eye. Last simple ray of dorsal very strong, bony, not serrated, as long as head. Ventrals below origin of dorsal. Caudal peduncle $1\frac{2}{3}$ to twice as long as deep. 4 scales between lateral line and root of ventral. A series of 3 to 6 round blackish spots on each side.

Total length 130 mm.

Several specimens.

Barbus macropristis.

D. III 7. A. III 5. L. lat. 39. L. tr. $\frac{6\frac{1}{2}-7\frac{1}{2}}{5\frac{1}{2}}$.

Depth of body equal to length of head, 4 times in total length. Snout rounded, $3\frac{1}{2}$ to 4 times in length of head; diameter of eye 4 to $4\frac{1}{2}$ times in length of head, interorbital width $2\frac{3}{4}$ times; lips feebly developed; barbels 2 on each side, anterior $\frac{1}{2}$ diameter of eye, posterior as long as eye. Last simple ray of dorsal very strong, bony, strongly serrated behind, nearly as long as or a little longer than head. Ventrals entirely in advance of dorsal. Caudal peduncle twice as long as deep. 3 scales between lateral line and root of ventral. No markings.

Total length 128 mm.

Two specimens.

Barbus Doggetti.

D. III 8. A. III 5. L. lat. 29. L. tr. $\frac{3\frac{1}{2}}{3\frac{1}{2}}$.

Depth of body equal to length of head, $3\frac{2}{3}$ times in total length. Snout rounded, $3\frac{1}{2}$ times in length of head; diameter of eye $3\frac{2}{3}$ times in length of head, interorbital width 3 times; lips feebly developed; barbels 2 on each side, minute. Last simple ray of dorsal not ossified, as long as head. Ventrals below anterior rays of dorsal. Caudal peduncle nearly twice as long as deep. 2 scales between lateral line and root of ventral. No markings.

Total length 96 millim.

A single specimen.

These fishes were obtained by the late Mr. W. G. Doggett, and have been presented to the British Museum by Col. Delmé Radcliffe.

LIII.—*Descriptions of Three new Snakes.* By G. A. Boulenger, F.R.S.

Hydræthiops lævis.

Rostral broader than deep, just visible from above and in contact with the internasal, which is divided or semidivided along the middle line; frontal once and one third as long as broad, as long as its distance from the end of the snout, shorter than the parietals; loreal usually fused with the præfrontal; one præ- and two postoculars; temporals 1+2; nine upper labials, fourth and fifth entering the eye, sixth and seventh in contact with the parietal; two pairs of chin-shields, the anterior in contact with four or five lower labials. Scales perfectly smooth, in 21 rows. Ventrals 154–163; anal divided; subcaudals 51–52. Yellowish or reddish brown above, with a series of large, dark olive-brown, black-edged spots, which may be confluent posteriorly into a zigzag band; head uniform olive-brown above and on the sides;

lower parts black, uniform or with a median series of small whitish spots on the anterior part of the body.

Total length 570 mm.; tail 110.

Two specimens from Efulen, S. Cameroon; collected by Mr. G. L. Bates.

Atractus vertebralis.

Snout rounded. Rostral small, broader than deep, just visible from above; internasals very small; præfrontals as long as broad; frontal as long as broad, as long as the præfrontals, two thirds the length of the parietals; loreal twice and a half as long as deep; two postoculars; temporals 1+2; seven or eight upper labials, third and fourth or fourth and fifth entering the eye; four lower labials in contact with the single pair of chin-shields, which are rather elongate, moderately broad, and separated from the symphysial. Scales in 17 rows. Ventrals 173; anal entire; subcaudals 21. Brown above, with small black spots and a black vertebral streak edged with yellowish; upper surface of head blackish; upper lip yellowish; ventral shields yellow in the middle, black on the sides, one or two shields here and there entirely black and forming cross-bars on the belly.

Total length 470 mm.; tail 35.

A single female specimen from Santo Domingo, Carabaya, Peruvian Andes, altitude 6000 feet; collected by Mr. G. Ockenden.

Apistocalamus Pratti.

Snout short, rounded. Rostral a little broader than deep, the portion visible from above measuring one third its distance from the frontal; internasals half the length of the præfrontals; frontal slightly longer than broad, as long as its distance from the end of the snout, much shorter than the parietals; nostril between two nasals *, the posterior forming a suture with the single præocular, which is nearly twice as long as deep; a single postocular; temporals 1+1; six upper labials, third and fourth entering the eye; three lower labials in contact with the anterior chin-shields; posterior chin-shields smaller, separated by a large scale. Scales in 15 rows. Ventrals 190; anal divided; subcaudals 41, partly single, partly paired. Olive-brown above; an oblique yellowish streak on each side of the nape; upper lip

* The discovery of this species necessitates an alteration in the generic diagnosis (Ann. Mus. Genova, 2, xviii. 1898, p. 705), as the first labial and the internasal do not border the nostril.

yellowish; lower parts yellowish, with a median series of olive-brown spots which, after the anterior fourth of the body, become confluent into a band.

Total length 355 mm.; tail 50.

A single male specimen from Dinawa, Owen Stanley Range, Brit. New Guinea, altitude about 4000 feet; collected by Mr. A. E. Pratt.

LIV.—*Descriptions of some new Species and Varieties of* Cataulus *from the Collection of the late Hugh Nevill, Esq.* By HUGH FULTON.

Cataulus rugosa, sp. n.

Shell very narrowly umbilicate, subfusiform, moderately solid, colour light yellowish brown, nucleus smooth, sculptured below with somewhat nodulous oblique striæ, which give a malleated appearance to the shell; whorls $6\frac{1}{2}$, moderately convex; basal carina moderately produced; aperture circular, reddish brown within; peristome yellowish, continuous; basal canal semicircular, situate at centre of basal portion of the peristome.

Maj. diam. 5; alt. $11\frac{1}{2}$ mm.

Loc. Ceylon.

This form is nearest to *C. marginatus*, but is much smaller, not so slender, and the suture is not margined.

Cataulus Sykesi, sp. n.

Shell narrowly umbilicate, subfusiform, solid, uniform light yellowish to uniform reddish-brown colour, arcuately striated, the striæ rather blunt and not very conspicuous; whorls nearly 7, slightly convex; basal carina prominent, with a conspicuous inner ridge; aperture subcircular, reddish brown within; peristome whitish, very much thickened but scarcely duplex, continuous; aperture of basal canal subcircular, situate slightly to the left of the centre of base of peristome.

Maj. diam. (yellow form) $6\frac{1}{2}$; alt. $14\frac{1}{2}$ mm.

" " (reddish-brown form) $6\frac{1}{2}$; alt. 14 mm.

Loc. Ceylon.

This form bears a general resemblance to *C. duplicatus*, Pf., but is smaller, has less whorls, and the suture of the earlier whorls is not margined as in that species.

The penultimate whorl of *duplicatus* is wider in proportion to the last whorl than in *Sykesi*; the latter is also distinguished by its prominent inner basal ridge at the umbilical area.

Cataulus marginatus, Pf., var. *crenulata*, nov.

Slightly broader than typical *marginatus*, less strongly malleated, and lacking the distinctly margined suture of that species; of a light reddish colour, and crenulated at and below the suture of the middle whorls, the antepenultimate showing it more distinctly.

Maj. diam. 6; alt. 15 mm.

Loc. Ceylon.

Cataulus Nevilli, Sykes, var. *flaveolabris*, nov.

Lighter-coloured and with a yellow peristome, the latter being more on a plane with the spire than in typical *Nevilli*, which is generally somewhat produced forward at the basal portion.

Maj. diam. 11; alt. 25 mm.

Loc. Ceylon.

LV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander T. H. Heming, R.N.*—Series III., No. 1. *On Mollusca from the Bay of Bengal and the Arabian Sea.* By EDGAR A. SMITH, I.S.O.

[Continued from vol. iv. p. 251.]

IN these 'Annals' for 1899, vol. iv. pp. 237–251, diagnoses were given of thirty-five new species from the collection about to be described. The publication of such lists as the following are of importance as regards our knowledge of both geographical and bathymetrical distribution. Many of the species were obtained at Stations 229, 232, and 233, the exact positions of which are as follows:—

Station 229.—Lat. 9° 29′ 34″ N., long. 75° 38′ E.: 360 fath.; green mud.

Station 232.—Lat. 7° 17′ 30″ N., long. 76° 54′ E.: 430 fath.; grey mud.

Station 233.—Lat. 13° 17′ 15″ N., long. 93° 10′ E.: 185 fath.; sand.

The thirty-five species already referred to have been figured in the "Illustrations of the Zoology of the 'Investigator,'" Mollusca, pls. ix.–xii. (1901). The sixteen new species now described will be figured in a future part of the same work.

Conus planiliratus, Sowerby.

Conus planiliratus, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 159.

Hab. Coromandel coast, 12 fath.

Conus Sowerbii, Reeve.

Conus sinensis (Sowerby ?), Reeve, Conch. Icon. pl. xv. fig. 77 *a*.
Conus Sowerbii, Reeve, Conch. Icon., Suppl. Emend. p. 2.

Hab. Off Coromandel coast, in 41 fath.

Conus turriculatus, Sowerby.

Conus turriculatus, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 160.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

The largest specimen of this species in the Cuming Collection, hitherto confused with *C. Sowerbii*, is 35 mm. in length. This is rather larger than the type, and, judging from the thinness of the lip, it is scarcely adult.

Conus semisulcatus, Sowerby.

Conus semisulcatus, Sowerby, Proc. Zool. Soc. 1870, p. 257, pl. xxii. fig. 13; Thes. Conch. vol. v. p. 253, pl. 508. fig. 666 (bad!).

Hab. —— ? (*Sowerby*); off Vizagapatam coast, 20 fath.

The type of this species in the collection of the British Museum is a young shell only 21 mm. in length. The more mature, possibly adult, examples from Vizagapatam, 33 mm. long, agree exactly with it in all other respects. The surface is clothed with a thin deciduous periostracum, which exhibits a few distant setose lines or ridges upon the body-whorl and is coarser and lamellated upon the spire, which has about five whorls succeeding the smooth glassy protoconch, finely coronated. The sulci upon the anterior end of the shell are about eleven in number.

Conus aculeiformis, Reeve.

Conus aculeiformis, Reeve, Conch. Icon. pl. xliv. fig. 240 *b*; Sowerby, Thes. Conch. vol. iii. pl. xvi. fig. 370.

Hab. Philippine Islands (*Reeve*); Holothuria Bank, N.W.

Australia, 15–30 fath. (Brit. Mus.); off Vizagapatam, 25 fath., off Coromandel coast, 41 fath., off Mangalore, 26–30 fath. ('Investigator').

The series of specimens from the above localities shows that the species varies somewhat in the strength of the sculpture and the depth of the coloration. The upper whorls of the spire may or may not be coronated. In the type they are strongly nodose, whilst in the specimens from N.W. Australia the coronation is almost obsolete, and in the examples from the Indian localities it is entirely absent. The transverse ridges upon the body-whorl are coarser and most prominent in the typical form and comparatively flattened in the Australian specimens. There are also other minor differences in the various examples which it would be tedious to explain in words, although they are quite apparent and interesting on comparison.

Conus Sieboldii, Reeve.

Conus Sieboldii, Conch. Icon., Suppl. pl. i. fig. 269; Sowerby, Thes. Con. vol. iii. pl. ccii. fig. 369; Weinkauff, Conch.-Cab. ed. 2, p. 285, pl. xlix. fig. 6.

Hab. Japan (*Reeve, Lischke, &c.*); Stations 229 and 232, off Malabar, in 360 fath., and off Travancore coast, in 430 fath. ('Investigator').

Only one of the five specimens examined shows any traces of the scattered brownish blotches which are characteristic of this species. This absence of colour is not remarkable, as these examples were from deep water, probably much deeper than that whence any of the previously recorded specimens were obtained. It will be remembered that the occurrence of *Ranella* (*Biplex*) *perca*, a well-known Japanese form, has already been recorded from deep water off Colombo*, and also the Japanese *Xenophora pallidula* from 188 fath. off the Andaman Islands †. It is therefore interesting to find another form hitherto supposed to be exclusively Japanese occurring in the Bay of Bengal.

The apex of the spire in these specimens, which were dredged alive, is eroded, so that the slight "coronation" of the whorls is destroyed. This would probably be the case in all specimens obtained at this particular station.

* Smith, Ann. & Mag. Nat. Hist. 1895, vol. xvi. p. 6.
† Sowerby, Proc. Malac. Soc. vol. i. p. 38.

Pleurotoma vagata, Smith.

Pleurotoma vagata, Smith, Ann. & Mag. Nat. Hist. 1895, vol. xvi. p. 3, pl. i. fig. 3.

Hab. Station 233, off Andaman Islands, in 185 fath.; also Station 229, off the Travancore coast, in 360 fath.

The specimens from the first locality agree in every respect with the unique type from 200–350 fath. off Trincomalee. The infrasutural keel is generally somewhat reddish, and the central carina is spotted with the same colour between the tubercles, which in some specimens become obsolete upon the body-whorl. The concavity of the upper part of the whorls becomes more obvious as the shell increases, so that it forms a deep channel upon the body-whorl in some specimens. In the shells from off the Travancore coast the keel at the suture is much more feeble than in the typical form.

Pleurotoma congener, Smith.

Pleurotoma congener, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 160, pl. iii. figs. 4, 5.

Hab. Station 229, off Travancore coast, in 360 fath.; also Station 233, off Andaman Islands, in 185 fath.

The specimens obtained off the Travancore coast are longer and narrower than the typical form, with a narrower tuberculated band round the middle of the whorls. Five out of the eight specimens examined, all dead and more or less broken, have the peculiar swelling on the upper part of the columella which was mentioned as occurring in some examples obtained off Colombo. The measurements of the largest specimen are:—

Length 62 mm., diam. 20; aperture 20 long, 8 wide.

Pleurotoma optata, Smith.

Pleurotoma optata, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 238; Illust. Zool. 'Investigator,' pl. ix. figs. 1, 1 *a*.

Hab. Station 232, off South India, 430 fath.; and Station 229, off Travancore in 360 fath.

Pleurotoma fusca, Hombron & Jacquinot, var.

Pleurotoma fusca, H. & J., Voy. Pôle Sud, p. 111, pl. xxv. figs. 19, 20.

Hab. Station 240, off Andaman Islands, 194 fath.

Two specimens, paler than the type, almost white, with a slightly shorter anterior canal. *Pl. gemmata*, Hinds, may be the same as this species, but the spire seems to be more slender. *Pl. amabilis*, Weinkauff, is very closely allied, if not identical. Hinds's locality, "California," may yet be confirmed.

Pleurotoma jubata, Hinds.

Pleurotoma jubata, Hinds, Reeve, Conch. Icon. fig. 52.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

One specimen, like the type, but with the beaded keel scarcely at all beaded.

Pleurotoma acutigemmata, var. *minor*.

Pleurotoma acutigemmata, Smith, Ann. & Mag. Nat. Hist. 1877, vol. xix. p. 489.

Hab. Off south coast of Ceylon, 34 fath.

A single specimen, only 13 mm. in length, like the type in form and colour, but with the gemmate keel almost smooth.

Pleurotoma unedo, Valenciennes.

Pleurotoma unedo, Valenciennes, Kiener, Coq. Viv. p. 19, pl. xiv. fig. 1; Reeve, Conch. Icon. fig. 12.

Hab. Eight miles south of Puri, 13 fath.

Pleurotoma (*Surcula*) *tornata* (Dillwyn).

Surcula tornata, Tryon, Man. Conch. vol. vi. p. 237, pl. v. fig. 62.

Hab. Same as preceding species.

Pleurotoma (*Surcula*) *symbiotes*, Wood-Mason & Alcock.

Pleurotoma (*Surcula*) *symbiotes*, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 161, pl. iii. figs. 7, 8.

Hab. Station 233, off Andaman Islands, in 185 fath.

These specimens do not differ from the type, which was obtained in 1043 fath. off Southern India. Being in fresh condition they are coated all over with the very thin periostracum mentioned in the description.

Pleurotoma (*Surcula*) *Thurstoni*, Smith.

Pleurotoma (*Surcula*) *Thurstoni*, Smith, Ann. & Mag. Nat. Hist. 1896, vol. xviii. p. 369.

Hab. Off Trincomalee, in 200–350 fath.; and Station 229, off Travancore coast, in 360 fath.

One specimen from the latter locality is larger than the type, being 55 mm. in length and 16 in width.

Pleurotoma (*Surcula*) *breviplicata*, Smith.

Pleurotoma (*Surcula*) *breviplicata*, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 238; Illust. Zool. 'Investigator,' pl. ix. figs. 3, 3 *a*.

Hab. Station 233, off Andaman Islands, in 185 fath.

Pleurotoma (*Surcula*) *eurina*, Smith.

Pleurotoma (*Surcula*) *eurina*, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 239; Illust. Zool. 'Investigator,' pl. ix. figs. 4, 4 *a*.

Hab. Station 232, off South India, in 430 fath.

Pleurotoma (*Surcula*) *præcipua*, Smith.

Pleurotoma (*Surcula*) *præcipua*, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 239; Illust. Zool. 'Investigator,' pl. ix. figs. 5, 5 *a*.

Hab. Station 229, off Travancore coast, in 360 fath.

Pleurotoma (*Surcula*) *arcana*, Smith.

Pleurotoma (*Surcula*) *arcana*, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 239; Illust. Zool. 'Investigator,' pl. ix. figs. 6, 6 *a*.

Hab. Station 233, off Andaman Islands, in 185 fath.; and Station 229, off Travancore coast, in 360 fath.

Pleurotoma (*Surcula*) *Margaritæ*, sp. n.

Testa fusiformis, turrita, albida, epidermide tenuissima lutescente induta; spira elongata, acuminata; anfractus 12, in medio angulati, nodose oblique plicati (plicis inferne attenuatis), supra concavi, infra subconvexi, undique spiraliter tenuiter et confertim striati lineisque incrementi flexuosis tenuibus sculpti, ultimus infra angulum convexus, antice breviter rostratus; apertura elongata, piriformis; labrum tenue, valde arcuatim prominens, superne late et profunde sinuatum; columella in medio rectiuscula, antice obliqua.

Longit. 60 mm., diam. 20; apertura cum canali 27 longa, 8 lata.

Hab. Off Andaman Islands, 405 fath.

In the body-whorl there is a slight convexity or rounded ridge just below the suture and above the excavation, below which occur the oblique nodose plications which gradually diminish in strength as the aperture is approached.

Pleurotoma (*Bathytoma*) *atractoides*, Watson.

Pleurotoma (*Genota*) *atractoides*, Watson, Gasteropoda 'Challenger' Expedition, p. 301, pl. xx. fig. 8 *a–c*.

Bathytoma atractoides, Harris, Cat. Austral. Ter. Moll. part i. p. 49.

Hab. Philippine Islands, 375 fath. ('Challenger'); Stations off Andaman Islands, 185–405 fath. ('Investigator'); in 188 fath. (*Sowerby*, P. Malac. Soc. i. p. 38).

The specimens from the Andaman Islands are perhaps a trifle shorter in proportion to their width than the type and have the transverse liræ upon the body-whorl more distinctly granose. A single oblique fold, not noticed by Watson, is present upon the middle of the columella. This is only visible when the outer lip is broken away. A very fine example from 405 fath. is much larger than the specimen obtained by the 'Challenger,' being 47 mm. in length and 20 in width. Three out of the four examples examined have a number of fine liræ within the outer lip, a feature not present in the 'Challenger' shell.

P. Wetherelli, Ed., of the London Clay, and the Miocene *P. cataphracta* are very closely allied forms.

From *P. Oldhami* this species differs in the absence of the channelled suture and the broad raised belt with a deep groove beneath it.

Pleurotoma (*Bathytoma*) *Oldhami*, Smith.

Pleurotoma (*Bathytoma*) *Oldhami*, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 238; Illust. Zool. 'Investigator,' pl. ix. figs. 2, 2 *a*.

Hab. Station 229, off Travancore coast, in 360 fath.

Pleurotoma (*Ancistrosyrinx*) *travancorica*, Smith, var. *granulata*.

Pleurotoma (*Ancistrosyrinx*) *travancorica*, Smith, Ann. & Mag. Nat. Hist. 1896, vol. xviii. p. 368; Illust. Zool. 'Investigator,' Mollusca, pl. vii. figs. 1, 1 *a*.

Hab. Station 229, off Travancore, in 360 fath.; Stations 233 and 240, off Andaman Islands, in 185–194 fath.

Three specimens from off Travancore differ from the type in having the lower part of the body-whorl covered with oblique rows of minute granules, also in having a spiral liration in the concavity of the whorls near the dentate keel. This liration bears small tubercles connected by short cross-ridges with the dentations of the keel. Two examples from the latter locality have the dentations at the angle of the whorls conspicuously upturned, so that the upper part of the volutions is deeply concave. The latter are twelve in number, of which the apical one is smooth and globular.

Drillia investigatoris, Smith.

Drillia investigatoris, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 240; Illust. Zool. 'Investigator,' pl. x. figs. 1, 1 *a*.

Hab. Station 233, off Andaman Islands, in 185 fath.

Drillia fugata, Smith.

Drillia fugata, Smith, Ann. & Mag. Nat. Hist. 1895, vol. xvi. p. 4, pl. i. figs. 5, 5 *a*.

Hab. Off Andaman Islands, in 405 fath.

A single specimen agreeing with the variety fig. 5 *a*.

Drillia captiva, Smith.

Drillia captiva, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 240; Illust. Zool. 'Investigator,' pl. x. fig. 2.

Hab. Station 233, off Andaman Islands, 185 fath.

Drillia capta, Smith.

Drillia capta, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 240; Illust. Zool. 'Investigator,' pl. x. fig. 3.

Hab. Station 233, off Andaman Islands, 185 fath.

Drillia Worthingtoni, sp. n.

Testa breviter fusiformis, fuscescenti-albida; anfractus 9, duo apicales læves, rotundati, cæteri superne excavati, infra nodose costati (costis in anfr. penult. 8–10) et transversim tenuissime striati, ultimus varice conspicuo rotundato ad sinistram instructo, inter varicem et labrum haud costatus; apertura parva; labrum tenue, supra late et subprofunde sinuatum; columella rectiuscula, callo tenui, supra prope sinum subnodoso, induta.

Longit. 16 mm., diam. 6; apertura 6 longa, 2 lata.

Hab. Station 240, off Andaman Islands, in 194 fath.; off Ross Island, 265 fath.

The lines of growth are fine and flexuous, and the fine spiral striæ only occur upon the lower half of the whorls, the concavity above exhibiting only the sinuated incremental lines.

Clathurella perlissa, sp. n.

Testa ovato-fusiformis, nitida, fuscescens, zona pallida infra suturam aliaque circa medium anfr. ultimi ornata; spira turrita, acuminata; anfractus 9, superiores 3, protoconcham constituentes, læves, primus convexus, duo sequentes infra medium carinati, cæteri (normales) supra decliviter excavati, infra convexi, circa medium costati, costis bituberculatis, in anfr. penultimo 10, in ultimo labrum versus obsoletis haud infra medium productis, ultimus antice contractus et oblique striatus; apertura parva, contracta; labrum incrassatum, varicosum, album, ad suturam sinuatum, intus denticulis 7–8 instructum, sed supra marginem acutum minutius crenulatum; columella alba, serie tuberculorum minutorum munita; canalis anterior obliquus, mediocriter angustatus.

Longit. $11\frac{1}{2}$ mm., diam. $5\frac{1}{2}$; apertura cum canali 6 longa, intus $1\frac{1}{3}$ lata.

Hab. Station 237, off Andaman Islands, 90 fath.

A very pretty glossy species. The costæ are traversed by two spirals producing a tuberculated appearance. Of the very small tubercles upon the columella a few at the upper or posterior part are more prominent than the rest.

Clathurella rugidentata (Sowerby).

Pleurotoma (*Clathurella*?) *rugidentata*, Sowerby, Proc. Malac. Soc. vol. i. p. 38, pl. iv. fig. 11.

Hab. Station 240, off Andaman Islands, 194 fath. ('Investigator'); in 188 fath. (*Sowerby*).

Besides the oblique slender costæ and the fine spiral liræ, nodulous at the points of intersection, the surface exhibits fine spiral raised striæ in the interstices.

Trophon tenuirostratus, Smith.

Trophon tenuirostratus, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 241; Illust. Zool. 'Investigator,' pl. x. figs. 4, 4 *a*.

Hab. Station 233, off Andaman Islands, in 185 fath.

Trophon indicus, Smith.

Trophon indicus, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 241; Illust. Zool. 'Investigator,' pl. x. figs. 5, 5 *a*.

Hab. Station 233, off Andaman Islands, in 185 fath.

Fusus captivus, Smith.

Fusus captivus, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 242; Illust. Zool. 'Investigator,' pl. x. figs. 8, 8 *a*.

Hab. Station 233, off Andaman Islands, 185 fath.

Murex ternispina, Lamarck.

Murex ternispina, Lamk., Kiener, Icon. Coq. Viv. p. 6, pls. viii., ix., fig. 1.

Hab. Twenty-six miles W.S.W. of Honawar, west coast of

India, in 28 fath.; off Mangalore, in 26–30 fath.; off south coast of Ceylon, 34 fath.; Station 237, off Andaman Islands, 90 fath.

Some variation exists among the series of specimens from these localities; those from off Honawar have the principal spiral ridges dotted with red and only very slightly tuberculated, whereas the examples from off Ceylon exhibit more distinct tubercles and no dotting, but instead a very faint brownish or reddish zone around the base of the body-whorl. The apical portion of the spire is also more produced and the sculpture of the first three normal whorls rather different. They are more rounded and more finely cancellated.

Murex Troscheli, Lischke.

Murex Troscheli, Lischke, Jap. Meeres-Conch. i. p. 41, pl. i. figs. 1, 2; ii. pp. 29, 164.

Hab. Station 237, off Andaman Islands, 90 fath., stones.

The largest specimen is 110 mm. in length. This is small in comparison with the type from Nagasaki, yet the shell appears to be mature. The spines also are rather longer and more slender. The whorls are rufo-lineated, but the spines are more slender and longer than as shown in Lischke's figures. Pilsbry * has pointed out a similar variation in Japanese specimens.

Murex mindanaensis, Sowerby.

Murex mindanaensis, Sowerby, Proc. Zool. Soc. 1840, p. 139.
Murex mindanaoensis, id. Conch. Ill. fig. 92, sp. 17; Thesaurus, iv. pl. 381. fig. 21.
Murex mindensis, Reeve, Conch. Icon. fig. 78.
Murex mindanenensis, Kobelt, Conch.-Cab. p. 111, pl. xxxiv. fig. 8.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

One specimen only, rather young, 40 millim. in length. The type was originally described from the Philippine Islands.

Murex axicornis, Lamarck.

Hab. Station 237, off Andaman Islands, 90 fath.; off south coast of Ceylon, 34 fath.

The Andaman examples are quite typical, as represented by Kiener's figure (Icon. Coq. Viv. pl. xlii. figs. 2), but those from Ceylon have shorter spines and generally three instead of two nodulous costæ between the varices.

* Cat. Marine Moll. Japan, p. 41.

Murex aculeatus, Lamarck.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'); Tizard Bank, China Sea, 20 fath. (H.M.S. 'Rambler,' in Brit. Mus.).

The specimens from the above localities more closely agree with Kiener's figure (Coq. Viv. pl. xxxix. figs. 3) than with the shell depicted by Reeve (Conch. Icon. vol. iii. fig. 60). They have a single intermediate tubercle or plication between the varices, and exhibit some transverse fine reddish lines, as shown in Kiener's figure. On the other hand, Reeve's shell has two intervening plicæ and only faint traces of the spiral lineation.

Phos roseatus, Hinds.

Phos roseatus, Hinds, Voy. 'Sulphur,' Zool. vol. ii. p. 38, pl. x. figs. 9, 10; Sowerby, Thesaurus, vol. iii. p. 90, pl. ccxxi. figs. 1–3; Tryon, Man. Conch. vol. iii. p. 217, pl. lxxxiii. figs. 508–9.

Hab. Off south coast of Ceylon, 34 fath.

A more slender and more finely sculptured form than that figured by Tryon and Sowerby. The species occurs at Sumatra, the Philippines, Moluccas, &c.

Nassaria suturalis (A. Adams).

Hindsia suturalis, A. Adams, Proc. Zool. Soc. 1853, p. 183; Kobelt, Conch.-Cab., *Purpuracea*, p. 318, pl. lxxvii. figs. 11, 12.

Nassaria suturalis, Sowerby, Thes. Conch. vol. iii. p. 86, pl. ccxx. figs. 15, 16; Tryon, Man. Conch. vol. iii. p. 221, fig. 542 (*acuminata*, part.).

Hab. Off south coast of Ceylon, 34 fath., and eight miles south of Puri, Bengal, 13 fath. ('Investigator'); Malacca (*A. Ad.*); Ceylon (*Layard*).

*N. bituberculari*s, A. Adams, from Sorsogon, Philippine Islands, is a synonym.

Nassaria nodicostata (A. Adams).

Hindsia nodicostata, A. Adams, Proc. Zool. Soc. 1853, p. 183; Kobelt, Conch.-Cab., *Purpuracea*, p. 322, pl. lxxvii. fig. 13.

Nassaria nodicostata, Sowerby, Thes. Conch. vol. iii. p. 86, pl. ccxx. fig. 13.

Hab. Station 239, off Andaman Islands, in 55 fath. ('Investigator'); —— ? (*A. Adams*).

This so-called species is probably only a small variety of *N. acuminata*, Reeve, from China, with which it has been united by Tryon * together with half a dozen other species.

* Man. Conch. vol. iii. p. 221, fig. 545.

Nassaria nivea (Gmelin).

Buccinum niveum, Gmelin, Syst. Nat. p. 3495, non p. 3504.
Triton niveus, Reeve, Conch. Icon. vol. ii. sp. 75.

Hab. Gulf of Martaban, 6–100 fath., and off Vizagapatam coast, 20 fath.

Found also at Tranquebar, Malacca, Ceylon, &c.

Nassaria lævior, Smith.

Nassaria lævior, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 242; Illust. Zool. 'Investigator,' pl. x. figs. 6, 6 *a*.

Hab. Station 237, off Andaman Islands, 90 fath.

Nassa gemmulata, var.

Buccinum gemmulatum, Lamarck, Kiener, Icon. Coq. Viv. p. 85, pl. xxii. fig. 84.
Nassa gemmulata, Reeve, Conch. Icon. vol. viii. fig. 29.
Var. = *N. variegata*, A. Adams, Reeve, *l. c.* fig. 70.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

The specimens from the above locality belong to the small finely granose form of this species named *variegata* by A. Adams. *Buccinum conoidale*, Deshayes, also, as suggested by Tryon, appears to belong to this species. *N. verrucosa*, A. Adams, is another variety.

Nassa crenulata (Bruguière).

Nassa crenulata, Bruguière, Reeve, Conch. Icon. vol. viii. figs. 2 *a*, 2 *b*.

Hab. Lat. 13° 17′ N., long. 93° 7′ E., off Andaman Islands, 90 fath.

Nassa aracanensis, Smith.

Nassa aracanensis, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 243; Illust. Zool. 'Investigator,' pl. xi. figs. 2, 2 *a*.

Hab. Reef Island, Kyuk Phyon, off Aracan coast.

Nassa diluta, Smith.

Nassa diluta, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 243; Illust. Zool. 'Investigator,' pl. xi. figs. 3, 3 *a*.

Hab. Off Colombo, 597 fath.; also off Kistna coast, 753 fath.

Metula Hindsi, H. & A. Adams.

Buccinum metula, Hinds, Voy. 'Sulphur,' p. 31, pl. xvi. figs. 13, 14
Tryon, Man. Conch. vol. iii. p. 153, pl. lxxii. fig. 240.

Buccinum mitrella, Adams & Reeve, Voy. 'Samarang,' Zool., Moll. p. 32, pl. xi. fig. 13; Tryon, *op. cit.* p. 152, pl. lxxii. fig. 239 (as *Metula*).

Hab. Off Coromandel coast, 41 fath.

Buccinum mitrella was originally described from the China Sea. The single specimen obtained by the 'Investigator' is larger than the type, being 24 mm. in length and 7 in width. The whorls also are slightly more convex. A feature not referred to in the description is the presence of varices at intervals up the spire, being merely the slightly thickened former outer lips of the aperture.

A careful examination of the description and figures given by Hinds of his *Buccinum metula* and a comparison of specimens in the Cuming collection apparently indicate that that species and *Buccinum mitrella* belong to the same form, differing only in size. The examples of *B. metula* in the British Museum are quite as small as that figured in the 'Sulphur,' and, with the exception of size, are undistinguishable from the larger form *mitrella*. Hinds's locality, "West coast of Veragua," may be an error.

Tritonidea delicata, Smith.

Tritonidea delicata, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 242; Illust. Zool. 'Investigator,' pl. x. figs. 7, 7 *a*.

Hab. Station 237, off Andaman Islands, 90 fath.

Pisania angusta, Smith.

Pisania angusta, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 243; Illust. Zool. 'Investigator,' pl. xi. figs. 1, 1 *a*.

Hab. Off south coast of Ceylon, 34 fath.

Columbella (Mitrella) supraplicata, Smith.

Columbella (Mitrella) supraplicata, Smith, Ann. & Mag. Nat Hist. 1899, vol. iv. p. 244; Illust. Zool. 'Investigator,' pl. xi. figs. 7, 7 *a*.

Hab. Station 232, off Travancore coast, in 430 fath.

Columbella (Meta) philippinarum, Reeve.

Hab. Station 237, off Andaman Islands, 90 fath. ('Investigator'); Philippine Islands (*Reeve*); N. Borneo (*Ussher & Everett*, in Brit. Mus.).

The 'Investigator' specimens, coming from deep water, have lost almost all the colour-markings which usually are present in this species. They are dirty white, with just feeble traces of brown zigzag lines and wavy longitudinal lineation. Two specimens in the Museum collection, collected in shallow water at the Andamans by Lieut. A. W. King and Capt. Francis Hamilton, have much brighter markings.

Latiaxis diadema (A. Adams).

Murex diadema, A. Adams, Proc. Zool. Soc. 1853, p. 70.
Latiaxis diadema, Sowerby, Thes. Conch. vol. v. p. 2, pl. ccccxxiv. fig. 11.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'); Philippines (*A. Ad.*); Mauritius (*Robillard*, in Brit. Mus.).

The type of this species has been so overcleaned that the very beautiful transverse sculpture is almost obliterated. It consists of very numerous fine liræ, which are minutely squamose and undulating. The two specimens from Ceylon are of a delicate rose tint within the aperture and have a series of flattened hollow spines upon the lower angle of the body-whorl. They do not curve upwards like those above, but stand out horizontally. The columella is coated with an erect pink callus which unites with the labrum above.

A specimen from Mauritius obtained by the late Victor Robillard is larger than the typical form and differs also in being totally white, and the second keel upon the body-whorl is ornamented with very numerous hollow, short, somewhat upcurved spines. Also between this series and the squamose crest at the base there is another series of smaller scale-like spines. The fine, delicate, transverse sculpture which covers the entire surface is of the same character as in the other examples.

Length 36 mm.

19. *Coralliophila indica*, Smith.

Coralliophila indica, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 244; Illust. Zool. 'Investigator,' pl. xi. figs. 8, 8 *a*.

Hab. Station 232, off South India, 430 fath.

Cancellaria trigonostoma, Lamarck.

Hab. Off Coromandel coast, in 41 fath.

The single small example differs from the typical form in having more distinct longitudinal plicæ and finer spiral striæ, the surface of the body-whorl being minutely reticulated. It consists of four normal and two and a half apical whorls, the latter being smooth and convex.

Cancellaria paucicostata, Sowerby.

Cancellaria paucicostata, Sowerby, Proc. Malac. Soc. vol. i. p. 160, pl. xii. fig. 26.

Testa angulatim ovata, imperforata, dilute fuscescens, oblique costata et transversim tenuiter subgranose lirata; anfractus 5, celeriter crescentes, supremi duo læves, convexi, tertius cancellatus, penult. costis circiter 16 instructus, ultimus supra medium obtuse angulatus, costis circa 8–10 sensim magis distantibus ornatus; apertura irregulariter triangularis, alba, longit. totius $\frac{1}{2}$ superans, antice leviter canaliculata; labrum incrassatum, intus tenuiter liratum; columella arcuata, triplicata, callo tenui induta. Longit. 17 mm., diam. 13, apertura 10 longa, 7 lata.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'); Persian Gulf (*Sowerby*).

The transverse liræ are very fine and alternately larger and smaller, and, being crossed by the lines of growth, have a very pretty subgranose appearance.

The type of this species in the British Museum is of a very pale reddish tint with a narrow whitish line round the middle of the body-whorl and another at the angulation above. In the Ceylonese specimen these pale zones are only just traceable. The liræ within the labrum are about seventeen in number.

Cancellaria cretacea, Smith.

Cancellaria cretacea, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 245; Illust. Zool. 'Investigator,' pl. xi. figs. 5, 5 *a*.

Hab. Station 229, off Travancore coast, in 360 fath.

Ancilla leucospira, Smith.

Ancilla leucospira, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 245; Illust. Zool. 'Investigator,' pl. xi. figs. 4, 4 *a*.

Hab. Station 240, lat. 11° 32′ N., long. 92° 46′ E., off Andaman Islands, 194 fath.

Ancilla glans, Smith.

Ancilla glans, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 246; Illust. Zool. 'Investigator,' pl. xi. figs. 6, 6 *a*.

Hab. Station 233, off Andaman Islands, 185 fath.

Ancilla Tindalli, Melvill.

Ancilla Tindalli, Melvill, Mem. & Proc. Manchester Lit. & Phil. Soc. 1898, vol. xlii. pt. ii. p. 14, pl. i. fig. 1.

Hab. Off south coast of Ceylon, 34 fath.

A single example agreeing in all respects with the type from the Angrias Bank, west of Bombay.

Marginella angustata, Sowerby.

Hab. Off Coromandel coast, 41 fath.

The specimens from this locality are much smaller than the types figured by Sowerby, the average length being only 13–14 mm. They differ also in exhibiting a small spire consisting of a few whorls, which, in the large form, becomes concealed by callus.

Marginella grisea (Jousseaume).

Persicula grisea, Jousseaume, Rev. Mag. Zool. 1875, p. 268.
Marginella obtusa, Sowerby, Proc. Zool. Soc. 1870, p. 254; non *M. obtusa*, Sow., 1846.
Marginella sexplicata, Dunker, ubi?; Weinkauff, Conch.-Cab. ed. 2, p. 85, pl. xvi. figs. 6, 7.

Hab. Gulf of Martaban, 67 fath.

It seems to me doubtful whether the shell figured by Weinkauff is the same species as that described by Sowerby. The type of *obtusa* in the British Museum is much larger (24 mm.) and narrower, has a flatter spire, and the plicæ on the columella seem different. I have been unable to find any reference to this species by Dunker before the year 1882 in his 'Index Moll. Maris Japon.' p. 57. The quotation by Weinkauff "Mus. Godeffr. Cat. 3 (1871)" is evidently erroneous, as that Catalogue was issued in 1866. Tryon, in his monograph of this species (Man. Conch. vol. v.), has merely followed Weinkauff, giving the same reference to the Godeffroy Catalogue; and Pilsbry also (Cat. Marine Moll. Japan, p. 24) throws no light upon the point.

Turritella fascialis, Menke.

Turritella fascialis, Menke, Kobelt, Conch.-Cab. ed. 2, p. 13, pl. iv. fig. 5.

Hab. Off south coast of Ceylon, 34 fath.

Undistinguishable from Japanese examples.

Turritella columnaris, Kiener.

Turritella columnaris, Kiener, Kobelt, *op. cit.* p. 48, pl. v. figs. 1, 2.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

Strombus Listeri, T. Gray.

Buccinum Bilingue canadense, Lister, Hist. Conch. pl. 855. fig. 12 *a*.
Strombus Listeri, T. Gray, Ann. & Mag. Nat. Hist. 1852, vol. x. p. 430; Tryon, Man. Conch. vol. vii. p. 114, pl. iv. fig. 45.
Strombus mirabilis, Sowerby, Proc. Zool. Soc. 1870, p. 257, pl. xxi. fig. 4.

Hab. Ceylon (*Sowerby*); Gulf of Martaban, in 67 fath. ('Investigator').

Only two young examples were obtained by the 'Investigator,' but the record of another locality is interesting. They consist of ten normal and three nuclear whorls, the latter being globose, smooth, and glossy. At this age, before the last whorl is formed, the shell is fusiform and the columella almost straight. The ground-colour is white, variegated with numerous undulating, somewhat zigzag, brown flames. The last whorl is obliquely grooved upon the lower or anterior part.

Strombus Sibbaldi, Sowerby.

Strombus Sibbaldii, Sowerby, Thesaurus Conch. vol. i. p. 28, pl. vi. figs. 10, 11; Reeve, Conch. Icon. vol. vi. pl. xviii. fig. 48.

Hab. Off south coast of Ceylon, 34 fath.; also off Coromandel coast, 41 fath.

A small, but apparently adult, shell from the latter locality is destitute of colour-marking, and only 27 mm. in length.

Rostellaria Powisii, Petit.

Rostellaria Powisii, Petit, Mag. de Zool. 1842, pl. liii.

Hab. China (*Petit* and others); Gulf of Martaban, in 67 fath. ('Investigator').

This species, which is figured in the monographs by Sowerby, Reeve, Kiener, Küster, and Tryon, appears to have hitherto been recorded from China only. Its occurrence in the Indian Ocean is therefore of some interest.

Xenophora (*Haliphæbus*) *solaris* (Linn.).

Hab. Off Ganjam coast, in 28–30 fath. ('Investigator'); Coromandel and Nicobars (*Chemnitz*); Malacca (*Cuming*).

Xenophora pallidula, Reeve.

Hab. Off Andaman Islands, in 185 fath., and off Tavancore coast in 360 fath. ('Investigator'); Japan (*Reeve*, &c.)

Pirula gracilis, Sowerby.

Pirula gracilis, Sowerby, Smith, Journ. Malacol. vol. iii. p. 67.
Pyrula Dussumieri, Kiener, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 164.

Hab. China Sea (*Kiener*, &c.); Station 69, in 20 fath. ('Investigator').

Ranella (*Biplex*) *perca* (Perry).

Hab. Station 240, off Andaman Islands, 194 fath.

Ranella bituberculata, Lamarck.

Hab. Off Mangalore, Malabar coast, 26–30 fath.

Distortrix cancellinus (Roissy).

Hab. Station 237, off Andaman Islands, 90 fath.; off Ganjam coast, 28–30 fath.; also 8 miles south of Puri, 13 fath.

Lotorium tripus, Lamarck.

Hab. Off south coast of Ceylon, 34 fath.; also off Malabar coast, 28 fath.

Ovula bullata, Adams & Reeve.

Ovulum bullatum, Adams & Reeve, Voy. 'Samarang,' Moll. p. 23, pl. vi. figs. 13 *a*, *b*; Reeve, Conch. Icon. vol. xv. pl. vi. figs. 26 *a*, *b*; Sowerby, Thesaurus, vol. ii. pl. ci. figs. 95, 96; Weinkauff, Conch.-Cab. ed. 2, p. 187, pl. xlviii. figs. 5 & 8.
Calpurnus bullatus, A. Adams, Journ. Linn. Soc., Zool. 1864, vol. vii. p. 95.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'); Singapore (*Ad. & Reeve*); Japan (*A. Ad.*).

Two specimens exactly like the type, the larger being $10\frac{1}{2}$ mm. in length.

Radius Angasi (Reeve).

Ovulum Angasi (Adams MSS.), Reeve, Conch. Icon. vol. xv. pl. x. figs. 43 *a–b*.

Hab. Off south coast of Ceylon, in 34 fath. ('Investigator'); Port Curtis, Queensland (*Reeve*).

Two specimens of a very pale rose tint, with the two extremities tipped with brown. The latter feature is faintly present in the type, although not referred to by Reeve. Both the anterior and posterior ends are obliquely striated dorsally. The ventral part of the body-whorl is rather more humpy in the Australian form than in those from Ceylon.

Trivia producta (Gaskoin).

Cypræa producta, Gaskoin, Reeve, Conch. Icon. vol. iii. pl. xxiv. figs. 137 *a*, *b*; Sowerby, Thes. Conch. vol. iv. p. 49, pl. 327. figs. 495, 496.

Hab. Off Coromandel coast, 41 fath. ('Investigator'); Agulhas Bank, S. Africa (*Sowerby*); Red Sea (*Weinkauff*); Borneo, Australia (*Tryon*).

Trivia pisum (Gaskoin).

Cypræa pisum, Gaskoin, Sowerby, *op. cit.* p. 44, pl. 326. figs. 448, 449.

Hab. Off south coast of Ceylon, 34 fath.

Scala Kieneri (Canefri).

Cirsotrema Kieneri, Canefri, Journ. de Conch. 1876, p. 155.
Scalaria decussata, Kiener, non Lamarck, Icon. Coq. Viv. p. 21, pl. vii. fig. 23; Sowerby, Thes. Conch. vol. i. p. 103, pl. xxxv. fig. 140.
Amæa Sowerbyi, Dunker, Index Moll. Mar. Jap. p. 69.
Scala fimbriolata, Melvill, Mon. Manchester Phil. Soc. 1897, vol. xli. p. 11; vol. xlii. pl. i. fig. 12.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'): other localities are:—Arabia (*Sowerby*); Japan (*A. Adams, Dunker, Pilsbry*); Mekran coast (*Melvill*); Darnley Island, N. Australia (*Mus. Cuming*).

I am inclined to believe that Tryon is right in considering the *S. decussata* of Sowerby the same as that figured by Kiener under that name. After carefully comparing the type of *S. fimbriolata*, a young shell, with this species, I have failed to find any distinguishing characters.

The shell described by Clessin * as a new species, under the name of *S. Sowerbyi*, is quite distinct from the present form.

Scala multiperforata (Sowerby).

Scalaria multiperforata, Sowerby, Conch. Icon. vol. xix. pl. xvi. fig. 125.

Hab. Off south coast of Ceylon, 34 fath. ('Investigator'); Mauritius (*Sowerby*).

A single large dead specimen, 40 mm. in length. It is doubtful whether this species is separable from *S. cochlea*, Sowerby, said to be from West Africa.

Scala subcasta (Smith).

Scalaria subcasta, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 246; Illust. Zool. 'Investigator,' pl. xii. figs. 2, 2 *a*.

Hab. Station 232, off Travancore coast, 430 fath.

* Conch.-Cab. ed. 2, p. 63, pl. xv. fig. 1.

Scala bengalensis (Smith).

Scalaria bengalensis, Smith, Ann. & Mag. Nat. Hist. 1899, vol. iv. p. 246; Illust. Zool. 'Investigator,' pl. xii. figs. 1, 1 *a*.

Hab. Station 229, off Travancore coast, in 360 fath.

Lacuna indica, Smith.

Lacuna indica, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 165, pl. iv. fig. 7.

Hab. Off Kistna coast, 753 fath.

The shell is white beneath an excessively thin deciduous epidermis, which produces the "sordide albida" appearance, as described in the original diagnosis.

Lacuna globosa, sp. n.

Testa globosa, tenuis, anguste umbilicata, pellucido-alba, periostraco-tenuissimo induta, limo rufescente sæpe incrustata, lineis incrementi sculpta; anfractus quatuor, celeriter accrescentes, perconvexi, ultimus antice oblique descendens, inferne circa umbilicum carina prominente gracili instructus; apertura irregulariter rotundata; peristoma tenue, continuum, margine externo infra late sed haud profunde sinuato, columellari in medio leviter reflexo et sinuato; operculum corneum, paucispirale, anfractibus 3–4 constructum.

Diam. maj. 5 mm., min. 4, alt. 5.

Hab. Station 212, in 111 fath.

Within the aperture a narrow and shallow groove corresponds with the external umbilical keel. Just above the termination of the latter the peristome exhibits a broad but shallow sinus. I regret being unable at present to give the position of Station 212.

Natica rufa, Born.

Natica rufa, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiv. p. 165, pl. iv. figs. 14, 14 *a*.

Hab. Bay of Bengal, 65 fath.

A single specimen with rather higher spire than usual.

Natica violacea, Sowerby.

Natica violacea, Philippi, Con.-Cab. ed. 2, p. 66 bis, pl. x. fig. 13.

Hab. Off Andaman Islands, 15 fath. ('Investigator'); other localities are Philippines, Fiji, Mauritius.

No description of the operculum appears to have been published, excepting that Sowerby, in the original diagnosis *, mentions that it is testaceous. It is white, glossy, and slightly concave externally, with a groove and a ridge parallel with the outer curved margin, whilst the straight or columellar side is finely serrate. Parallel with the curved outline may be noticed numerous faint subpellucid lines which arise between the denticles on the serrated edge.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Memoirs of the Geological Survey of the United Kingdom.—The Cretaceous Rocks of Britain. Vol. III. *The Upper Chalk of England.* By A. J. Jukes-Browne. With Contributions by William Hill, F.G.S. 8vo. Pp. x and 566. With 79 Illustrations in the text and 1 Plate. 1904. E. Stanford, London; J. Menzies, Edinburgh; and Hodges & Co., Dublin. Price 10*s.*

As in the case of Vol. II. of this work (noticed in the Ann. & Mag. Nat. Hist. for February 1904), the Board of Agriculture and Fisheries, desirous that agriculturalists and others should have full benefit, has distributed this volume also for review.

The Memoirs of the Geological Survey of the United Kingdom always bring together much valuable material, and this volume is in no way wanting in this respect. The Upper Chalk is defined by the authors as consisting of the zones of *Holaster planus*, *Micraster cor-testudinarium*, *Micraster cor-anguinum*, *Marsupites*, *Actinocamax quadratus*, *Belemnitella mucronata*, and *Ostrea lunata*. The zonal divisions of the Chalk are fully recognized in this volume, although the authors seem reluctant to part with the obsolete divisions of "Upper," "Middle," and "Lower," which have now such small significance. They also seem to hanker after a fresh system of zonal nomenclature (p. 5), but this seems to us to be unnecessary. In the descriptions of the coast-sections full credit is given to Dr. Rowe, who must certainly feel rewarded in reading the generous tribute to his work in the Preface by the Director. Indeed it is quite clear, and is so stated (p. 38), that the publication of Messrs. Rowe and Sherborn's work necessitated the re-writing of those parts of this Memoir which deal with the districts that they have examined; and this is the more clearly brought out at pp. 275–278 ("Yorkshire"), if anyone will take the trouble to compare the official account with that recently published by Dr. Rowe in the 'Proceedings' of the Geologists' Association. It is more and more evident that future work in the field must be conducted by those who have more than a working knowledge of the zoology of the beds which they are surveying, as the exactitude of results achieved

* Tankerville Cat. p. xi.

of late years in the Silurian, Carboniferous, and Chalk rocks has amply demonstrated.

After the description of each coast-section, the authors deal in detail with the inland exposures, and collect together a mass of information which should prove extremely valuable when a zonal survey of Counties is undertaken. That this must come in the near future is evident by a recent attempt by Mr. Jukes-Browne himself to indicate the zones in the Chalk of Suffolk from fossils collected in pits. In the description of the Norfolk coast, Mr. Jukes-Browne establishes a new zone, the zone of *Ostrea lunata*, on the collections of Messrs. C. Reid and R. M. Brydone: the results obtained by the latter were published in 1900. It is comforting to be reminded that there is a certain amount of this interesting zone inland, as shown by the Well at Mundesley, since the northern shore-mass of *lunata* Chalk at Trimingham is almost worn away.

Chapter xxi. is devoted to a sketch of the Upper Chalk of France, wisely inserted for comparison. Chapter xxii. (pp. 302–353), dealing with the microscopical characters of the Chalk, by Mr. Hill, is a summary, with additions, of his well-known papers on the subject. The author is indebted to Mr. F. Chapman (now of Melbourne) for determining the Foraminifera and Ostracoda (p. iv). A discussion of the chemical composition of the Chalk occupies Chapter xxiii. (pp. 354–360). The bathymetric conditions and the variations of the sea-bottom during the formation of the Upper Chalk occupy Chapter xxiv.; an account of the economic products, Chapter xxv. (pp. 379–402); of the physical features, Chapter xxvi. (pp. 402–424); and of the water-supply from the Chalk, Chapter xxvii. (pp. 425–446). One Appendix contains critical remarks on some of the fossils, and gives a list of all the known fossils up from the Upper Greensand (Selbornian) to the *O. lunata* zone, with careful indications of the zonal succession. Appendix II. gives a full Bibliography of publications relating to the rocks and fossils of the Upper Cretaceous Series of England.

We congratulate the Officers of the Geological Survey and Messrs. Jukes-Browne and Hill on having completed a very laborious and tedious task. We wish we could do the same for the printers. The paper seems better than usual, but there appears to be a difficulty in keeping the type clean; while in two copies of this work that we have seen the diagram at p. 206 is shorn of many of its letters. There are a few editorial slips—e. g., *Pecten serrat* at p. 12. Many of the woodcuts are too antiquated for current books; such new ones as that on p. 26 are indeed a long way "after Rowe"; and it is puzzling to distinguish in the picture at p. 91 the special layers of flint alluded to in the text.

Pictures of Bird-Life. By R. B. Lodge.
London: Bousfield & Co. 1903.

Nowhere, perhaps, has the perfection of the camera and of photographic methods been more appreciated than among field-naturalists.

Within the last few years there has arisen, in consequence, quite a bewildering number of volumes, large and small, dealing with animal life, and especially birds, all illustrated by photographs. Many of these volumes have but little to recommend them: others constitute standing monuments of infinite patience and laborious research; among these Mr. Lodge's work will take front rank.

Mr. Lodge is not merely a photographer who finds birds conveniently useful subjects for the purpose of book-making; on the contrary, he is an ornithologist first and a photographer afterwards—albeit a skilled photographer, as the pages of this volume testify.

Considerations of space forbid anything more than the merest outline of the scope of this book or reference to anything more than a few isolated facts to show the accuracy and value of the observations which render the text such delightful reading. The Author commences with a chapter on bird-life in a suburban parish, and then goes on to describe such easily accessible observation-stations as the Lincolnshire mud-flats, the Norfolk broads, and the Farne Islands. Next follows an account of his more ambitious explorations in the Dutch marshes, the Spanish marismas, and the fjords and forests of Denmark. Observations of real scientific value occur plentifully throughout these pages. Less welcome, and equally numerous, are painful references to the work of extermination which is proceeding apace throughout these islands. This is due partly to the insensate greed of the collector, and partly to the gross ignorance of the gamekeeper, who, in addition, and in spite of laws for the prevention of cruelty to animals, is guilty of acts of barbarity which can only be described as devilish. It is high time that some more effective legislation was introduced for the suppression of these evils.

There are three chapters in this book which will prove very acceptable to many, since they deal with the question of the photographer's outfit and automatic photography by electricity—an extremely valuable aid in obtaining pictures of suspicious birds, otherwise unapproachable.

There are over two hundred illustrations in this book, some of which are of great beauty. The eight coloured plates are all unusually good. The book is well bound, well printed, and a work of which both author and publisher may feel proud.

MISCELLANEOUS.

Teleostome Phylogeny: a Correction.

I AM indebted to Mr. Boulenger for kindly calling my attention to a mistake in my paper on Teleostome phylogeny in the last number of the 'Annals.' On page 331, in the definition of the order Dipneusti the word "not" should be omitted, thus reading "Clavicle distinct from the cleithrum."—C. TATE REGAN.

INDEX TO VOL. XIII.

END OF THE THIRTEENTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

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The Annals and magazine of natural history