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

PRIDEAUX JOHN SELBY, Esq., F.L.S.,
CHARLES C. BABINGTON, Esq., M.A., F.R.S., F.L.S., F.G.S.,
JOHN EDWARD GRAY, Ph.D., F.R.S., F.L.S., V.P.Z.S. &c.,
AND
WILLIAM FRANCIS, Ph.D., F.L.S.

VOL. XVII.—THIRD SERIES.

LONDON:
PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.
SOLD BY LONGMANS, GREEN, READER, AND DYER; SIMPKIN, MARSHALL, AND CO.; KENT AND CO.; BAILLIÈRE, REGENT STREET, AND PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES AND SMITH, DUBLIN: AND ASHER, BERLIN.
1866.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. XVII.

[THIRD SERIES.]

NUMBER XCVII.

Page

NUMBER XCVIII.

NUMBER XCIX.

NUMBER C.

NUMBER CI.

NUMBER CII.

PLATES IN VOL. XVII.

ERRATUM:—In page 286, for *Euodia* read *Enodia*.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

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

No. 97. JANUARY 1866.

I.—*On the Classification of the Annelides.* By A. de Quatrefages*.

All naturalists know what Linnæus and his immediate successors understood by the word *Vermes*; they also know that Cuvier was the first to disentangle the chaos in which the want of precise knowledge had long left this mass of Invertebrata, and that in consequence of the division of the animal kingdom into four sections (*embranchements*), the expression *Vermes* ceased for a long time to be applied to any group of the animals of which it had formerly been the common designation. Without enumerating here the numerous endeavours made for the purpose of perfectionating the first conceptions of the great reformer of zoology, I shall merely remind the reader that M. Milne-Edwards proposed to divide the Articulata of Cuvier into two subsections; that one of these divisions has received the name of *Vermes*, which appeared to be finally struck out of our scientific catalogues; and that this view has been accepted by a great number of naturalists. For my part, I believe it to be fully justified.

The *subsection Vermes* being thus established, it remains to

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' 1865, Zoologie, p. 253. This memoir includes a reply to some remarks by M. Claparède on M. Quatrefages' system; of the latter a translation will appear in a future Number.

divide it into subordinate groups. Many attempts have been made in this direction: I myself, as early as 1849, proposed a distribution which, dividing the *Vermes* into two series composed of corresponding terms, allows us to appreciate and distinguish the *relations of analogy* and the *relations of affinity**. This mode of conception of this embarrassing group, which everything seems to me to justify more and more, led me from that period to separate from the *class of Annelida* two great groups which had been united therewith by Cuvier, Lamarck, and their successors, namely the *Lumbricina* and the *Hirudinea*, which to me constitute two distinct *classes*, that of the *Erythræma* and that of *Bdellea*.

Thus reduced, the class of Annelida, as I understand it, no longer contains either the armed Gephyrea, which have been placed among the Chætopod Annelides by several naturalists, or the Leeches and Lumbricina. It is composed entirely of the *Annélides dorsibranches* and *Annélides tubicoles* of Cuvier (*A. néréidées* and *A. serpulées* of Savigny; *A. errantes* and *A. tubicoles* of Audouin and Milne-Edwards, and of most authors; *Rapacia*, *Limivora*, and *Gymnocopa* of Grube).

As by most of my predecessors, the totality of species here to be arranged is divided by me into two *orders*; but the considerations which have led me to this result differ from those which have generally been followed. Hence result considerable differences in the formation of the orders themselves and of the *sub-orders*, and in the number and arrangement of the *families*.

The latter first occupied my attention. In my eyes they constitute the fundamental element of every systematic classification. Essentially they are only the Linnæan genera better understood and better defined. The species once distributed into really natural families, their grouping in divisions of a higher order becomes at once easier and more certain, and in any case we must pretty nearly get correct and distinct notions upon the totality of the *class*.

It is because I am deeply convinced of the truth of the preceding statements that I set myself especially, and in the first place, to limit my families strictly, not placing in them any but

* I here reproduce the table which I published in the 'Institut' (No. 816):—

Diœcious worms.	Monœcious worms.
Annélides.	*Erythrèmes.*
Rotateurs.	
Géphyriens.	
Malacobdelles.	*Bdelles.*
Myocœlés.	*Turbellariés.*
Nématoïdes.	
	Cestoïdes.

those genera whose relationship was indisputable, and their affinities easily grasped. Now the class of Annelides, in consequence of its very great variability of type, presents a great number of genera which, although composed of very well-known species, do not present this double character. In such cases I have not hesitated to isolate them—to place them, so to speak, outside the series—depending on the investigations of my successors to assign them sooner or later a definitive place. Systematic minds, those who always require absolute conclusions, will probably blame me for having acted thus; but those naturalists who prefer certainty to rapidity of progress will, I hope, approve my course. I have also, of course, placed among the *incertæ sedis* those species and genera upon which we are in want of sufficient data; but I have endeavoured to determine at least the family to which they should be referred, and I believe I have succeeded in the great majority of cases.

Another consequence of the precision which I have endeavoured to introduce in the establishment of the families has been that I have been led to increase their number more than had been done by any of my predecessors. Savigny only reckoned seven, which is due to the small number of species known in his day. Johnston increased this number to fifteen, Grube to nineteen, and Schmarda to twenty-one. Although I place Grube's entire family *Amitidea* among the *incertæ sedis*, I have thought it necessary to divide the class into twenty-six families.

This multiplication of fundamental groups will not, however, at all surprise those who take account of the progress made since the publication of the 'Système des Annélides' (1820). Savigny only admitted twenty-six genera. Milne-Edwards, in the second edition of Lamarck's work (1830), admitted forty-nine. At the time of the publication of his 'Familien der Anneliden' (1851) Grube classified eighty-six genera. In 1861 Schmarda, in his 'Neue wirbellose Thiere,' admits ninety-seven. Now, by adding to the labours of my predecessors the results of my own investigations, either on the sea-shore or in the magnificent collections of the museum, I have arrived at the number of 245 genera, of which 181 have been able to be placed in a systematic series, and 64 still remain *incertæ sedis* for reasons which I have just indicated.

I do not, however, think that I have allowed myself to be betrayed into an exaggerated multiplication of these elementary groups. The number of constituent species has never appeared to me to be a real reason for effecting a breaking up which would not have reposed upon a totality of precise characters. This exigency has even led me to reject several genera established

1*

by my predecessors. In every case where, in a collection of species, the differences have appeared to me to depend solely upon the more or less marked development of one or several characters, I have united them in a single generic group, confining myself to the establishment in the latter of *tribes* and *sections* fitted to facilitate investigation. Thus the genus *Polynoë*, for example, containing seventy-seven species, has been divided into two tribes and ten sections.

In return, whenever I have noticed very distinct characters, I have not hesitated to establish a genus, even should it contain only a single species. This circumstance has occurred several times in the family of the *Syllidea*. Here the confusion of the two parts of the head, and the consequent non-distinction of the antennæ and tentacles, had often caused the union of species which, when once the nature of these parts and organs was recognized, evidently required to be separated.

The families once determined, it remained to group them in *orders* and *suborders*. This distribution, attempted at different times, had led my predecessors to results which sometimes differed considerably. Without dwelling upon purely historical details, I shall confine myself here to the indication of the course followed by me.

If there be a group in which the employment of ALL the characters is not only useful but necessary in the appreciation of zoological relations, it is most certainly the group of Annelides, and this in consequence of the extreme variability by which it is distinguished. But the more we attempt to grasp the characters, the more indispensable does it become to arrange them in the order of their importance. Now to judge of this importance the naturalist must choose between two modes of action which are very different, although often confounded—that of Cuvier and that of Jussieu.

The former places himself at the physiological point of view. He seeks the dominating characters in the organs charged with the function which appears to him to be of the highest value. This mode of appreciation presupposes that each function is performed by means of a special organ. Now at the present day we know that this is by no means the case in a great number of Invertebrata. The method of Cuvier therefore reposes on an *à priori* which is true for the Vertebrata and for some groups of Invertebrata, but incorrect for the rest. The Annelides present frequent examples of this inexactitude, and, indeed, precisely in the order of the anatomical arrangements belonging to one of the most important functions, to one of those which Cuvier placed in the foremost rank—that of respiration. It is scarcely necessary to refer to the fact that, in this class, certain groups have well-developed branchiæ, whilst other groups, sometimes very nearly allied to the former, do not present the least trace of special respiratory organs. Cuvier's principle, and the rules which he deduced from it, are therefore inapplicable to this class.

Jussieu kept strictly to observation. With him the most essential character is that which persists in the largest number of species and groups. This rational and wise manner of appreciating the value of characters is that which I have thought it necessary to adopt.

It has led me to recognize that one of the fundamental principles taught by Blainville had in this case a very decided value, and that it was in the modifications of the external form that we should seek for the bases of the distribution of the families.

Thus the Annelides are essentially diœcious animals, composed of segments which repeat themselves, and bear on each side a perfectly characteristic organ—a foot armed with exsertile and retractile setæ.

It was natural enough to think that the modifications bearing on this general type must have a great value in relation to the present matter. In particular, every exception to the law of repetition appeared necessarily to take a place in the first rank, and to be the more important in proportion as it reached a greater number of secondary groups.

In fact, when we examine the Annelides from this point of view, we find that they divide at once into two groups. In one of these the same parts are repeated from one extremity of the body to the other. Hence the animals present no distinct regions. This group constitutes our first order, that of the ANNELIDÆ ERRATICÆ. It is composed almost entirely of species belonging to the *Dorsibranches* of Cuvier, the *Errantes* of MM. Audouin and Milne-Edwards, and the *Rapacia* of Grube; I have only added to them the *Chlorœmea* and the *Polyophthalmea.*

In the second group the law of repetition of parts is suddenly interrupted in particular places, and the body is thus composed of distinct regions, in each of which the segments resemble each other, whilst they differ from one region to the other. This constitutes is for me the order of the A. SEDENTARIÆ. It includes all the *Tubicoles* of Cuvier and of Audouin and Milne-Edwards—that is to say, the *Serpulées* of Savigny, the *Limivora* of Grube. I also place with them a certain number of the *Errantes* of the former, some *Rapacia* of the latter of these naturalists, and the *Tomopterides* (*Gymnocopa*, Gr.).

Each of these two orders is divided into two suborders by means of considerations of the same nature, and derived likewise from exceptions presented to the law of repetition.

Thus in the first order (*A. erraticæ*) the greatest number of the species are entirely composed of similar segments; in other words, the repetition is manifested from segment to segment. In some others the repetition only takes place from pair to pair of segments, at least on the greater part of the body. The former constitute for me the *suborder* of *Erraticæ propriæ*; the latter that of the *Erraticæ aberrantes.*

In the same way, among the Sedentariæ, a very small group, including only the *Chætopterea,* shows us the law of repetition failing in the segments of a single region; it constitutes for me the suborder of *Sedentariæ aberrantes.* In the second suborder of this division the law of repetition is observed in the different regions of the body; it includes the *S. propriæ.*

As a matter of course, in the establishment of the families, I have taken into account anatomical and physiological as well as external characters. But in the table which I have the honour to place before the reader, I have had recourse solely to the latter, in order to facilitate the zoological study of the species. The armature of the mouth, the absence or presence of branchiæ, the position and form of the latter, the absence or the presence of certain appendages of the head or of the feet, the modifications of these latter, &c., have been employed successively in the order just indicated. This order itself was the consequence of the principle of the relative constancy of the characters. It has enabled me to characterize each family with precision, and to group them in such a manner as to bring into relief a certain number of general results, well fitted, it appears to me, to justify the method followed.

Thus, on glancing at the accompanying table, every naturalist will perceive that the divisions resulting from considerations derived solely from external characters are equally homogeneous from an anatomical point of view. He will also perceive that the totality of the families in the two orders subdivides into secondary groups corresponding to so many more or less important subtypes, of which the representatives are united; and, lastly, that the exceptional or *aberrant* types are also quite naturally brought to the notice of the reader. I may be permitted to dwell a little upon these considerations.

Leaving out of consideration for the present the Suborders I. and III., including the general aberrant types of the two great fundamental divisions, there remain, as composing the *Erraticæ propriæ,* thirteen families, and ten for the *Sedentariæ propriæ.* Let us first notice the former.

The presence of cephalic rotatory apparatus serving for locomotion, in the first place sets completely on one side the very exceptional type of the *Polyophthalmea.* The remaining twelve families represent the type of the *A. erraticæ* in all essential points.

These twelve families are themselves divided into two groups, remarkably distinct in many respects, although the table only indicates one difference, that presented by the armature of the mouth. The *Eunicea* and *Lumbrinerea* on the one hand, and on the other the ten other families, present, from an anatomical point of view, such marked contrasts, that it will probably some day be necessary to represent them in the classification itself, by forming a separate suborder with the two families just mentioned. Thus, to cite only a very striking fact, I will mention that, according to investigations of my own already of an old date, the stomatogastric nervous system originates upon the cerebrum itself in the *Eunicea* and *Lumbrinerea,* whilst it issues from the connective in the *Nereïdea,* the *Nephthydea,* the *Phyllodocea,* the *Glycerea,* &c. The digestive apparatus presents equally remarkable differences, extending not only to the armature, but even to the organization of the trunk.

The ten families with the buccal armature simple, or none, also divide into some well-marked secondary groups. Of these, the *Glycerea* alone form one. In them the head seems to attempt a repetition of the body on a small scale, and in the opposite direction. It is composed of more or less numerous segments, and thus departs completely from the ordinary type. It may be remarked that this morphological modification likewise coincides with very interesting anatomical peculiarities, among which I shall limit myself to citing the presence of distinct globules in the blood, the existence of branchiæ of an exceptional structure, the almost complete absence of interannular diaphragms, &c.

The *Glycerea* set on one side, we find two groups very distinctly characterized by the presence and absence of branchiæ. A perfectly similar fact had already presented itself in the group of Erraticæ with the buccal armature complicated. But, in the the latter, the disappearance of the branchiæ may be regarded as a simple fact of organic simplification coincident with others bearing especially upon the vascular apparatus. The type, moreover, remains the same in the arrangement of the nervous system and digestive apparatus. In point of fact, the *Lumbrinerea* are *degraded Eunicea.* It is otherwise with the Erraticæ with a simple buccal armature. We cannot, for example, regard the type of the *Nereïdea* as derived by degradation from the type *Nephthys*; for the former, in all respects equal to the latter, is superior to it in some particulars (such as the development of the trunk and of the stomatogastric nervous apparatus). Still less can we refer the *Nereïdea* to the *Nerinea* or the *Cirratulea* by considerations of the same nature. We are even led to see that, whilst in the Erraticæ with a complicated buccal armature the superiority belongs incontestably to the branchiate family, in those with a simple buccal armature the superiority reverts, on the contrary, to one at least of the abranchiate families (*Nereïdea*). Nevertheless, in both divisions, the branchiate and abranchiate species very evidently occupy the position of mutually *corresponding terms*, if we place ourselves at the systematic point of view of respiration.

From what has just been said, it follows that the Erraticæ with a complicated buccal armature form a remarkably natural division, inasmuch as the type, remaining the same, presents itself to the naturalist sometimes as being realized very completely, sometimes as degraded. The two families resulting from these different conditions are, moreover, very homogeneous. In the first, that of the *Eunicea*, which possesses branchiæ, these vary as regards their form and complication, without its being possible, however, to separate the genera from each other. The same intimate relations exist between the genera belonging to the abranchiate family (*Lumbrinerea*).

Nothing of this kind occurs among the Erraticæ with a simple buccal armature. Here, in the branchiate species, the least variation in the respiratory organ coincides with other modifications of sufficient importance for the multiplication and distinct separation of the families, and these modifications affect even the most central organs, the nervous system. The composition of the cerebrum and the mode of distribution of the nervous trunks are quite exceptional in the *Nephthydes*, which, in other respects, would closely approach the *Nereïdea* and the *Phyllodocea*; the *Nerinea* have the abdominal chain double, and in this respect resemble the best-characterized Sedentariæ (*Serpulæ* and *Sabellæ*); the *Cirratuli*, on the contrary, present abdominal ganglia which appear as if fused into a ribbon, which, again, reminds us of what exists in other Sedentariæ (*Clymene*). All these facts, and many others, indicate the existence of several distinct secondary types in this totality of branchiate Erraticæ with the buccal armature simple.

We find rather more heterogeneity in the species of the same division which are destitute of branchiæ. Here the *Nereïdea* may be regarded to a certain extent as the highest expression of a type to which belong the *Syllidea*, the *Hesionea*, and the *Phyllodocea*. Nevertheless the resemblance is not strongly marked, either internally or externally.

The *Syllidea*, a great number of which would perhaps depart less widely from the family with which they have been so long united, are, however, well distinguished by a striking degradation both internal and external. Moreover, in proportion as we are acquainted with it, this family of *Syllidea* acquires more and more the physiognomy of a little world apart, in which organic variability is displayed within still more extended limits than in the rest of the class, and which of itself presents examples of some of the most interesting physiological phenomena. I refer to the facts of geneagenesis which have hitherto only been observed in this family and in some small species of Sedentariæ of which we cannot make a distinct family.

To sum up, of the fifteen families which compose the order Erraticæ, seven possess branchiæ, and eight are destitute of those organs. The advantage in favour of the latter increases considerably when we descend to the details of species and genera. To the abranchiate types belong all those genera which are distinguished by the number of their species (such as *Polynoë*, seventy-seven species, *Nereïs*, eighty-one species). If we examine the order Sedentariæ from this point of view, we find that it is in quite a different case. Here, of eleven families, three only are deprived of branchial organs; eight possess well-marked branchiæ. Moreover, of the three abranchiate families (*Chætopterea*, *Tomopteridea*, *Clymenea*), there are two which together only include three genera with very few species; whilst among the branchiate families we find the richest in genera and species (*Terebellea* and *Serpulea**). From this comparison we may conclude that among the Erratic Annelides the type tends up to a certain point to be realized without special respiratory organs; whilst among the Sedentary Annelides the opposite tendency is most distinctly manifested.

In both orders we meet with species bearing branchiæ on the head, and others bearing them on the body. But in the Erraticæ the former form only a single family, composed of a small number of genera and species (*Chloræmea*†); in the Sedentariæ, on the contrary, the family which presents this peculiarity is much richer in genera and species (*Serpulea*). Moreover the *Chloræmea*, by the totality of their organization, and especially by the entirely exceptional arrangement of their digestive apparatus, constitute a truly *aberrant group* in the midst of the other families of the order. On the contrary, the Sedentariæ with cephalic branchiæ probably present the most complete realization of the type of the order to which they belong.

If we were better acquainted with the organization of the Sedentariæ with abdominal somatic branchiæ, we might probably be

* The *Sabellæ* and allied genera belong, in my opinion, to this family.

† With me the buccal ring forms part of the head.

able to show that the converse is equally true. But here the most important type, that of the *Ariciea,* is wanting, and our data are sufficient only as regards the *Arenicolea.* Now, to judge from this example, we may say that the species which present this peculiarity depart in certain respects from the general type of the class, and are sufficiently removed from the type of the order to have led to their having been often removed from it.

Savigny placed the *Ariciæ* among his Néréidés (*Erraticæ*). He has been imitated by Cuvier, Blainville, Audouin and Edwards, Grube, &c. Most of these authors have referred the *Arenicolæ* and the *Opheliæ* to the same type. On the other hand, the *Siphostomata,* the *Pherusæ,* &c., species of the family *Chloræmea,* have generally been placed by the side of species which enter into our order of Sedentariæ as established here.

Whilst acting otherwise than my predecessors, I can easily understand how they were led to the conclusions which I dispute. It is impossible to deny the resemblances which ally the *Chloræmea* to the best-characterized Sedentariæ. On the other hand, the *Arenicolæ,* the *Opheliæ,* and especially the *Ariciæ,* have certainly something which approximates them to the Erraticæ. But these relations in both cases are due to *analogies,* and not to *affinities.* The *Chloræmea* are *the representatives of the type of the Sedentariæ* in the midst of the true Erraticæ. The *Opheliea,* the *Arenicolæ,* and the *Ariciæ* in the same way are *the representatives of the Erraticæ* among the Sedentariæ. There is, so to speak, *reciprocity* between the two orders—each of them having in the other some species which recall it to mind. These species, up to a certain point, are *reciprocal terms* of one another.

The preceding examples perhaps will not suffice to lead all naturalists to admit the fact, here of fundamental importance, of this *reciprocity of representation,* and the consequences which flow from it for the appreciation of true *relations of affinity.* The following is another and a more conclusive one, because it bears in both orders upon families as well marked as possible, because the inverse modifications bearing upon the same organs are at once very simple and very striking, and because, whilst influencing one of the most essential characters of the order, they do not authorize the formation even of new families, but only of *tribes.*

The family of *Nereïdea* as circumscribed by me is certainly one of the most natural and best defined. Essentially it includes only the genera *Lycastis* and *Nereïs* of the old writers. Œrsted in describing the *Heteronereïdes,* and Blainville in founding the genus *Nereïlepas,* effected mere dismemberments relatively to Savigny. But from the point of view which has served me for the division of the Annelides in general, it will be seen that these two genera form, in reality, a small and very remarkable separate group. In fact, the law of repetition so generally applied in the Erraticæ, and so manifest in the *Nereïdes* proper, here undergoes a striking exception. In the *Heteronereïdes* especially, the foot, that fundamental organ, changes its form rapidly posteriorly in such a manner that the body presents two perfectly well-marked regions. Here, then, the essential character of the Sedentariæ makes its appearance. Is it possible from this fact alone to transport the *Heteronereïdes* to that order? Or should we even isolate them from the *Nereïdes*? A more careful examination shows that both these conclusions would be equally unjustified.

Thus anteriorly the *Heteronereïdes* are in all respects true *Nereïdes*, both externally and internally. The feet in particular are exactly the ordinary feet of the *Nereïdes*, to their very least details; and these feet are essentially arranged for walking. Posteriorly the body itself presents no change; it remains the body of a *Nereïs*. The feet alone are modified so as to become powerful organs of natation. But while becoming adapted to this new function, they still retain their original type. We find in them all the elements of the anterior feet, occupying the same position under slightly different forms, and complicated only by a small number of accessory parts.

The differences between the anterior and posterior regions are therefore more apparent than real; but the division of the body into two distinct parts exists none the less. There is here evidently as it were a reflexion of the type of the Sedentariæ making its appearance in the midst of one of the families most clearly belonging to the Erraticæ.

The *Terebellea* and the *Serpulea* present us with the exact *réciproque* of the preceding fact. In both we find a certain number of species which, as regards the two anterior regions (the head and thorax), completely realize the type of their family, but in which the posterior region of the abdomen no longer presents in its rami and setæ those changes which characterize it in the normal Sedentariæ, in the *Serpulea* proper. In these exceptional species the abdominal feet remain similar to those of the thorax, so that from one extremity of the body to the other we find no more distinct regions than in the Erraticæ. Nevertheless, in all other respects these species remain faithful to their types.

Thus these abnormal Sedentariæ are true *Terebellea*, or true *Serpulea* in their anterior portion, as the *Heteronereïdes* are true *Nereïdea* in the same part of the body. In the posterior region the *Heteroterebellea* and *Heteroserpulea* approach the Erraticæ, as the *Heteronereïdes* approach the Sedentariæ in the same region.

In the latter the resemblance is produced by the *appearance of an exceptionally distinct region*; in the former by the *disappearance of a normally distinct region*. In all it is in the feet that the unusual characters are manifested. Lastly, however striking these characters may be, they are the result of modifications which are really very simple, and which in no respect alter the special type of the organs affected.

It seems to me impossible to imagine a more complete fact of reciprocity, or one better fitted to illustrate the nature of the relations resulting from modifications of this kind. It is evident that we cannot place the *Heteronereïdes* among the Sedentariæ, any more than we can arrange a *Heteroterebelea* among the Erraticæ. We cannot even isolate the former from the family of the *Nereïdea*, or the second from that of the *Terebellea*, without the rupture of the most evident *affinities*. But these affinities are here complicated by *relations of analogy*. In the case before us the latter are much less marked than the affinities, and no one will hesitate as to the place belonging to the species under consideration. On the other hand, the *analogies* become stronger, and the *affinities* less marked in the *Arenicolæ*, *Ariciæ*, and *Opheliæ*; and this has has led to the confounding of these two sorts of relations, and to the placing of these three last genera among the Erraticæ, whilst the *Siphostomata* (*Chloræmea*) were removed to the Sedentariæ.

The reader will now understand, I hope, what I mean by the words *reciprocal terms*, and the nature of the relations which these terms present either with the group to which they sometimes seem to belong, or with that to which they belong in reality. I believe that the investigation of facts of the same kind must, in certain cases, be of considerable importance, and that such will be discovered elsewhere than among the Annelides —for example, among the Acephalous Mollusca.

It is not uninteresting to inquire which of the two orders into which the Annelides are divided makes the most efforts, so to speak, to establish these *relations of reciprocity*. The share is, in fact, very unequal: among the Erraticæ a single family betrays in its entirety certain characters which place it in the category of groups of which we are now speaking (*Chloræmea*). Among the Sedentariæ we find three (*Arenicolea*, *Ariciea*, and *Serpulea*), and perhaps a fourth (*Leucodorea*). In the first order a single family must be divided into tribes, in consequence of modifications which this type undergoes in the direction now under consideration (*Nereïdea*). We find two of these in the second (*Terebellea*, *Serpulea*); moreover, in both of them the number of heteromorphous genera is much greater than in the *Nereïdea*.

It will be seen, I hope, from what precedes, that the *reciprocal terms* are very distinct from *corresponding terms,* although the existence of the latter depends equally upon considerations derived from *analogy,* and not from *affinity.* There is *correspondence* when, in two great groups more or less remote, we find *similar* and not *inverse* modifications being produced. For example, the branchiate and abranchiate Sedentariæ are in a general way and in certain respects the *corresponding terms* of the branchiate and abranchiate Erraticæ. Nevertheless in this case the organic and morphological differences are sometimes great enough at least to dissemble these analogies. And yet, on close examination, it is difficult not to be struck by the fact that in both orders the respiratory organs present extremely similar modifications. Thus, at the first glance, the cephalic branchiæ of the *Chlorœmea* resemble those of certain low Sedentariæ*; the arborescent somatic branchiæ of certain *Amphinomea* evidently correspond with the branchiæ situated in the same region of the body, and presenting the same form, in the *Arenicolea;* and I may say the same of the branchiæ of the *Nephthydea* and *Nerinea* as compared with those of the *Ariciea* and *Hermellea.*

But it is especially in the details of certain families, and when the genera become numerous, that we see numerous *corresponding terms* make their appearance. We may judge of this by a mere glance at the table of *Syllidea.* Here the number of well-characterized genera rises to thirty-one, and from group to group we see repeated the absence or the presence of frontal lobes, the same number of antennæ, tentacles, eyes, &c. These groups and genera are, in every acceptation of the word, the *analogues,* or the *corresponding terms* of each other.

The frequency of this kind of relations results from a remarkable fact, presented by no class of the animal kingdom in so marked a manner as by the *Annelides.* In them the immense variety of secondary characters is obtained in the most simple manner, by modifications of the same nature, or even very often completely identical, repeating themselves in groups which are otherwise distinguished by well-marked differences, in such a manner that a very considerable number of results is usually obtained with a truly marvellous economy of processes. The *Syllidea,* the *Terebellea,* and the *Serpulea* offer us remarkable examples of this fact. In the *Terebellea* in particular, the three known heteromorphous genera are the exact repetition of three normal genera, and are distinguished only because they have in common the kind of modifications which I have indicated above.

* These resemblances are, however, more apparent than real; for the branchiæ of the *Chlorœmea* issue from the buccal ring, and not from the head properly so called.

Nowhere, I think, can we point out so complete a manifestation of the *law of economy* upon which M. Milne-Edwards has very justly insisted in his 'Essai de Zoologie générale.'

Reciprocal terms also often make their appearance in the families, and from tribe to tribe; but it will be understood that examples of them are rare, precisely because, the families being very natural, there are but few that I have been obliged to subdivide. Indeed, properly speaking, I only know of one truly worthy of attention, namely that presented by the family *Serpulea*. Here the small group of *Sabellea* with a calcareous tube, compared with the other representatives of the *Sabella*-type, presents a remarkable exception, which assimilates it to the true *Serpulea*, all of which have tubes of this nature. Hence many authors have arranged the *Protulæ* by the side of the latter and far from the *Sabellæ*, with which they have such evident relations in their organization. On the other hand, the genus *Filigrana*, although composed of species which inhabit a calcareous tube, does not possess true opercula, and is related in other respects to the *Sabellea*. Although not so evident as in the cases previously cited, the reciprocity cannot be overlooked here.

It may be remarked that, as regards the form and arrangement of the branchiæ, the *Protulæ* and the *Psygmobranchi* (*Sabellea* with calcareous tubes) precisely repeat the two arrangements presented by the *Serpulæ*, the *Vermiliæ*, and the *Cymospiræ* (true *Serpulea*), so that they play the double part of reciprocal and corresponding terms.

In glancing over the various tables of the families, the reader will easily remark that the characters placed in the first rank are far from being always derived from the same organs. Most frequently the feet, or the totality of the body, have served me as a starting-point; but sometimes the cephalic appendages, sometimes the number and arrangement of the branchiæ, &c., the proboscis, or even the eyes have furnished me with the most general characters. This is because, in fact, in the class of Annelides as in the animal kingdom in general, the same apparatus does not retain throughout an identical and constant value as a means of characterization. It is evident, for example, that when in the whole of a family, as in the *Eunicea*, the feet are uniformly uniramose, furnished with two cirri, and armed with setæ modelled on the same type, we cannot find in them the characters of groups or genera; at the utmost they will serve for the distinction of the species. On the contrary, in the *Syllidea*, in which the same organs become progressively degraded until they only present a small setigerous mamilla, the naturalist finds excellent characters in their successive modifications affecting one of the most essential parts of the body.

I will terminate these generalities by a last observation. The simple statement of the preceding facts would suffice to enable us to conclude with certainty that the relations existing between the different groups of the class of Annelides are extremely multifarious. Even if we confine ourselves to the families, it must be evident that any linear classification is absolutely incapable of giving a real idea of these relations; and a glance at the following Table places this conclusion beyond a doubt. We cannot arrange these twenty-six families either in a single or in several series without the interruption of zoological relations more or less intimate. The arrangement on a single plane attempted by Grube is equally incapable of giving even an approximate idea of these relations. To arrive at this, it would be indispensable to have recourse to the multiple superposed planes so justly proposed by M. Chevreul.

The consequence to be drawn from this fact is, that there always enters a certain arbitrary element into the relative position of the groups which the necessities of *nomenclature* compel us to arrange in a series. I can therefore easily understand that some of my *confrères* may find fault with the order that I have adopted; nevertheless I think I may say that an arrangement which enables us to ascertain, even by a very rapid examination, the principal general facts above indicated, must at least present some advantages.

Class ANNELIDA.

(2 Orders, 4 Suborders, 26 Families.)

Order I. Erraticæ.

Regions of the body similar.

I. Segments dissimilar	Suborder I. E. ABERRANTES.
A. With elytra	1. *Aphroditea.*
B. Without elytra	2. *Palmyrea.*
II. Segments similar or subsimilar	Suborder II. E. PROPRIÆ.
A. No rotatory apparatus.	
a. Buccal armature complex.	
* With branchiæ	3. *Eunicea.*
† Without branchiæ	4. *Lumbrinerea.*
b. Buccal armature simple or none.	
* Head of ordinary form.	
α. With true branchiæ.	
a. Branchiæ somatic.	
** Branchiæ arborescent	5. *Amphinomea.*
†† Branchiæ cirriform, short.	
αα. No true tentacles	6. *Nephthydea.*
ββ. With true tentacles	7. *Nerinea.*
§§ Branchiæ cirriform, clongated	8. *Cirratulea.*
b. Branchiæ cephalic	9. *Chlorœmea.*
β. No true branchiæ.	
a. One pair of jaws and some denticles	10. *Nereïdea.*

b. Jaws scarcely ever present, sometimes denticles, never both together.
** Cirri simple.
1. Trunk not exsertile .... 11. *Syllidea.*
2. Trunk exsertile .... 12. *Hesionea.*
†† Cirri lamellar .... 13. *Phyllodocea.*
† Head conical and composed of distinct segments............................ 14. *Glycerea.*
B. A rotatory apparatus .... 15. *Polyophthalmea.*

Order II. Sedentariæ.

Regions of the body dissimilar.

I. Segments of one or more regions very dissimilar to each other .... Suborder III. S. aberrantes.
16. *Chætopterea.*
II. Segments of the different regions always similar or subsimilar to each other ....Suborder IV. S. propriæ.
A. No branchiæ.
a. No setæ on the feet .... 17. *Tomopteridea.*
b. With setæ on all or nearly all the feet ...... 18. *Clymenea.*
B. With branchiæ.
a. Branchiæ somatic.
* Branchiæ abdominal or abdominal and thoracic.
α. Branchiæ arborescent................ 19. *Arenicolea.*
β. Branchiæ cirriform or laciniate.
a. With no prehensile cirri or tentacles.
** Rami not very distinct .... 20. *Opheliea.*
†† Rami very distinctly marked...... 21. *Ariciea.*
b. Without prehensile cirri, but with tentacles......................... 22. *Leucodorea.*
c. With prehensile cirri .... 23. *Hermellea.*
† Branchiæ exclusively thoracic.
α. Operculum formed of setæ............ 24. *Pectinarea.*
β. No operculum...................... 25. *Terebellea.*
b. Branchiæ cephalic .... 26. *Serpulea.*

Family 1. Aphroditea. (15 genera.)

I. Elytra only dorsal.
A. Elytra confined to a portion of the feet.
a. No dorsal cirri .... 1. *Pholoë.*
b. With dorsal cirri.
* Dorsal cirri alternating with the elytra.
α. Jaws none or rudimentary.
a. With hairs on the feet .... 2. *Aphrodite.*
b. No hairs on the feet.
** 3 antennæ .... 3. *Hermione.*
†† 2 antennæ .... 4. *Milnesia.*
β. Jaws corneous.
a. 4 antennæ .... 5. *Polyodontes.*
b. 3 antennæ
** With pseudobranchial tubercles .. 6. *Acoëtes.*
†† With no pseudobranchial tubercles.
1. Elytra all along the body ...... 7. *Polynoë.*

2. Elytra leaving the posterior part of the body naked............ 8. *Lepidonotus.*
c. 2 antennæ......................... 9. *Iphione.*
† Dorsal cirri on all the feet.
α. Elytra covering the whole body.
a. 3 antennæ .... 10. *Sthenelaïs.*
b. 2 antennæ .... 11. *Sigalion.*
c. 1 antenna......................... 12. *Psammolyce.*
β. Elytra leaving the posterior part naked.. 13. *Hemilepidia.*
B. Dorsal cirri on all the feet .... 14. *Pelogenia.*
II. Elytra dorsal and abdominal .... 15. *Gastrolepidia.*

GENERA INCERTÆ SEDIS 2: *Hermenia, Eumolphe.*

Family II. **Palmyrea** (4 genera).

I. Segments not numerous.
A. Feet biramose.
a. 1 antenna .... 1. *Palmyra.*
b. 2 antennæ.............................. 2. *Chrysopetalon.*
B. Feet uniramose .... 3. *Paleanotus.*
II. Segments numerous .... 4. *Bhawania.*

Family III. **Eunicea** (4 genera).

I. Antennæ 5.
A. With tentacles .... 1. *Eunice.*
B. Without tentacles .... 2. *Marphysa.*
II. Antennæ 7.
A. With tentacles .... 3. *Diopatra.*
B. Without tentacles .... 4. *Onuphis.*

Family IV. **Lumbrinerea** (8 genera).

I. Antennæ wanting.
A. No dorsal cirrus .... 1. *Lombrinereïs**.
B. With a dorsal cirrus .... 2. *Notocirrus.*
II. Antenna single.
A. No dorsal cirrus .... 3. *Blainvillea.*
B. With a dorsal cirrus .... 4. *Nematonereïs.*
III. Antennæ 2................................ 5. *Œnone.*
IV. Antennæ 3.
A. Head free................................. 6. *Lysidice.*
B. Head concealed .... 7. *Aglaura.*
V. Antennæ 5 .... 8. *Plioceras.*

GENUS INCERTÆ SEDIS: *Zygolobus.*

Family V. **Amphinomea** (7 genera).

I. Feet biramose.
A. With antennæ and tentacles.
a. Branchiæ pinnatifid....................... 1. *Chloë.*
b. Branchiæ arborescent .... 2. *Amphinome.*
c. Branchiæ cirriform .... 3. *Linophera.*
B. With an antenna.......................... 4. *Euphrosyne.*

---

* *Lumbriconereïs,* Blainville.

II. Feet uniramose.
  A. With antennæ and tentacles................ 5. *Hipponoë.*
  B. Antennæ and tentacles wanting.
    a. Branchiæ in rows........................ 6. *Lophonota.*
    b. Branchiæ in groups...................... 7. *Didymobranchus.*

Genera incertæ sedis 2: *Aristenia, Cryptonotus.*

Family VI. **Nephthydea** (3 genera).

I. Head bearing antennæ.
  A. Antennæ 4 .... 1. *Nephthys.*
  B. Antennæ 2 .... 2. *Portelia.*
II. Antennæ wanting .... 3. *Diplobranchus.*

Family VII. **Nerinea** (6 genera).

I. Feet biramose.
  A. Feet without cirri.
    a. No uncini .... 1. *Nerine.*
    b. Uncini present.......................... 2. *Uncinia.*
  B. Feet bearing cirri.
    a. Inferior cirri only...................... 3. *Aonis.*
    b. Inferior and superior cirri.
      * No eyes .... 4. *Malacocera.*
      † Eyes present .... 5. *Colobranchus.*
II. Feet uniramose .... 6. *Pygospio.*

Genera incertæ sedis 2: *Pygophyllum, Clytia.*

Family VIII. **Cirratulea** (6 genera).

I. Branchiæ on nearly all the segments.
  A. Branchiæ both pedal and dorsal.
    a. The two sorts of branchiæ appearing at the same time .... 1. *Cirratulus.*
    b. Pedal branchiæ preceding the dorsal ...... 2. *Audouinia.*
  B. Branchiæ pedal only .... 3. *Cirrinereïs.*
II. Branchiæ only on the first segments.
  A. No tentacles.............................. 4. *Dodecaceræa.*
  B. One pair of tentacles .... 5. *Heterocirrus.*
  C. Three pairs of tentacles .... 6. *Nagaranseta.*

Family IX. **Chloræmea** (2 tribes, 5 genera).

I. Body covered with hairs (Tribe *Chloræmea prop.*) 1. *Chloræma.*
II. Body without hairs, or with very short hairs. (Tribe *Chloræmea nuda*).
  A. Head protected by setæ.
    a. All the feet biramose.
      * Head very distinct .... 2. *Siphostomum.*
      † Head indistinct .... 3. *Pherusa.*
    b. Only the first feet biramose .... 4. *Lophiocephala.*
  B. Head entirely uncovered .... 5. *Brada.*

Genera incertæ sedis 4: *Spinther, Flemingia, Stylaroïdes, Tecturella.*

Family X. Nereïdea (2 tribes, 4 genera).

I. Body forming one region (Tribe *Nereïdea prop.*).
  A. Feet uniramose .... 1. *Lycastis.*
  B. Feet biramose .... 2. *Nereis.*
II. Body forming two regions (Tribe *Heteronereïdea*).
  A. All the setæ like those of *Nereïs* .... 3. *Nereïlepas.*
  B. Part or the whole of the setæ reniform ...... 4. *Heteronereïs.*

Genera incertæ sedis 2: *Micronereïs, Zothea.*

Family XI. Syllidea (31 genera).

I. Feet moveable.
  A. With dorsal and abdominal cirri.
    a. No tubercles on the body.
      * Gizzard armed.
        α. 4 antennæ.
          a. 12 tentacles .... 1. *Syllidia.*
          b. No tentacles .... 2. *Prionognathus.*
        β. 3 antennæ.......................... 3. *Gnathosyllis.*
      † Gizzard unarmed.
        α. Head and buccal segment distinct.
          a. With frontal lobes.
            ** Antennæ 5 .... 4. *Pterosyllis.*
            †† Antennæ 4 .... 5. *Brania.*
            §§ Antennæ 3.
              1. Tentacles 8 .... 6. *Procoma.*
              2. Tentacles 4.
                Eyes 4 .... 7. *Syllis.*
                Eyes 6 .... 8. *Ehlersia.*
              3. Tentacles 0 .... 9. *Exogone.*
            ‡‡ Antennæ 2 .... 10. *Grubea.*
          b. No frontal lobes.
            ** Antennæ 4.
              1. Tentacles 16 .... 11. *Kefersteinia.*
              2. Tentacles 0 .... 12. *Eucerastes.*
            †† Antennæ 3.
              1. Tentacles 4.
                Eyes 4 .... 13. *Autolytus.*
                Eyes 0 .... 14. *Trichosyllis.*
              2. Tentacles 2 .... 15. *Heterosyllis.*
              3. Tentacles 0 .... 16. *Gossia.*
        β. Head and buccal segment confounded.
          a. With frontal lobes.
            ** 3 antennæ and 4 tentacles determinable .... 17. *Claparedia.*
            †† Antennæ and tentacles indeterminable
              8........ 18. *Cystonereïs.*
              5........ 19. *Sphærosyllis.*
              4........ 20. *Oophylax.*
              3........ 21. *Isosyllis.*
          b. No frontal lobes; antennæ and tentacles indeterminable
              7........ 22. *Thylaciphora.*
              5........ 23. *Ambliosyllis.*
              0........ 24. *Tetraglena.*
    b. With tubercles on the body .... 25. *Eurysyllis.*
  B. No abdominal cirri.
    a. With frontal lobes .... 6. *Sylline.*

b. No frontal lobes.
* Antennæ 3.
α. Tentacles 4 .... 27. *Myrianida.*
β. Tentacles 2 .... 28. *Ioida.*
† Antennæ 2 .... 29. *Mycrosyllis.*
C. Neither dorsal nor abdominal cirri .... 30. *Schmardia.*
II. Feet immoveable .... 31. *Dujardinia.*

Genera incertæ sedis 17 : *Polybostricus, Sacconereïs, Polynice, Diplocercæa, Photocharis, Macrochæta, Syllia, Crithida, Anisoceras, Staurocephalus, Sigambra, Diplotis, Ephesia, Sphærodorum, Pollicita, Apærosyllis, Cirroceros.*

Family XII. **Hesionea** (10 genera).

I. Feet uniramose.
A. Size comparatively large.
a. Segments very numerous .... 1. *Myriana.*
b. Segments few.
* Antennæ 4 .... 2. *Hesione.*
† Antennæ 2 .... 3. *Fallacia.*
B. Size small.
a. Antennæ 4.
* Tentacles 14 .... 4. *Peribea.*
† Tentacles 8 .... 5. *Psamathe.*
§ Tentacles 6 .... 6. *Lopadorhynchus.*
b. Antennæ 5.
* Tentacles 12 .... 7. *Podarcus.*
† Tentacles 10 .... 8. *Mania.*
II. Feet biramose.
A. Antennæ 8 .... 9. *Pseudosyllis.*
B. Antennæ 4 .... 10. *Castalia.*

Genera incertæ sedis 5 : *Pisione, Oxydromus, Halimede, Cirrosyllis, Orseïs.*

Family XIII. **Phyllodocea** (2 tribes, 12 genera).

I. Eyes of ordinary size (Tribe *Phyllodocea prop.*).
A. Feet uniramose.
a. Antennæ 5.
* Tentacles 10 .... 1. *Kinbergia.*
† Tentacles 8 .... 2. *Eulalia.*
§ Tentacles 6 .... 3. *Eracia.*
b. Antennæ 4.
* Tentacles 8 .... 4. *Phyllodoce.*
† Tentacles 6 .... 5. *Carobia.*
§ Tentacles 4 .... 6. *Eteone.*
‡ Tentacles 2 .... 7. *Lugia.*
c. Antennæ 2 .... 8. *Macrophyllum.*
B. Feet biramose .... 9. *Notophyllum.*
II. Eyes very large (Tribe *Phyllodocea Alciopea*).
A. Feet bearing two glandular organs .... 10. *Alciope.*
B. Feet with a single glandular organ.
a. Antennæ 5 .... 11. *Krohnia.*
b. Antennæ 0 .... 12. *Torrea.*

Genera incertæ sedis 2 : *Eumenia, Liocope.*

Family XIV. **Glycerea** (3 genera).

I. Feet biramose.
  A. Rami approximate........................ 1. *Glycera.*
  B. Rami distant .... 2. *Goniada.*
II. Feet uniramose .... 3. *Hemipoda.*

GENERA INCERTÆ SEDIS 2: *Glycinide, Proboscidia.*

Family XV. **Polyophthalmea** (1 genus, *Polyophthalmus*).

Family XVI. **Chætopterea** (1 genus, *Chætopterus*).

GENUS INCERTÆ SEDIS: *Spiochætopterus.*

Family XVII. **Tomopteridea** (1 genus, *Tomopteris*).

Family XVIII. **Clymenea** (2 tribes, 10 genera).

I. Body in three regions (Tribe *Clymenea prop.*).
  A. With an anal funnel.
    a. No respiratory cæca.
      * Cephalic plate developed .... 1. *Clymene.*
      † Cephalic plate wanting or rudimentary.... 2. *Leiocephalus.*
    b. Respiratory cæca present .... 3. *Johnstonia.*
  B. With an anal plate.
    a. With a cephalic plate .... 4. *Maldane.*
    b. No cephalic plate .... 5. *Petaloproctus.*
  C. Neither plate nor funnel .... 6. *Ammochares.*
II. Body in two regions (Tribe *Clymenea degrad.*).
  A. Head truncate............................. 7. *Clymenidia.*
  B. Head not truncate.
    a. Head acute.
      * Posterior region with simple setæ .... 8. *Arenia.*
      † Posterior region with only uncini .... 9. *Ancistria.*
    b. Head clavate .... 10. *Clymenia.*

GENERA INCERTÆ SEDIS 3: *Capitella, Notomastus, Dasybranchus.*

Family XIX. **Arenicolea** (2 genera).

I. Branchiferous feet consecutive .... 1. *Arenicola.*
II. Branchiferous feet separated by abranchiate ones 2. *Chorizobranchus.*

GENERA INCERTÆ SEDIS 2: *Scalibregma, Polyphysia.*

Family XX. **Opheliea** (3 genera).

I. Feet with a single branchia.
  A. On the middle region....................... 1. *Ophelia.*
  B. Nearly on the whole body.................. 2. *Travisia.*
II. Feet with several branchiæ .... 3. *Branchoscolex.*

GENERA INCERTÆ SEDIS 3: *Ophelina, Ammotripane, Sclerocheilus.*

Family XXI. **Ariciea** (5 genera).

I. Trunk of ordinary form.
  A. Lower ramus of anterior feet bearing uncini.
    a. No antennæ .... 1. *Aricia.*
    b. With antennæ .... 2. *Orbinia.*

B. Lower ramus of anterior feet with simple setæ.
a. No caruncle .... 3. *Scoloplos.*
b. Caruncle present .... 4. *Porcia.*
II. Trunk divided into foliaceous lobes............ 5. *Anthostomum.*

Genera incertæ sedis 4: *Magelona, Gisela, Theodisca, Hermandura.*

Family XXII. **Leucodorea** (5 genera).

I. Feet different.
A. Feet biramose.
a. Branchiæ superior .... 1. *Leucodore.*
b. Branchiæ inferior.
* Third segment abnormal .... 2. *Disoma.*
† Fifth segment abnormal .... 3. *Polydora.*
B. Feet uniramose .... 4. *Spione.*
II. Feet similar .... 5. *Spiophanes.*

Genus incertæ sedis: *Spio.*

Family XXIII. **Hermellea** (3 genera).

I. Body in 3 regions.
A. Operculum with 3 ranges of setæ............ 1. *Hermella.*
B. Operculum with 2 ranges of setæ............ 2. *Pallasia.*
II. Body in 2 regions .... 3. *Centrocorone.*

Genera incertæ sedis 2: *Branchiosabella, Uncinochæta.*

Family XXIV. **Pectinarea** (2 genera).

I. Branchiæ 2 pairs .... 1. *Pectinaria.*
II. Branchiæ 3 pairs........................... 2. *Scalis.*

Family XXV. **Terebellea** (3 tribes, 11 genera).

I. Body in 2 regions (*Terebellea prop.*).
A. With dorsal branchiæ (Tribe *T. branchiata*).
a. Dorsal branchiæ arborescent { 3 pairs .... 1. *Terebella.*
2 pairs .... 2. *Physelia.*
1 pair .... 3. *Idalia.* }
b. Dorsal branchiæ pectinated, median .... 4. *Terebellides.*
c. Dorsal branchiæ cirriform.
* Buccal cirri simple .... 5. *Phenacia.*
† Buccal cirri pinnate .... 6. *Sabellidis.*
d. Dorsal branchiæ cirriform and pinnate...... 7. *Isolda.*
B. No dorsal branchiæ (Tribe *T. abranchiata*).... 8. *Apneumea.*
II. Body in one region (Tribe *Heteroterebellea*).
A. Dorsal branchiæ arborescent { 3 pairs ...... 9. *Heteroterebella.*
2 pairs ...... 10. *Heterophyselia.* }
B. Branchiæ cirriform........................ 11. *Heterophenacia.*

Genera incertæ sedis 7: *Rhytocephalus, Amphicteïs, Polycirrus, Sabellina, Anisomelas, Piratesa, Lumara.*

Family XXVI. **Serpulea** (3 tribes, 21 genera).

I. Head without an operculum.
A. Regions distinct (Tribe *S. Sabellea*).
a. Tube membranous.
* Branchiæ with a circular base.
α. Cirri free.
a. No caudal eyes.......................... 1. *Sabella.*

b. Caudal eyes.
1. Antennæ present.
With a collar .... 2. *Oria.*
With no collar .... 3. *Amphiglena.*
2. No antennæ .... 4. *Fabricia.*
β. Branchial cirri united .... 5. *Chonea.*
† Branchiæ with a spiral base.
α. A single branchia in spiral .... 6. *Spirographa.*
β. Both branchiæ in spiral .... 7. *Distylia.*
b. Tube calcareous.
* Branchiæ with a spiral base .... 8. *Protula.*
† Branchiæ with a circular base............ 9. *Psygmobranchus.*
B. Regions indistinct (Tribe *S. Heterosabellea*).
a. With feet.
* Branchial cirri free.
α. With barbules .... 10. *Anamœbæa.*
β. No barbules .... 11. *Amphicorine.*
† Branchial cirri united .... 12. *Myxicola.*
b. Without feet.
* Branchiæ with barbules .... 13. *Gymnosoma.*
† Branchiæ without barbules .... 14. *Phoronis.*
II. Head with an operculum (Tribe *Serpulea prop.*).
A. Two or more false opercula .... 15. *Filigrana.*
B. With true opercula.
a. Tube completely rolled up .... 16. *Spirorbis.*
b. Tube more or less sinuous.
* Two symmetrical opercula .... 17. *Codonytes.*
† One operculum.
α. Tube free .... 18. *Ditrupa.*
β. Tube attached.
a. Branchiæ with a circular base.
1. Operculum corneous .... 19. *Serpula.*
2. Operculum corneo-calcareous...... 20. *Vermilia.*
b. Branchiæ with a spiral base .... 21. *Cymospira.*

Genera incertæ sedis 5: *Spiramella, Apomatus, Spiroglypha, Stoa, Vermiculum.*

Class GEPHYREA.

(2 Orders, 7 Families.)

I. Body bearing setæ .... Order I. G. armata.
A. Several anterior bundles .... 1. *Sternaspidea.*
B. Two simple anterior setæ.
a. With posterior setæ...................... 2. *Echiurea.*
b. No posterior setæ .... 3. *Bonellea.*
II. Body not bearing setæ .... Order II. G. inermia.
A. Anus terminal.
a. With external posterior branchiæ.......... 4. *Priapulea.*
b. No external posterior branchiæ .... 5. *Loxosiphonea.*
B. Anus dorsal.
a. Scutes present .... 6. *Aspidosiphonea.*
b. No scutes .... 7. *Sipunculea.*

Family I. Sternaspidea (genus *Sternaspis*).

Family II. Echiurea (genus *Echiurus*).

Family III. **Bonellea** (2 genera).

I. Cephalic appendage simple	1. *Thalassema.*
II. Cephalic appendage bifurcate	2. *Bonellia.*

Genera incertæ sedis 3 : *Ochetostoma, Lesinia, Halicryptus.*

Family IV. **Priapulea** (3 genera).

I. Branchiæ supported on a stem	1........	1. *Priapulus.*
	2........	2. *Chætoderma.*
II. Branchiæ borne on a prolongation of the body ..		3. *Trypanius.*

Family V. **Loxosiphonea** (2 genera).

I. Body bearing 1 scute	1. *Loxosiphon.*
II. Body bearing 2 scutes	2. *Diesingia.*

Family VI. **Aspidosiphonea** (genus *Aspidosiphon*).

Family VII. **Sipunculea** (2 genera).

I. Buccal cirri simple	1. *Sipunculus.*
II. Buccal cirri pinnate or ramified	2. *Dendrostomum.*

Generæ incertæ sedis 2 : *Ascosoma, Anoplosomatum.*

[To be continued.]

II.—*Carcinological Gleanings.*—No. II. By C. Spence Bate.

[Plate II.]

Brachyura.

Achæus Cranchii.

This species is spoken of by Bell as being rare, two specimens only having been recorded—one from Falmouth, the second from the south coast of Ireland. Certainly this little Crab is by no means uncommon off the coast of South Devon, in depths of from 6 to 20 fathoms of water, as we have taken it with the dredge in Plymouth Sound, and frequently had it brought in by the trawlers.

Among the specimens that we dredged, two were taken from about 6 fathoms of water, near the Knap buoy, off the western end of the Plymouth Breakwater, which appear to belong to a very distinct variety. Our attention was first drawn to it from observing a peculiarity in its habit, differing from that of the known species, which is that it covers itself with weed, as we know is commonly done by animals of the allied genus *Pisa.*

Certainly in *Pisa* this is no accidental circumstance, since all the spines are sharp-pointed and curved, thus forming strong hooks, on which hang the various kinds of weed.

My friend Mr. Hamilton Whiteford informed me some time since that he had in his aquarium a crab of this genus, which, having cast its skin in confinement, he observed to gather pieces of weed from the surrounding rocks, and with its claws place them on the spines, so decorating itself that to a very great extent it destroyed its natural appearance.

Some who have written on this habit have imagined this clothing of itself to be the result of an instinctive love of artificial decoration, innate in the creature. I am more inclined to believe that it arises from a sense of danger, and a consequent desire of the animal to conceal itself beneath such things as appear to hide and therefore protect it, than from any natural coxcombry inherent in the animal.

In the typical form of *Achæus Cranchii* the spines are straight —a circumstance that gives the animal generally a hairy appearance. In this variety the spines are all curved, and lie so close to the surface of the animal, that, to unassisted vision, the body and legs appear quite smooth; but closer inspection shows that these spines are all hooked, as in the genus *Pisa*. Careful observation of these two varieties of *A. Cranchii* fails, however, to detect, beyond the form of the spines, any very marked dissimilarity of form or structure sufficient to warrant their being arranged as specifically distinct.

ANOMURA.

Of the interesting genus of Soldier Crabs (*Pagurus*) six or seven species exist on the south coast of Devon, viz.:—

Pagurus Bernhardus.	*Pagurus lævis.*
—— *Prideauxii.*	—— *ulidianus.*
—— *cuanensis.*	—— *Dillwynii.*
—— *Hyndmanii.*	

Of the species known as *Pagurus ulidianus,* Mr. Bell, in his work on the British Crustacea, remarks "that it is extremely like the young of *P. Bernhardus;*" and certainly, until we can capture a specimen carrying ova, there is every reason to believe that the two are but different stages in the growth of the same animal.

Of *Pagurus Dillwynii* no specimen has hitherto been recorded since the one originally described in the 'Annals of Nat. Hist.' (1851), from a specimen taken on the coast of South Wales, near the Worms Head, Glamorganshire. So long a period has elapsed, that on more than one occasion we have thought it prudent to have a peep at the original specimen, to assure ourselves that we had not committed a mistake.

During this present summer, while on a visit at Teignmouth, observing a woman shrimping on the sandy beach, we requested to have a look at the contents of her bag, and were delighted to find, amongst a small catch of the common Shrimp, numerous specimens of *Pagurus Dillwynii*. After purchasing her entire stock, we hastened to the beach, and, within the margin of the incoming tide, took numerous specimens, which we kept alive for a short time. This, the prettiest of all the pretty genus, has the habit of burrowing in the sand; and it is probably owing to this circumstance that the animal has not been met with more frequently. But, curious to relate, since it has been found at Teignmouth, we have dredged it, in about 4 fathoms of water, in Bigberry Bay, and also taken a single specimen, in about 6 fathoms, as near to Plymouth as the mouth of the river Yealm.

An interesting point in the history of the development of this genus we have been enabled to make out: it is about the last week of April or the first of May that the larva appear most abundantly to quit the ova. Early in June we were enabled to capture many specimens of the young animal in various degrees of progressive development—a circumstance that has enabled us to determine that the genus *Glaucothoë*, founded on *G. Peronii*, and described by Prof. Milne-Edwards in the 'Ann. des Sc. Nat.' for March 1830, is none other than an immature stage of the genus *Pagurus*, at which period the little creature possesses all the characters of a Macrurous Decapod, and swims freely in the ocean, until, obliged by increasing age to take refuge in the cast-off shell of a univalve Mollusk, it sinks to the bottom, and commences life as a Hermit Crab.

Macrura.

In the genus *Palinurus* exists a curious and interesting structural condition of the inferior pair of antennæ, which, I believe, has never been pointed out.

In all Macrurous Decapoda the inferior pair of antennæ is furnished with a scale or articulated process (*scaphocérite* of Milne-Edwards), which is invariably situated at the distal extremity of the third joint of the peduncle. Now, in *Palinurus* this scale or squamiferous appendage is so incorporated with the wall of the peduncle as to exhibit its form on the surface only, thus demonstrating that the third and fourth joints of the peduncle are fused together; and the lateral scale is incorporated with it also. Pl. II. fig. 3 *c*.

Crangon.

In the elaborate memoir of the late Prof. Kinahan on the genus *Crangon* (Trans. Royal Irish Acad. vol. xxiv. p. 46) we think that either he has erroneously figured the common Shrimp (*C. vulgaris*), or the common Shrimp of the Irish coasts differs from the edible Shrimp of the English markets.

The small and delicate second pair of pereiopoda that Prof. Bell has described as being "nearly as long as the third," and figures rather shorter than the first pair, Dr. Kinahan has figured as long again as the first pair: the animal is also drawn more slender generally than is the common Shrimp. Neither can we see the desirability or convenience of the generic separation of those species that possess the second pair of pereiopoda short, from those that have the same appendages of somewhat greater length.

Caradina.

In adding this genus for the first time to the list of the British Crustacea, we do so merely in words, since it has, we believe, been long known under the name of *Hippolyte varians* of Leach. It is remarkable that this species should have so long remained misinterpreted, since it is recorded as abundant along the south coast of England, from Cornwall to Poole Harbour, as well as having been found extensively round the Irish coast.

Though the colour of the animal generally is a pale transparent green, having a darker line along the prima via, we have not unfrequently taken it of a deep claret-red. This variation in colour I am inclined to believe is due to the weed on which it has been recently feeding; for indubitably the colouring-matter is due to the fluids in circulation, and not to any pigment existing in the dermal tissues. It is probably from this variability of colour that the species has received its distinguishing name. We have occasionally taken this species when dredging at Plymouth, but never so abundantly as of late, in rather deeper water just outside the breakwater.

We had previously observed the peculiar robust-looking first pair of pereiopoda; but it was not until very recently that we discovered they had the structure which has been described as the character of the genus *Caradina*, in which the propodos articulates with the carpus, not centrally, but at the infero-anterior angle, and thus appears as a partially dislocated joint.

There is a second form, that appears to us to be specifically distinct from the preceding. It is more slender generally, and has the rostrum long and narrow, having two teeth above, one near the base, flanked by a lateral tooth on each side just above the orbit, and one near the apical extremity of the rostrum, which corresponds with one on the under side immediately beneath it; and in one specimen we saw a second tooth also, posterior to this last. To this species we give the name of

Caradina tenuis. Pl. II. fig. 1.

The distinction between this and the preceding species consists in the more slender proportions generally of the latter, and in the position of the teeth on the rostrum, which in *C. varians* has the basal tooth on the dorsal surface further from its base, and the infero-subapical tooth a little posterior to the supero-subapical tooth, whereas the tooth that is situated near the base of the inferior surface of the rostrum is in *C. tenuis* placed but little posterior to the subapical tooth.

In all other respects the two species agree; so that we think it not at all improbable that they may be but the two sexes of one species. To this supposition strength is given from the circumstance that, while we took numerous specimens of *C. varians,* most of which were carrying ova, none of the few specimens of *C. tenuis* were so. But to this negative evidence we have to oppose another of a negative character also, which is that we have no experience of any species of Prawns that bear such sexual distinction, both as to size and form. The length of *C. varians* is an inch, that of *C. tenuis* half an inch.

ISOPODA.

Some time since, Dr. Fritz Müller sent us some specimens of an Isopod which he has named *Sphæroma terebrans,* procured from timber that had been immersed in the sea; since which we have received, through Mr. Brisbane Neill, some very similar specimens from Capt. Mitchell, of the Madras Museum. A close examination is required to distinguish a specific character separating these from the Brazilian specimens; and I think that the only one that can be relied upon is, that the pointed and hook-shaped termination of the appendage of the mandible in Müller's specimens, is represented in those from Madras by a flat broad joint. I therefore think that, minor variations being taken into consideration, together with the distance of the two habitats, we do not err in considering the following a distinct species from that found by Fritz Müller. We therefore propose for it the name of

Sphæroma vastator. Pl. II. fig. 4.

The animal is of a long oval shape, without any distinct coxæ, and furnished with four longitudinal parallel rows of tubercles or blunt teeth on the three posterior somites of the pereion and the anterior portion of the pleon.

The *eyes* are round and prominent. The superior antennæ have the first joint of the peduncle broader than the second, which is very short and round; the third is twice as long as the second, but much shorter than the first, and the flagellum gradually tapers to an obtuse point, and is formed of several articuli, of which the first is much the longest. The inferior antennæ are subequal with the superior, being perhaps slightly longer.

The mandibles are robust, and furnished with strong pointed incisor teeth as well as a powerful molar tubercle, between which exists a process armed with six or seven strong, equal-lengthed, serrated spines, which are probably used in the tearing down of the wood into which the animal burrows. The secondary appendage to this organ is short and three-jointed; the third joint is the shortest and is nearly as broad as long; it is ciliated upon the flexile margin with hairs, which gradually increase in length towards the apex of the appendage.

The maxilliped, or third siagonopod, consists of five joints, of which the basal is longest and broadest, and carries the other four as an appendage, in this somewhat resembling the form of the second pair of gnathopoda in the Crabs.

The two pairs of gnathopoda and the first pair of pereiopoda resemble each other in form and size. They are slender and comparatively feeble appendages, and furnished on the anterior margin with long plumose hairs—suggesting, from their similarity of feature with the same appendages in *Arcturus*, that the latter is not such an anomalous Isopod as some carcinologists have supposed; the coxa is fused with the dorsal portion of the somite, and forms an overhanging lateral plate-like process; the basis and ischium are long and slender, and the latter is furnished with a thick row of plumose hairs on the anterior margin, which stands at right angles with the joint; the meros is short, anteriorly produced to a point, and furnished with a row of plumose hairs similar to the preceding; the carpus and propodos are short, slender, and furnished with short cilia on both anterior and posterior margins; the dactylos is short, curved, unguiculated, and armed with a small subapical tooth or secondary unguis.

The last four pairs of pereiopoda resemble each other in general form; they are very robust and strong, and are furnished on the anterior and posterior margins with rows of stout bushy hairs, which appear to increase in number and strength posteriorly, and some of which take a spinous character in the last two pairs, as on the distal extremity of the propodos, where they become spines with serrated margins.

The first three pairs of pleopoda consist of a broad basal supporting an inner and an outer plate, the former of which is broadest at the base and ciliated at the apex; the latter is pear-shaped, being largest near the apex, and furnished with a row of plumose cilia along the outer margin.

The fourth and fifth pairs of pleopoda have the inner and posterior plates converted into branchial organs, consisting of five or six foliaceous plates overlying one another. The posterior pair is marginal, and consists of a single branch on a strong and fixed peduncle, which is produced to a point directed inwardly; to the under surface of this, near the middle, articulates the solitary ramus; this is slightly curved and produced to a pointed apex, and is furnished with five or six sharp teeth on the outer margin; the inner margin is smooth, and so is the inferior, both of which last are furnished with short fine cilia, in this offering perhaps the readiest distinguishing feature from the South American species, which has this appendage fringed with long and coarse hairs.

According to Capt. Mitchell, this animal was procured "from a piece of wood which had formed part of a railway bridge over one of the backwaters on the west coast of the Indian peninsula. The wood was honeycombed with cylindrical holes, from about $\frac{1}{10}$th to $\frac{2}{10}$ths of an inch in diameter, placed close together. In many of these holes the animal was rolled up like a ball."

The colour of the animal, as it appeared when it arrived in England in spirits, is not to be depended on as resembling that of the living creature; but it was a subdued sage-green. Its length is about $\frac{1}{3}$rd of an inch, while its breadth is about half as much. Certainly these two closely allied species are among the largest and most powerful wood-destroyers that we know.

Many things have been tried to protect submarine wood from the ravages of its many excavators; but the only things that appear to have any success are the red oxide of iron and creosote. The works at Portland, which have been built with wood saturated with the latter, are, we are informed, entirely free from the depredations of these creatures.

Mahogany and probably teak wood, as well as the hemlock-tree of North America (which last, however, is, we believe, useless for most purposes), are, we are informed, exempt from their depredations.

We think that there can be little doubt that these and probably all wood-borers make the excavations for the purpose of food, preferring those trees that have sappy or innocuous juices to those of a hard or baneful nature. The mouth appears well adapted in this species for the purpose: the mandibles are strong and powerful appendages, and furnished with a rasping organ, while the strong posterior pairs of pleopoda are well adapted for the purpose of pressing the animal forward in its cavity; the posterior pair of pleopoda must be very effective organs also, by the leverage that may be attained through them for assisting the animal to turn easily in its narrow cave.

EXPLANATION OF PLATE II.

Fig. 1. *Caradina tenuis*: 1″, rostrum.
Fig. 2″. *Caradina varians*, rostrum; 2 *h*, first pair of pereiopoda.
Fig. 3 *c*. *Palinurus vulgaris*, second pair of antennæ; c^3, scaphocerite.
Fig. 4. *Sphæroma vastator*: c, cephalon; *b*, superior antenna; *c*, inferior antenna; *d*, mandible; *d″*, mandibular appendage; *f*, second siagonopod; *g*, third siagonopod; *h*, *i*, gnathopoda; *k*, first pair of pereiopoda; *l*, second pair; *m*, third pair; *n*, *o*, fourth and fifth pairs; *p*, *q*, *r*, first three pairs of pleopoda; *s*, fourth pair; *t*, fifth pair; *v*, posterior pair of pleopoda.
Fig. 5. *Sphæroma terebrans* (Fr. Müller): *d″*, mandibular appendage; *v*, posterior pair of pleopoda.

III.—*Contributions to an Insect Fauna of the Amazons Valley.* Coleoptera: Longicornes. By H. W. Bates, Esq.

[Continued from vol. xvi. p. 314.]

Genus Cacostola (Dej. Cat.), Fairmaire.

Fairm. Ann. Soc. Ent. Fr. (1859), p. 532.

This genus, imperfectly characterized by M. Fairmaire, comprises a number of small-sized linear insects, closely allied to *Hesycha* and *Trestonia*, but distinguished by their narrow forms, obscure coloration, and especially by their much shorter heads, the muzzle being very little prolonged beyond the lower margin of the eyes. The antennæ are moderately distant at their bases, their supporting tubercles having a conical projection on their inner sides; they are slender, filiform, naked, and very little longer than the body; their first joint forms a smooth club, their third joint is in some species curved, and their terminal joint is at least as long as the preceding. The thorax is short and cylindrical, with a scarcely perceptible prominence in the middle of each side, and the surface punctured, not wrinkled transversely. The elytra are linear, obtusely rounded at their apices, and their surface is free from ridges and tubercles. The legs are short, the thighs clavate, and the claw-joint of the tarsi longer than the remainder taken together. The sterna are narrow, the pro- and mesosterna of equal width, and simple. The species are found, like the *Trestoniæ*, clinging to slender decaying branches of trees.

1. *Cacostola simplex*, Pascoe.

Pachypeza simplex, Pascoe, Trans. Ent. Soc. n. s. v. pt. 1. p. 44.

C. linearis, griseo-fusca; thorace elytrorumque lateribus griseo lineatis; capite latiusculo; antennis articulo tertio subrecto. Long. $4\frac{1}{2}$–5 lin. ♂ ♀.

Head moderately broad; forehead uneven, and, with the vertex, punctured, tawny-grey. Antennæ distant at the base, supporting tubercles with their inner edges prominent; filiform, but somewhat tapering to the extremity, dark brown, bases of joints grey; third joint scarce perceptibly curved. Thorax of the same width as the head, cylindrical, scarcely longer than broad; lateral tubercle inconspicuous; surface coarsely but sparingly punctured, greyish brown, dorsal line and two obscure lateral streaks grey. Elytra linear, coarsely punctured (more thickly so towards the base), and with faint longitudinal elevations on the disk, brown, sides in some examples paler; disk with one or more oblique grey vittæ. Body beneath and legs greyish brown; abdomen variegated with brown and grey.

Tapajos and Upper Amazons, also Cayenne. Examples from Cayenne and the Tapajos are much darker than those from the Upper Amazons.

2. *Cacostola flexicornis*, n. sp.

C. linearis, castaneo-fusca, obscura; capite angustiore; thorace brevi; elytris creberrime punctatis; antennis tenuibus, articulo tertio valde curvato. Long. $3\frac{1}{2}$ lin. ♂ ♀.

Head small; forehead with a deeply impressed longitudinal line, punctured, coarsely pubescent; vertex coarsely punctured; antenniferous tubercles with a small conical projection on their inner sides. Antennæ rather slender, dark brown, with the bases of the joints pale testaceous; third joint strongly bent; terminal joint in the male half as long again as the preceding. Thorax short, lateral prominences conspicuous, surface closely punctured, dark rusty brown. Elytra linear, very closely and equally punctured from base to apex, dark rusty brown. Body beneath and legs dingy ashy; abdomen variegated.

Slender dead twigs, Santarem.

Genus Amphicnæia, nov. gen.

Body small, linear. Head very short, vertically; upper portion of the eyes encircling the base of the antennæ; but the reniform lobe of considerable width, and not attenuated as in the eyes of the genus *Dorcasta**; lower lobe convex, prominent; forehead convex. Antenniferous tubercles very short, oblique, and unarmed: antennæ filiform, stout, clothed

* The upper, reniform portion of the eyes in *Dorcasta* is very narrow, and, in the middle, attenuated. This is a step towards the total disappearance of the upper lobe, which is a distinguishing feature of *Spalacopsis*, Newm., a genus closely allied to *Dorcasta*.

with short hairs, the joints beneath fringed with long and straight hairs; first joint moderately short, thickened nearly from the base; third joint straight. Thorax cylindrical, sides without tubercles, surface punctured. Elytra linear, apex rounded, surface punctured throughout. Legs moderately elongated; thighs clavate; claw-joint of tarsi about as long as the three remaining joints taken together. Sterna narrow, simple.

This genus forms a portion of a small group—including *Dorcasta, Aprosopus,* and *Spalacopsis* (= *Eutheia,* Guér.)—which differs from all the foregoing in the form of the head and in the shortness of the antenniferous tubercles.

1. *Amphicnæia lineata,* n. sp.

A. brevis, sublinearis, fusco-nigra, thoracis vittis tribus, scutello et elytrorum vittis duabus lateralibus griseis; elytris longe setosis, crebre punctatis, apice subobtuse rotundatis. Long. 2½ lin.

Head very short in front; forehead thickly punctured throughout. Antennæ filiform, rather thick, black. Thorax very thickly punctured, convex; dorsal line and a lateral vitta on each side greyish. Scutellum grey. Elytra sublinear, moderately narrowed towards the apex, and rounded at the tips; surface thickly punctured throughout, and clothed with longish stiff hairs; blackish brown, with two tawny-ashy vittæ on each side approximating towards the base. Body beneath and legs rusty, shining, thinly clothed with greyish pile.

Ega; common on dead twigs.

2. *Amphicnæia pusilla,* n. sp.

A. minuta, testaceo-fusca; thorace punctato, griseo trivittato; elytris setosis, punctatis, testaceo-fuscis, sutura lateribusque obscurioribus; antennis pedibusque ferrugineis. Long. 1½ lin.

Head rusty brown, forehead punctured, vertex and occiput thickly punctured. Antennæ rusty red, sparingly setose, basal joint rather thick, forming an ovate club. Thorax evenly punctured throughout, rusty brown, the dorsal line and a broadish vitta on each side grey. Scutellum grey. Elytra linear, punctured throughout, testaceous, suture and sides rusty brown. Body beneath and legs pale ferruginous.

Santarem.

Closely allied to *A. lineata,* but distinguished by its smaller size and different coloration*.

* A third species occurs at Rio Janeiro, in South Brazil:—

A. lyctoides. Linearis, fusco-ferruginea; corpore supra crebre passim punctato. Antennæ infra sparsim hirsutæ. Elytra linearia, glabra, punctis sublineatim ordinatis. Corpus subtus et pedes fusco-ferruginea, Genus Aletretia, nov. gen.

Body elongate-elliptical. Head short, vertically; forehead convex; eyes not prominent; upper or reniform lobe moderately broad and reaching the centre of the crown, so that the eyes above are separated only by the longitudinal line of the vertex. Antenniferous tubercles short, unarmed: antennæ stout, a little longer than the body, and tapering towards the apex, fringed beneath with long and fine hairs; basal joint moderately short and thickened almost from the base. Thorax cylindrical, lateral tubercles very small. Elytra narrowed towards the apex, the tips obliquely and briefly truncated. Legs moderately elongated, tarsi narrow, claw-joint stout and as long as the three remaining joints taken together.

The form and clothing of the antennæ, shape of claw-joint, and general habit show this genus to be closely allied to the preceding, notwithstanding the numerous points of difference.

Aletretia inscripta, n. sp.

A. elongato-elliptica, nigra; thorace vittis quinque, elytris utrinque vittis quatuor (juxta basin et pone medium interruptis) fulvo-griseis, spatio nigro mediano elytrorum lineola transversa fulvo-grisea. Long. $3\frac{1}{2}$–$4\frac{1}{2}$ lin. ♂ ♀.

Head clothed with greyish or tawny pile, not visibly punctured; central line deeply impressed; eyes nearly touching on the vertex. Antennæ one-third longer than the body, dark brown, pubescent, fringed with long fine hairs beneath. Thorax cylindrical, rather broader in the middle, and having on each side a minute tubercle; surface punctured throughout, black, clothed with fine grey pile, and marked with five greyish-tawny vittæ. Scutellum tawny grey. Elytra narrowed towards the apex, the tip briefly and squarely truncate, with the outer angle prominent; surface deeply but sparsely punctured towards the base, faintly so and glossy towards the apex, black, the basal half with four light-brown vittæ (the second one from the suture alone reaching the base), and the apical part with a number of short streaks of the same colour, the intermediate black space having on each elytron a transverse wedge-shaped line. Body beneath and legs clothed with light-brown pile.

Upper and Lower Amazons; on dead twigs.

Genus Dorcasta, Pascoe.

Pascoe, Trans. Ent. Soc. n. s. iv. p. 264.

In this genus the body is much more elongated than in any

---

glabra: episternis, pectore segmentisque abdominalibus medio grosse punctatis. Long. $1\frac{3}{4}$ lin. *Hab.* in Rio Janeiro.

of the preceding, being narrow and linear, but tapering towards the apex of the elytra. The head has an elongated crown, or, in other words, is prolonged horizontally; and the forehead in the typical species is directed obliquely towards the edge of the prosternum. The upper reniform lobe of the eyes is very narrow. The antennæ are not longer than the body, and are closely approximated at their bases; but the antenniferous tubercles are not elevated or armed; the antennal joints are short, thick, and setose, the bristles on the under surface being longest; the basal joint is thickened from the base, and of equal breadth thence to the apex. The legs are short and stout, and the claw-joint of the tarsi is about equal in length to the remaining joints taken together. The elytra are briefly sinuate-truncate, and dentate at the apex.

1. *Dorcasta oryx*, Pascoe.

Dorcasta oryx, Pasc. Trans. Ent. Soc. n. s. iv. p. 264.

D. sublinearis vel attenuato-elliptica, fusca, griseo tomentosa; capite thoraceque vitta laterali lineaque dorsali fulvis; elytris utrinque fulvo trilineatis, apice oblique sinuato-truncatis, angulis acutis; corpore toto setoso; capite elongato, infra valde retracto. Long. $3\frac{1}{4}$ lin.

Abundant on dry twigs in hedges, Santarem. The *Hippopsis dasycera* of Erichson (Schomburgk's Reise in Brit. Guiana, vol. iii.) is evidently a *Dorcasta* closely allied to *D. oryx*, if not the same species.

2. *Dorcasta lignea*, n. sp.

D. linearis, grisea, capite thoraceque lineis duabus dorsalibus, regione scutellari et elytrorum vitta lata curvata fusco-nigris; capite elongato, infra retracto; elytris striato-punctatis, subcostatis, apice oblique sinuato-truncatis, angulis externis valde productis crassis obtusis: corpore haud setoso. Long. 4 lin.

Head prolonged above and retracted beneath, as in *D. oryx*; forehead clothed with tawny-grey pile; vertex and occiput dingy tawny, lineated with black; upper reniform lobe of the eyes extremely attenuated in the middle; vertex punctured. Antennæ about as long as the body, clothed with short setæ; basal joint oblong, angular; colour blackish, bases of joints greyish. Thorax convex in front; surface punctured, dingy tawny; sides each with a light-grey line; centre with two flexuous blackish lines extending to the head and meeting on the crown. Elytra free from setæ, slightly tapering from base to apex, the latter obliquely sinuate-truncate, with the outer angles produced into vertically thickened lobes; surface with coarse punctures arranged in lines, some of the interstices subcostate; colour dingy grey; the scutellar area and a broad streak, curving from each shoulder to the suture and subapical margin, dark brown. Body beneath and legs dingy brown.

Dry twigs, Santarem.

3. *Dorcasta occulta*, n. sp.

D. cylindrica, postice subobtusa, grisescens, brunneo variegata, regione scutellari fusco-nigra; elytris juxta apices abrupte declivibus, apice breviter subobliquc sinuato-truncatis, angulis acutis; capite infra minus retracto. Long. $2\frac{3}{4}$ lin.

Head less elongated and less retracted beneath than in the typical species, clothed with dingy greyish tomentum; central line deeply impressed; upper lobe of eyes attenuated. Antennæ thick, filiform, sparsely clothed with short bristles, longer underneath; basal joint oblong, angular. Thorax convex, sparingly punctured, tawny grey, with whitish streaks on the sides. Elytra cylindrical, subobtuse and abruptly declivous near the apex, the latter briefly sinuate-truncate, both angles slightly produced and acute; surface free from bristles, coarsely punctured, partly in lines, dingy grey-tawny, with brownish spots, a large patch over the scutellar area, and sometimes a curved spot on each side, in the middle, dark brown. Body beneath and legs tawny ashy.

Santarem, on dry twigs.

4. *Dorcasta cœnosa*, n. sp.

D. cylindrica, postice subobtusa, griseo-fusca; thoracis lateribus et elytrorum maculis cinereis; elytris apice oblique sinuato-truncatis, angulis prominulis acutis; capite infra minus retracto. Long. $1\frac{3}{4}$ lin.

Head less elongated and retracted beneath than in the typical species, rusty-brown, clothed with dingy-grey tomentum; central line deeply impressed; upper lobe of eyes attenuated in the middle, the extremity, on the crown, raised. Antennæ filiform, clothed throughout with short setæ; basal joint thickened abruptly from the base, oblong: colour dingy brown. Thorax subcylindrical, slightly tumid in the middle; surface punctured, rusty grey-brown, sides pale ashy. Elytra linear, narrowed a little before the apex, the latter obliquely sinuate-truncate, with both angles acute; surface coarsely punctured, greyish rusty brown, with an ashy streak near each shoulder, and a discoidal ashy line divided into spots by brown specks. Body beneath and legs rusty brown.

Santarem, on dried twigs.

Group *Hippopsinæ*.

Genus Megacera, Serville.

Serv. Ann. Soc. Ent. Fr. iv. p. 43.

Megacera agrees with *Hippopsis* in the greatly elongated form of body, and in the long setiform antennæ, more than twice the length of the body, and fringed with fine bristles or hairs beneath. It differs, according to Serville, in the vertical instead of retracted inclination of the face, and in the elytra being squarely instead of obliquely truncated or pointed at the apex. I find, on the examination of a series of species, that these two characters do not go together, some species having the head of a *Megacera* with the elytra of an *Hippopsis*. One of the following species described under *Megacera* (*M. prælata*) has, however, a facies quite distinct from *Hippopsis*, owing to the greatly swollen posterior orbits of the eyes and absence of lineation in the colours of the thorax and elytra. In general form it much resembles *M. vittata* of Serville, the type of the genus.

1. *Megacera prælata*, n. sp.

M. linearis, parallelogrammica, olivaceo-cinerea; capite, thorace, elytrorum basi et antennis obscurioribus; antennis longissimis; capite verticali, orbitu oculorum incrassato; thorace transversim valde rugoso; elytris sinuato-truncatis, angulis prominulis acutis. Long. corp. 9 lin., antenn. 28 lin.

Head with vertex moderately elongated and subconvex, punctured; face short, nearly vertical, clothed with dark olive-ashy tomentum; posterior orbit of eyes thickened and prominent. Antennæ more than three times the length of the body, blackish, scantily clothed with olivaceous tomentum. Thorax cylindrical, anterior and posterior transverse sulcus well marked, the intermediate part of the dorsal surface covered with coarse transverse rugæ; dark olivaceous. Elytra linear, very slightly narrowed close to the apex, the latter transversely sinuate-truncate, both angles faintly prominent; surface finely punctured towards the base, light olivaceous ashy, smooth, base a little darker. Body beneath and legs clothed with smooth olivaceous-ashy tomentum.

One example on a slender branch in the forest, Ega.

2. *Megacera apicalis*, n. sp.

M. linearis, postice perparum angustata, griseo-nigra; capite pone oculos tumidulo, lateribus lineisque duabus verticis antice convergentibus fulvis; thorace et elytris utrinque fulvo trivittatis, vitta interiore elytrorum juxta basin attenuata, vittis omnibus ante apicem in fasciam griseo-fulvam terminatis, ipso apice nigro, sinuato-truncato, angulis acutis. Long. 5½–7 lin.

Head with vertex moderately prolonged; face short, slightly retracted; black, clothed with thin grey pile, sides and two coronal vittæ converging in front tawny; vertex coarsely but sparingly punctured; sides somewhat tumid behind the eyes. Antennæ nearly three times the length of the body, basal joints densely fringed beneath; colour blackish, thinly clothed with grey pile. Thorax cylindrical, a little narrowed in front, surface coarsely punctured, the punctures here and there running into rugæ; greyish black, with six tawny vittæ. Elytra linear, very slightly narrowed from base to apex, the latter transversely sinuate-truncate, both angles acute; surface thickly punctured, except near the apex, greyish black; each elytron marked with three tawny vittæ, the innermost one of which is very narrow near the base, and all terminate in a broad, subapical, tawny-ashy belt, which is succeeded by a black belt occupying the apex. Body beneath and legs grey; sides of breast with two tawny streaks.

Ega, on slender branches.

3. *Megacera rigidula*, n. sp.

M. linearis tenuis, postice sensim attenuata, griseo-nigra; capite lateribus vittisque duabus verticis cinereo-fulvis; thorace grosse sparsim punctato, vittis sex, et elytris utrinque vittis tribus cinereo-fulvis, vittis duabus lateralibus elytrorum ante apicem terminatis. Long. $4\frac{1}{2}$ lin.

Head with vertex moderately prolonged, face short, slightly retracted; black, clothed with grey pile, covered with large punctures; sides and two convergent vittæ on the vertex ashy tawny. Antennæ rust-coloured. Thorax cylindrical, covered with large scattered punctures, some of which are confluent, and marked with six tawny-ashy vittæ. Elytra slender, gradually narrowed from base to apex, the latter sinuate-truncate, with both angles produced and acute, the external one most so; surface coarsely punctate-striate to the apex, greyish rusty black, each elytron with three ashy-tawny vittæ, all thickest towards the base (the lateral one furcate), and the two lateral ones terminating before the apex in an ashy spot. Body beneath and legs grey, the tomentum more dense on the sides of the body.

Santarem.

Genus Hippopsis, Serville.

Serville, Encycl. Méthod. x. p. 336.

As already observed in the remarks under the head of *Megacera*, this genus is remarkable for the very elongated narrow form of body, and equally elongated hair-like antennæ, which are fringed with fine hairs beneath, at least the basal joints. The body is not linear, as in *Megacera*, but is gradually attenuated posteriorly, the elytra having their apices prolonged into a point. The degree to which this prolongation of the elytral tips is carried varies in the different species, and offers a good mark for distinguishing some of them. In some, namely those which approach *Megacera*, the elytra are simply very obliquely sinuate-truncate at the apex, both angles of the truncature being acute, but the external one greatly prolonged. In others the external angle is still further prolonged, and the sutural one only just perceptible. This feature is carried out to greater lengths in other species, in which the truncature is so extremely oblique as to be imperceptible, the elytra then appearing to be terminated each in a long, fine point.

The species of *Hippopsis,* like all other Onciderităe, are parasitic on the slender branches of trees. They choose, however, the most slender twigs, and cling to them so closely by their short stout legs and elongated claws as to be difficult of detection. All that I have seen possess the same style of coloration —a ground-colour black or brown, clothed with extremely fine grey pile, and marked with tawny or dingy grey stripes extending over head, thorax, and elytra, the diversities of which sometimes form good specific characters.

1. *Hippopsis truncatella,* n. sp.

H. linearis, fusca, capite, thorace et elytris utrinque vittis tribus testaceo-griseis; capite thorace latiore, pone oculos sensim angustato; elytris paulo ante apices attenuatis, apice utrinque oblique sinuato-truncatis, angulo interiore prominulo acuto, exteriore late producto, vittis griseis duabus interioribus ante apicem conjunctis. Long. $4\frac{1}{2}$ lin.

Head broader than the thorax, curvilinearly narrowed behind the eyes; face strongly retracted; eyes prominent; brown, face clothed with thick greyish pile; vertex coarsely punctured, and, with the sides, marked with six greyish vittæ, the two central ones of which gradually converge on the crown, and the four others traverse the deflexed sides of the neck and cheeks. Antennæ slender, basal joint gradually thickened from base to apex; colour rusty brown. Thorax narrower than the head or elytra, cylindrical, coarsely punctured, brown, marked on each side with three greyish vittæ, the lowermost of which is continuous along the sides of the breast. Elytra scarcely perceptibly narrowed from the shoulders to near the apex, thence rapidly narrowed; the apex truncated a little obliquely, the truncature incurved near the sutural angle, which is produced and acute, the outer angle being broad and also acute, but moderately produced; surface thickly punctured, partly in lines, brown, and marked on each elytron with three broad, greyish vittæ, the two inner ones of which unite before the apex, and the lateral one interrupted at the shoulder, under which is a small grey streak. Body beneath and legs clothed with fine greyish tomentum.

Pará and Lower Amazons.

2. *Hippopsis griseola*, n. sp.

H. linearis, fusca griseo-suffusa; thorace elytrisque utrinque vittis tribus, collo vitta lata, vertice lineis duabus parallelis testaceo-cinereis; capite pone oculos tumidulo, deinde angustato, vittis elytrorum omnibus ante apicem commixtis; elytris apice acuminatis, divaricatis. Long. $4\frac{3}{4}$ lin.

Head a little broader than the thorax, tumid behind the eyes, then rather abruptly narrowed; face strongly retracted; brown, rather thickly clothed with grey pile, side of the neck with a broad ashy vitta, vertex with two narrower vittæ parallel up to the eyes. Antennæ rusty brown, basal joint gradually thickened from base to apex. Thorax cylindrical, surface having very large confluent punctures, brown, clothed with fine grey pile, and marked with six testaceous-ashy vittæ. Elytra linear to near the apex, thence gradually narrowed, each elytron ending in a point, the sutural side of which is nearly straight, the outer side a little incurved, hence giving an outward turn to the pointed apices; surface punctured, partly in lines, punctures fainter near the apex, brown, clothed with grey tomentum, and marked on each elytron with three testaceous-ashy vittæ, all of which coalesce at a distance from the apex. Body beneath and legs thinly clothed with greyish pile, sides of breast and abdomen streaked with denser tomentum.

Santarem.

3. *Hippopsis clavigera*, n. sp.

H. linearis, tenuis, fusca, vertice vittis quatuor geminatis, thorace et elytris utrinque vittis tribus griseis; corpore toto grosse punctato; antennis articulo basali apice clavato. Long. $2\frac{3}{4}$ lin.

Head broader than the thorax, gradually narrowed behind the eyes, beneath strongly retracted; forehead elevated at the summit a little above the level of the crown; antenniferous tubercles suborbicular and prominent; eyes lateral, nearly round, slightly emarginated near the base of the antennæ, but not extending in a reniform lobe upon the vertex; the latter closely punctured, marked with four greyish stripes united in pairs posteriorly; face clothed with greyish hairs. Antennæ very slender, capilliform, scantily fringed with long hairs; basal joint slender, somewhat abruptly clavate towards the apex. Thorax cylindrical, evenly and thickly punctured; brown, marked with six greyish vittæ. Elytra linear, gradually tapering, more quickly so nearer the apex, which is moderately prolonged and pointed, without truncature; surface closely punctured from base to apex, brown, marked with three broad greyish stripes. Body beneath coarsely but evenly punctured throughout, and, with the legs, thinly clothed with greyish pile.

This singular little species occurred only at Santarem, on the Lower Amazons.

4. *Hippopsis prona*, n. sp.

H. linearis, elongata, fusca, nitida, collo vitta lata laterali, vertice lineis duabus, thorace et elytris utrinque vittis tribus testaceo-griseis; capite infra valde retracto, supra quadrato; elytris leviter oblique truncatis, acutissimis. Long. 5 lin.

Head above quadrate, the lateral outline behind the eyes being nearly straight; face elongated and very strongly retracted, tending towards the horizontal position, clothed with greyish hairs, and deeply impressed on the summit between the antennæ; vertex coarsely punctured, having a shining, raised dorsal line, brown; sides each with a broad vitta, and vertex with two stripes, greyish. Antennæ piceous, finely and densely fringed, basal joint gradually thickened from base to apex. Thorax cylindrical, covered with large even punctures; rusty brown, marked with six tawny-grey stripes. Elytra much elongated, four and a half times the length of the thorax, linear, gradually narrowed, and near the apex more quickly narrowed; the latter prolonged into an acute point, the inner side of the prolongation formed by an oblique truncature, the sutural angle of which is distinct; surface punctured in distinct rows, punctures indistinct towards the apex, brown, shining, marked on each elytron with three testaceous-grey stripes, the inner two of which unite at the apex; the middle stripe is fainter and greyer than the other two, and is interrupted towards the base. Body beneath faintly punctured, piceous, and, with the legs, clothed with thin, grey pile.

S. Paulo, Upper Amazons.

5. *Hippopsis fractilinea*, n. sp.

H. elongato-fusiformis, fusco-nigra, collo vitta laterali, vertice lineis duabus, thorace et elytris utrinque vittis duabus fulvis, vitta interiore elytrorum mox pone medium fracta; thorace supra transverse ruguloso; elytris valde acuminatis. Long. 5–10 lin.

Head narrower than the middle part of the thorax, and constricted midway between the eyes and the hind margin; face very short, moderately retracted, clothed with fulvous pile, central line deeply impressed; antenniferous tubercles with their inner margin dentate; vertex having a few large punctures in the middle, and a shining central line impressed posteriorly; dark brown, sides each with a stripe, vertex with two narrow converging lines fulvous. Antennæ greatly elongated, black. Thorax narrowed in front, and constricted near its hind margin, surface transversely punctate-rugose; brownish black, shining, surface with two tawny lines, sides each with one similar line continuous with a streak on the side of the breast. Elytra tapering from base to apex, each elytron ending in a straight point, the sutural edge being also nearly straight; surface shining brown-black, punctured (except towards the apex), and marked on each with two tawny vittæ, the inner one of which is severed after the middle, the severed ends oblique and running parallel for a short distance; suture towards the base and disk marked with faint silky grey lines. Body beneath shining black, clothed with fine silky greyish pile; abdomen with three tawny stripes. Legs black, clothed with silky tawny pile.

Common on dead branches of trees at Ega.

[To be continued.]

IV.—*On the Terrestrial and Fluviatile Mollusca of Trinidad.*

By R. J. Lechmere Guppy, Civil Service, Trinidad.

The most complete list of the terrestrial Mollusca of Trinidad which I have seen is that contained in a paper by Mr. Bland, "On the Geographical Distribution of the West-India Land-Shells"*. In this list are given thirteen land-shells; and mention is made, in the same paper, of two freshwater Mollusca. Of the thirteen land-shells enumerated by Mr. Bland I have only found eleven; but, besides these, I have found thirteen other terrestrial Gasteropoda; and in addition to the two freshwater Mollusca, I have found five fluviatile Gasteropoda and one Conchifer, making a total number of thirty-two species of terrestrial and fluviatile Mollusca.

In the 'Annals and Magazine of Natural History' for October 1864† I described some species of operculate Mollusca of the land and fresh waters of Trinidad. I now propose to complete and correct the list of the Operculata, and to give some account of the Inoperculata, so as to bring under view in one memoir the whole of the terrestrial and fluviatile molluscan fauna of the island.

With regard to classification, I have done the best I could under the circumstances. There is so much confusion respecting some of the genera (e. g. *Orthalicus, Subulina, Opeas,* and others made from the old genus *Bulimus*), that I see no way of escaping the difficulties attendant on assigning the proper place to the species of those groups; and until the classification of the Helicidæ shall be remodelled by competent authority, generic names must in some cases go for very little. I have therefore in this paper included one or two species in the genus *Bulimus*

* Ann. Lyceum Nat. Hist. New York, vol. vii.

† Ser. 3. vol. xiv. p. 243.

which, I am of opinion, ought to be separated therefrom. I think that the peculiar animal of *B. oblongus* may entitle it to generic distinction, though it remains to be seen if any of the most nearly allied forms have similar animals. Then *Bulimus octonoides* and *B. caracasensis* seem also to deserve separate places. Pfeiffer, Beck, Albers, Chenu, and many others have adopted and devised genera for the reception of similar forms; but, as each author appears to have his own peculiar views as to what species shall be included in each particular genus, and as in the majority of cases I feel myself unable to subscribe to those views, it seems to me that the only course left open is the one I have adopted.

Neritina, Lamarck.

Neritina microstoma, D'Orb.

The Trinidad examples agree with specimens from Cuba, and also with D'Orbigny's description and figures in the 'Moll. de Cuba;' but they do not accord so well with the examples in the British Museum. Some of the specimens of *N. virginea* strongly resemble the Trinidad shell.

Paludestrina, D'Orbigny.

Paludestrina spiralis, Guppy.

Bithinia spiralis, Guppy, Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 244.

Further observation has enabled me to refer this mollusk to D'Orbigny's genus, and to add the following remarks:—

The operculum is thin and paucispiral, its nucleus subcentral. The eyes are on bosses on the outer and hinder sides of the tentacles. The animal strongly resembles that of *Skenea*. It is viviparous, and about November it contains eggs and young in every stage of development. The young shell is depressed and umbilicate, and resembles *Skenea planorbis*. Before birth the young mollusk is already furnished with an operculum.

Lingual teeth 3.1.3: central with a triangular, reflexed, serrate edge; first lateral small, serrate; second transverse, serrate on the reflexed edge; third slender, claw-shaped, serrate. This dentition, though not altogether unlike that of some of the Melaniadæ, presents considerable resemblance to that of certain of the Calyptræadæ.

Ampullaria, Lamarck.

Ampullaria urceus, Müller. (*A. rugosa*, Lam.)

The *animal* is black, and the left siphon, when fully protruded, is longer than the shell. The right siphon is short. The head is produced into two lobes, which are extended into acute tentacular processes. The eyes are well developed, and hard, like those of a fish; they are placed on stout pedicels joined to the outer and hinder side of the tentacles, which are acutely pointed and of moderate length. The jaws are large, smooth, and almost shelly. The lingual teeth are 3.1.3: central broad, subquadrate, with a strong apical point, on each side of which are two smaller dentations; first lateral broad, obtusely pointed, with a dentation on the inner edge; two outer laterals similar, simply claw-shaped. The dental membrane is supported on two large triangular cartilages, to which are attached strong muscles.

This species inhabits the larger rivers and swamps, burying itself in the mud during the dry season.

Var. *purpurascens* (*A. purpurascens*, Guppy, Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 243). I described this form as a distinct species, but I have since seen reason to believe it only a variety of *A. urceus*.

Ampullaria effusa, Chemn. (*A. glauca*, Linn.)

This shell is rather variable, both as to colour and shape. I have described a variety, for which I propose the name *conica*, in the 'Annals' (*loc. cit.*), and I have also there described the eggs and young shell of *A. effusa*. Another variety of *A. effusa* I propose to distinguish by the name *tristis*. In this variety the spire is rather more elevated than in the type, the peristome more prominent, and the colour-bands are either altogether absent or externally indistinct, the shell being of a dark horn-colour. These varieties would probably be regarded as distinct species by many naturalists; but my acquaintance with the habits of the species enables me to affirm that the differences are not specific.

This species, like *A. urceus*, buries itself during the continuance of drought. It can exist for months in a torpid state. The typical form is found in rapid streams, while the varieties *conica* and *tristis* occur in slow-running water and in ponds.

I think it probable that *A. crocostoma*, Phil., a Venezuelan shell, is only another variety of this species; and there may be other forms which ought in strictness to come under the same specific appellation.

MARISA, Gray.

Marisa cornu-arietis, Linn., sp.

M. Knorrii, Phil.; *Ceratodes fasciatus*, Guilding.

The *animal* is grey, mottled and streaked with brown and black. The muzzle is produced into two acute tentaculiform lobes. The left siphon, as well as the right one, is rudimentary and scarcely closed, and consists merely of an extended fold of the neck-lappet.

A smaller variety occurs in some places. While in the type the spire is depressed below the level of the last whorl, in the variety the apex is slightly above that level. I propose to call this variety *Swifti*, after Mr. Swift, of St. Thomas, who, amongst many other valuable hints, pointed out to me the differences in these shells.

Marisa cornu-arietis prefers ponds and the more quiet streams, as might be inferred from the shape of its shell, which does not enable the animal to resist a strong current so well as the globular shells of the *Ampullariæ*. It is therefore less common in mountain-streams. Its capability of resisting drought is also very much less than that of *A. urceus* and *A. effusa*.

The lingual dentition is 3 . 1 . 3, as in *Ampullaria*. The central tooth has three dentations on each side of the strong, acute apical point. The mandibles are similar to those of *Ampullaria effusa*, but thinner and weaker. The eggs are deposited in jelly-like masses on twigs, &c., in the water. The young mollusks, when hatched, are imperforate and subglobose, very similar to the young of *A. effusa*.

Adamsiella, Pfeiffer.

Adamsiella aripensis, Guppy.

(Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 246.)

This mollusk lives principally among the dead leaves on the ground in the forests. It frequently suspends itself by two or three glutinous threads from branches on the under surface of leaves at a height of one or two feet from the earth.

Cyclotus, Guilding.

In my former account* of the two species of this genus inhabiting Trinidad I did not give a full description of the animal, because I was under the impression that naturalists were sufficiently acquainted with the general characters of the genus. But I find that Mr. W. T. Blanford†, observing that certain Indian species have a divided foot like *Cyclostoma*, has proposed for them the generic name of *Cyclotopsis*. He is also of opinion that the American species should be classed with *Cyclostoma*.

The *animal* of *Cyclotus translucidus*, Sow., is of a pinkish colour, light about the body and foot, but deep on the tentacles; the foot is broad, undivided, and obtusely pointed behind; the tentacles subulate; the eyes small, black, and sessile at the bases

* Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 245.

† *Ibid.* vol. xiii. p. 446.

of the tentacles; the head is prolonged into an obtuse undivided muzzle, which scarcely extends forward beyond the foot; the ♂ organ is large and subulate, situate medially on the back of the neck. The animal resembles generally *Cyclophorus*, and not *Cyclostoma**.

The animal of *C. rugatus* does not differ remarkably from the preceding; and I feel confident that the animals of the allied West-Indian and American forms will be found on examination to be similar also. The lingual dentition fully bears out these remarks. The teeth of the *Cyclophoridæ* are 3 . 1 . 3, while those of the *Cyclostomidæ* are 2 . 1 . 2 or 00 . 2 . 1 . 2. 00. The Trinidad *Cycloti* have the former dentition.

From these considerations I do not think it probable that, in the present state of our knowledge, a new genus need be constituted for theAmerican (including the West-Indian) species.

Cyclotus translucidus, Sow., sp.

C. trinitensis, Guppy, Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 245.

Though I was at first led to consider the Trinidad shell to be distinct, I am now of opinion that it cannot be separated from the Venezuelan species.

This and the following species are found among dead leaves in forests, on calcareous soils.

Cyclotus rugatus, Guppy.

(Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 246.)

This shell is closely allied to *C. stramineus*, Reeve, from which it is readily to be distinguished by the fine fold-like striæ being oblique and rising diagonally forward in *C. stramineus*. These striæ are also continued to the aperture in that species; but in *C. rugatus* the striæ run in zigzags, and coincide in general direction with the lines of growth, resembling in this respect the Jamaica species *C. corrugatus* and *C. jamaicensis*. *C. rugatus* is distinguished from these latter forms by its general shape and by the absence of any ridge round the umbilicus. In *C. rugatus* the angularly wrinkled striæ become nearly obsolete at the aperture. *C. stramineus* has a spire of half a whorl more than *C. rugatus*. Again, specimens of the latter shell are generally easily distinguished by their dark reddish-brown colour.

HELICINA, Lamarck.

Helicina nemoralis, Guppy.

Helicina zonata, Guppy, Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 247.

This shell is very like *H. jamaicensis*, from which it may most

* D'Orbigny has given figures of the animal of *C. inca* (Voy. Amér. Mérid. Mollusques, pl. 46. figs. 21–23). The figure given by Chenu (Man. de Conch. vol. i. p. 2. f. 11) is probably copied from D'Orbigny, and also that in Mrs. Gray's 'Figures of Mollusca.'

readily be distinguished by the coloration and by the band of chestnut above the suture in the present species. There are some minor differences.

As the specific name *zonata* had been previously applied by Lesson to a *Helicina,* I am under the necessity of giving a new name to this species. I therefore propose to call it *H. nemoralis.* It is found on the leaves of trees in the forests.

Helicina barbata, Guppy.

(Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 247.)

This shell is so nearly allied to *H. Dysoni,* Pf., of Honduras (and perhaps also to *H. foveata,* Pf., of the Antilles) that it is possible they are no more than varieties of one species.

Physa, Draparnaud.

Physa rivalis, Maton & Rackett.

The mantle is ornamented with stripes and undulating bands, which, during the life of the animal, seem to be on the shell.

The dental band is broad, and covered with numerous minute teeth, which are simple, slender, and slightly curved. They are arranged in fifty or sixty divergent curved rows of about 250 or 300 each.

The Trinidad shell does not attain so large a size as that of Cuba (*P. Sowerbiana,* D'Orb.) and the Antilles; but, owing to the close resemblance in all other respects, I feel unable to separate it as a species.

Planorbis, Guettard.

Planorbis terversanus, D'Orbigny.

The greatest breadth of the Trinidad examples is about 0·4 inch.

The lingual teeth are numerous, tricuspid, with a broad base. The central tooth has two strong, prominent, acute cusps, with a small intermediate point. The laterals are somewhat triangular, the outer cusp being strongly developed, the two inner ones merely small points. Outside of the fifth row of laterals the teeth become much smaller.

Vaginulus, Férussac.

Vaginulus Sloanei, Fér.

The dental band is broad, the teeth numerous, simple, similar; the median row small. In its dentition this species resembles the Helicidæ more than *Testacellus.*

The eggs are oval-oblong, transparent, gelatinous, about $\frac{1}{4}$ inch long, and united in chains of ten or twelve.

Succinea, Draparnaud.

Succinea approximans, Shuttleworth.

This shell resembles *S. propinqua,* Drouet, which may possibly prove to be a variety.

The *animal* is speckled and streaked with black. The lower pair of tentacles are small. It is found in moist places, but never in water. The lingual teeth are numerous, in straight rows, on subquadrate bases, edges reflexed; central with one strong rounded point, and a smaller one on each side; laterals bidentate, inner cusp largest, with an obsolete toothlet on its inner edge.

Bulimus, Scopoli.

Bulimus oblongus, Müller, sp.

The peculiar conformation of the head of this mollusk was noticed by D'Orbigny, and figured by him*. On each side of the head is a flattened appendage, which is divided into eight short, obtuse tentacular processes, each about $\frac{1}{10}$th of an inch in length. These probably aid in enabling the animal to burrow in the soil, and perhaps even in discriminating food.

The sexes are separate; the genital orifice is large and situate beneath the upper tentacle on the right side, near the junction of the above-described appendages with the body. The ♂ organ is about 2 inches long, club-shaped, furnished internally with a long stout cartilage. The lingual band is broad, and covered with numerous similar teeth in straight rows; the cusps simple, rather obtuse. The dental membrane is folded over a strong cartilage. There are two mandibles, somewhat as in the Cephalopods, the upper one rather horseshoe-shaped, the lower one tongue-like and triangular, occupying the cavity of the throat.

Bulimus zebra, Müller.

D'Orbigny, in the 'Moll. de Cuba,' makes *B. undatus* a synonym of *B. zebra,* and gives the preference to the latter name on account of priority. I have followed him, though I am aware that many naturalists consider these to be distinct species. Beck (Index) makes the West-Indian shell *Orthalicus undatus,* and the South-American one *O. zebra*; but having compared all the specimens and figures within my reach, I am unable to perceive any constant differences. These shells, as well as *B. phlogerus,* D'Orb., seem to me to belong to one species; and *B. regina,* Fér., may possibly be a reversed variety of the same.

The lingual band is very large, covered with numerous similar subquadrate teeth, in somewhat divergent rows.

* Voy. Amér. Mérid. p. 297, pl. 37. f. 1, 2. There is a figure also in Mrs. Gray's 'Figures of Mollusca.'

Bulimus multifasciatus, Lam.

The body of the animal is brown. The five bands of chestnut on the shell, which are also represented on the mantle, are occasionally so much interrupted as to form rows of rather distant square spots. The shell is somewhat variable as to size.

Lingual teeth numerous, similar; median with an apical toothlet, and a smaller point on each side of it; laterals in diverging rows, each with an oblique, broadly reflexed cutting-edge. Mandible semicircular, corrugate.

I propose to describe, as a variety of this species, a form found in the southern parts of the island :—

Var. *imperfectus*. *Shell* subperforate, oblong-conic, thin, fragile, subpellucid, shining, striated by fine longitudinal lines of growth, and zoned with five chestnut bands, of which the fourth is the broadest, and the second the smallest; whorls 5–6, scarcely convex; peristome simple, acute. Height 0·6 inch, breadth 0·3 inch; height of aperture 0·25 inch.

This variety is much like the young of the typical form. Its peristome is more complete than in the young shell of the type, but never expanded as in the adults. In the southern parts of the island, where this variety occurs, I have never met with a single example of the type form. The *B. rufolineatus* of Drouet, probably a variety of the *B. pœcilus* of D'Orbigny, somewhat resembles this variety; but that species seems to have only 3–4 bands of colour, while its whorls are a little more convex and its aperture larger.

Bulimus immaculatus, C. B. Adams.

B. flavidus, Menke; *B. stramineus*, Guilding, part.

This shell is not to be confounded with the true *B. stramineus*. *B. immaculatus* is similar in shape and size to *B. multifasciatus*. It wants the bands of colour which adorn the latter, and it is usually of a white colour, tinged more or less with yellow, especially near the aperture. The animal is whitish, more or less deeply tinged with yellow. Lingual dentition as in *B. multifasciatus*.

This and the two foregoing and the following species are entirely arboreal in their habits.

Bulimus aureolus, n. sp.

Shell subperforate, ovate-conic, rather acuminate, thin, yellow, shining, translucid, finely striated by minute and close longitudinal lines of growth, crossed by finer decussating striæ; whorls 5, scarcely convex, except the last, which is somewhat carinate; aperture ovate; peristome simple, acute. Height 0·6 inch, breadth 0·3 inch; height of aperture 0·32 inch.

The *animal* has a bright yellow mantle, the vascular system of which is beautifully displayed through the transparent yellow shell. Along the middle of the last whorl runs a vessel, from which branches are given off to each side. The pulsation of the heart can be very distinctly seen in this species.

The lingual teeth are numerous; medians tricuspid; laterals with an oblique, reflexed cutting-edge, and with two short, rounded toothlets. Mandible semicircular, corrugate.

Bulimus fraterculus, Fér.

The Trinidad examples of this species are smaller than those of the Antilles, and seem to me to resemble somewhat *B. orthodoxus*, Drouet, a Guiana species. The dimensions of the largest example I have found are as follows:—height 0·7 inch, greatest breadth 0·3 inch.

Bulimus octonoides, Adams.

A shell somewhat like *Stenogyra octona* at first sight, but distinguished by the form of the whorls and of the aperture, and by the columella not being truncate. Perhaps *B. subula*, Pf., belongs to this species.

Bulimus caracasensis, Reeve.

B. micra, D'Orb.*, and *B. oryza*, Brug., seem to belong to this species. If this should prove to be the case, the latter name would be preferable.

Lingual teeth numerous, on a very small dental band; medians minute, simple, acute; laterals symmetrical, with three rounded cusps, of which the middle one is the most prominent.

This and the preceding are terrestrial in their habits.

STENOGYRA, Shuttleworth.

Shell subulate, whorls numerous, columella truncate.

Stenogyra octona, Linn., sp.

This species is very common in gardens and cultivations, where it lives on the ground, generally preferring to pass the day under leaves, pieces of wood, flower-pots, &c. At night, in damp weather, it creeps out to attack the shoots and the bases of the stems of young and tender plants, doing thereby much mischief. The eggs, which are subspherical, and have a white testaceous envelope, often remain in the shell, whose aperture they nearly fill, and hatch after the death of the parent.

* The examples of this species in D'Orbigny's collection in the British Museum are labelled "*B. camba*." It may be difficult to ascertain what the latter species really is, as D'Orbigny, in his plates in the 'Voyage,' gives the name to two different species; and in the index he refers to a third plate, on which that name does not appear.

Lingual teeth numerous; medians minute, simple; laterals symmetrical, tricuspid, central cusp much the largest.

I cannot separate this species from *S. terebraster*, Lam.

TORNATELLINA, Shuttleworth.

Tornatellina lamellata, Pot. & Mich.

Leptinaria antillarum, Shuttleworth.

This species is viviparous. In July and August it is found full of young shells. It is terrestrial, being found chiefly among decaying wood and vegetable matter.

Lingual teeth numerous; medians small, simple; laterals with a single, long, acute, pellucid cusp, and two obsolete dentations on the outer side. The mandible is somewhat horseshoe-shaped, apparently composed of a number of pentagonal prisms laid obliquely, resembling the shell-structure of Brachiopoda.

PLEKOCHEILUS, Guilding.

Plekocheilus auris-sciuri, n. sp.

Shell rimate, oblong-conic, solid, silky-shining, with longitudinal lines of growth which become somewhat smoothly squamose on the last whorl; wholly white, or more often marbled, spotted, or striped longitudinally with fuscous or chestnut on a whitish, yellowish, or pinkish ground; whorls 6, rather convex, the last one compressed near the aperture; suture followed by an impressed line, which is more distinct on the last whorl; aperture constricted, angularly suboval; peristome white, expanded and reflected, much thickened, especially in the middle of the outer margin; inner margin sinuate, thickened and reflected over the umbilical fissure, bearing an obsolete tooth at its termination on the penultimate whorl; margins joined by a thin callus extending into the interior, under which is usually a stripe of chestnut-colour; columella with a strong fold. Height 1·65 inch, greatest breadth 0·7 inch; height of aperture 0·65 inch.

This very peculiar type of shell is represented in St. Vincent by *P. undulatus*, a species allied to the present, from which it may be distinguished by *P. auris-sciuri* being generally smaller and very considerably narrower in proportion to its height. The aperture is more angular and more produced anteriorly. *P. auris-sciuri* is therefore of the two the form that shows the greatest divergence from *Bulimus*. *P. distortus*, Brug., a Venezuelan shell, shows a still greater divergence from the type-forms of *Bulimus*. *P. distortus* is a longer and larger shell than the Trinidad species, and it is much narrower in proportion to its length. *P. auris-sciuri* has its whorls more convex, and the columellar tooth is considerably less developed than in *P. distortus*. *P. auris-sciuri* is thus intermediate between the Venezuelan species and that of St. Vincent.

The young shell is thin, and resembles a *Succinea*-shaped *Bulimus*. The animal has plain head-lobes. Lingual teeth—central with a single long acute cusp, base produced on both sides; laterals with a rather square point, on each side of which is an obsolete toothlet, base produced outwardly. Mandible semicircular, with distant coarse striæ.

This species is arboreal. In Bland's list it is given as *P. glaber*, from which it is evidently distinct.

Ennea, H. & A. Adams.

Ennea bicolor, Hutton.

This species reminds one somewhat of shells of the genus *Carychium*. It seems to be very rare in Trinidad; for I have only seen four examples, of which only two were alive. It inhabits the crevices of rocks in damp places near streams.

The tentacles (four) of *Ennea bicolor* are bright pink, the foot pale yellow. The lingual membrane is long and narrow; teeth slender, somewhat hooked. The dentition does not resemble that of the typical *Pupæ* (e. g. *P. chrysalis*, *P. striatella*, &c.). *Pupa striatella* has teeth resembling those of some of the *Bulimi*.

Vertigo, Müller.

Vertigo Eyriesi, Drouet.

Pupa Eyriesii, Drouet, Moll. Guy. Franç. p. 71, pl. 2. f. 16, 17.

The two examples which have occurred to me in Trinidad are somewhat larger than the dimensions given by Drouet. They are 0·07 inch high, and 0·035 inch in extreme width. They were found on ferns.

Cylindrella, Pfeiffer.

Cylindrella trinitaria, Pfeiffer.

The *animal* is ashy-grey, becoming nearly black about the head and tentacles. Foot elongate, narrow; tentacles (4) slender. Lingual ribbon very long and narrow; teeth 3 . 1 . 3; medians narrow, bicuspid, with two tubercles on the base; first and second laterals with simple round cusps; outer lateral inconspicuous, rather claw-shaped.

The mollusk is rarely seen in motion, except when it is actually raining. The steep and overhanging sides of the small rocks of rugged limestone in the woods on the Laventille Hills, near Port-of-Spain, are frequently decorated with dozens of these little shells attached by their apertures to the rock.

STREPTAXIS, Gray.

Streptaxis deformis, Fér., sp.

The *animal* is of a delicate pink or yellow colour; and it is found both on trees and on the ground in the woods. Lingual teeth 10.0.10, aculeate. Judging by the teeth, no less than by the form of the immature shell, *Streptaxis* would be classed nearer to *Zonites* than to *Helix*. The teeth are all simple, like those on the lateral portion of the dental membrane of *Zonites cellarius*; but in *Streptaxis deformis* they are longer, and have narrower bases.

SIMPULOPSIS, Beck.

Simpulopsis corrugatus, n. sp.

Shell imperforate, subglobose, very thin, membranaceous, somewhat flexible, greenish hyaline, corrugated by stout, rather irregular, longitudinal ribs; suture linear; spire small, convex; whorls 4, convex, rapidly increasing, the last one forming the greater portion of the shell; aperture large, rather oblique, rounded; peristome simple; columella arcuate. Height 0·38 inch, greatest breadth 0·47 inch; height of aperture 0·3 inch, breadth of aperture 0·25 inch.

Animal greyish-brown; tentacles four; eyes on the upper pair. Mantle-edge narrowly reflexed over the peristome. I regret having been unable to examine the teeth of this mollusk, the only three examples I found having decomposed before I had an opportunity of preserving the soft parts.

This species comes nearest to *S. brasiliensis*. The aperture is more nearly orbicular, and the ribs larger than in *S. rufovirens*. The shell is less *Succinea*-shaped than that of *S. brasiliensis*.

CONULUS, Moquin-Tandon.

Conulus vacans, n. sp.

Shell small, trochiform-depressed, subperforate, thin, fragile, pellucid, shining, brownish horn-coloured; whorls 5, carinate, flattened and obliquely striate above, closely covered with fine, longitudinal, rather wavy striæ, visible under a lens, and most distinct on the polished under surface; spire conoidal; aperture lunate; peristome simple, acute; columellar margin slightly reflected. Greatest diameter 0·18 inch, height 0·12 inch.

The *animal* has four stout tentacles. Mantle filling the aperture and projecting, but not reflected over any part of the shell. Foot narrow, truncate, with a small retractile appendage on the truncate tail. ♂ organ stout, on the right side, below and a little behind the upper pair of tentacles. The foot has a median band separated by a fine line or groove from the lateral portions on each side.

Lingual teeth about 30 . 5 . 0 . 5 . 30, broad, subequal: central obsolete; first five laterals symmetrical, with a larger rounded cusp having a smaller cusp of similar shape on each side; outer laterals bicuspid, resembling the teeth of *Testacellus*.

Conulus vacans lives on epiphytal orchids, and also on the roots and stems of ferns. It is viviparous; and in the wet season individuals are found containing ten or twelve young, in different stages. When excluded, the young shell has two whorls, and is about one-tenth of the diameter of the full-grown shell.

Anodon, Cuvier.

Anodon Leotaudi, n. sp.

Shell transverse, oval-oblong, very inequilateral, somewhat folded posteriorly, striated by numerous concentric lines of growth, which become rather subrugose towards the margins, and which are crossed by numerous inconspicuous radiating striæ; valves moderately thick; umbones somewhat tumid; epidermis shining, dark olive-brown, passing into black; hinge-line long, slightly curved and forming an angle with the rounded anterior end; posterior end with a steep oblique slope, scarcely truncate; interior brilliantly iridescent, inclining to rose-colour. Length 3·3 inches, height 1·8 inch, thickness 1·2 inch; length of hinge-line 2·3 inches.

The nearest species to this is perhaps *A. amazonensis*, Lea*, from which this species may be distinguished by its longer hinge-line, its steeper posterior slope, and the more abrupt angle formed by the hinge-line with the anterior end. Similar characters separate it from *A. trigona*, Spix, than which it is more transverse.

I have much pleasure in dedicating this shell to my friend Dr. Leotaud, the learned ornithologist of Trinidad, in acknowledgment of his having presented me with the first example I had seen of the species.

Cyclostomus citrinus, Sow., is recorded as a Trinidad shell. I have never found any mollusk answering to the description of that species; and I should not be surprised if the true habitat turned out to be Trinidad de Cuba.

Helix perplexa, Fér. (*H. granifera*, Gray). This is stated to be a Trinidad species; but I believe the true locality to be Grenada.

Helix discolor, Fér. Also reported as a Trinidad species; but I have not found it in the island. Of *H. Isabella*, Fér., I once

* Observations on *Unio*, &c. vol. x. pl. 46.

found a single derelict example near the shore, which might have come on drift-wood or otherwise from some other island.

Valvata agglutinans. In my former communication in the 'Annals' I described a shell under this name. It seems, however, to be similar to the *Thelidomus brasiliensis* of Swainson. It is not a mollusk, but the larva-case of a species of *Phryganea.*

Melampus coffea exists in abundance on the northern and eastern coasts, where *M. pusillus* and *Pedipes afra* will probably also be found. But as these shells never occur beyond the influence of salt water, and as their geographical distribution is similar to that of the marine Mollusca, I have not included them in this list.

Of *Neritina* we have two marine species, viz. *N. viridis* and *N. meleagris.* The latter will live where there is a considerable admixture of fresh water*.

Distribution.

The island of Trinidad is divided into two divisions, northern and southern. The former consists in great part of ancient formations, of uncertain date, chiefly of mica-schist, compact and crystalline limestones, and a few associated shales. These rocks form a high range of hills, some of which attain elevations of 2500 to 3000 feet. A wide tract of stratified detritus, through which flows the river Caroni, runs from west to east for the greater part of the distance across the island, separating the northern district from the southern. This separation is continued to the Atlantic, on the eastern side, by barren sandy and siliceous strata, upon which, as upon the stratified detritus before mentioned, no terrestrial mollusk lives. It is rather curious that this division has been sufficient to cause a noticeable difference in the molluscan fauna of each district. In the table I have drawn up to exhibit the distribution of the species, I have inserted columns to show how far this is the case. From this table it will be seen that the molluscan fauna of the northern division has a greater number of species identical with or allied to those of Venezuela and the Antilles than that of the southern; while that of the latter has a greater affinity to the fauna of the Guianas. This fact may not go for much, it is true, and it is possible that some of the species may ultimately be found to have a wider range; but I thought the point worth noting. Where I have deemed the species peculiar, I have taken an allied form for the purpose of carrying out the comparison.

* Some living land-shells from the Antilles (*Bulimus exilis, B. virgulatus,* a species of *Cistula,* and *Macroceramus signatus*) escaped from my vivarium on one occasion. Should these be hereafter found in Trinidad, they should not be confounded with the aboriginal Mollusca.

It will be seen by the table that scarcely more than one-third (12) of the whole number (33†) of species found in the island are peculiar to it. Of the remainder, sixteen are found in the Antilles and thirteen in South America, eight being common to the Antilles and the continent.

Examples of all the peculiar species, and of most of the other shells mentioned in this communication, have been deposited in the British Museum.

Table showing the Distribution of the Terrestrial and Fluviatile Mollusca of Trinidad.

	North Division.	South Division.	Allied Species, where the species is peculiar.	Locality, if found elsewhere; if peculiar, Locality of allied Species.
Neritina microstoma ..	*	..	....	Cuba.
Paludestrina spiralis ..	*	..	P. candeana	S. America.
Ampullaria urceus	*	*	....	Venezuela.
—— effusa	*	*	....	S. America.
Marisa cornu-arietis ..	*	*	....	S. Amer.; St. Vincent.
Adamsiella aripensis ..	*	..	A. xanthostoma, &c.	Jamaica.
Cyclotus translucidus ..	*	*	....	Venezuela.
—— rugatus	*	..	C. stramineus	Venezuela.
Helicina nemoralis	*	*	H. jamaicensis	Jamaica.
—— barbata	*	*	H. Dysoni........	Honduras.
Physa rivalis	*	..	....	Antilles.
Planorbis terversanus ..	*	*	....	Cuba.
Vaginulus Sloanei	*	..	....	Jamaica; Cuba.
Succinea approximans..	*	*	....	Antilles.
Bulimus oblongus	*	*	....	S. America; Antilles
—— zebra	*	..	....	Antilles; S. America.
—— fraterculus	*	*	....	S. America; Antilles.
—— immaculatus	*	..	....	Antilles.
—— multifasciatus....	*	..	....	S. America; Antilles.
—— *var.* imperfectus‡	..	*		
—— aureolus	..	*	B. limpidus	S. America.
—— octonoides	*	*	....	Antilles.
—— caracasensis......	*	*	....	Venezuela; Antilles.
Plekocheilus auris-sciuri	*	*	{ P. undulatus ...... P. distortus	St. Vincent. Venezuela.
Tornatellina lamellata..	*	*	....	S. America; Antilles.
Stenogyra octona......	*	*	....	S. America; Antilles.
Ennea bicolor	*	..	....	St. Thomas, E. Indies.
Vertigo Eyriesi	..	*	....	Guiana.
Cylindrella trinitaria ..	*	..	C. collaris	Antilles.
Streptaxis deformis....	*	*	....	S. America.
Simpulopsis corrugatus.	..	*	S. brasiliensis	S. America.
Conulus vacans	*	*	C. semen-lini	S. America.
Anodon Leotaudi	..	*	A. amazonensis....	S. America.

† Including one marked variety.
‡ This variety has been included in this list principally on account of its distribution.

40 Upper Baker Street, N.W., Nov. 28, 1865.

V.—*Notice of some new Species of* Callithrix *in the Collection of the British Museum.* By Dr. J. E. Gray, F.R.S. &c.

There is perhaps no genus of American Monkeys that appears more difficult to distinguish than the beautiful group of small Monkeys named *Callithrix.* There is a large series of them in the British Museum, and among them there are two species which do not as yet appear to have been noticed in the Catalogues.

Count Hoffmansegg described two species many years ago. Spix has figured five; but two of the figures are so badly coloured that, if it were not for the description, one might doubt which species they were intended to represent. M. I. Geoffroy has figured two; but his figures have the defect of over-brightness, as Spix's have that of dulness.

The species in the British Museum may be thus arranged:—

1. *The fur soft, with abundant, elongated, stiffer hairs.*

a. The hands and feet red. 1. *C. cuprea,* Spix, t. 17 = *C. discors,* Geoff.

b. The hands and feet whitish. 2. *C. donacophila,* D'Orb.; 3. *C. Moloch,* Hoffm.; 4. *C. ornata,* n. sp.

c. The hands white, the feet black. 5. *C. amicta,* Geoff.; 6. *C. torquata,* Hoffm.

d. The hands and feet black. 7. *C. personata,* Geoff.; 8. *C. nigrifrons,* Spix, t. 15; 9. *C. castaneoventris,* n. sp.

The second series consists of the species which have only a soft woolly fur and the hands and feet black—as (10) *C. melanochir,* Geoff. Paris Mus. Cat., (11) *C. gigo,* Spix, t. 18: but of this group unfortunately there is not any specimen in the Museum; and they cannot be the young of the other species, as there are several young specimens of the first group in the Museum, and they have the longer bristly hairs of the adult animal.

This separation of the species by the colour of the hands may appear to be very artificial; but the hands of the different specimens from the same locality do not vary, while there is often a considerable variation in the depth of the colour in the other parts of the fur.

Callithrix ornata, n. sp.

Fur black and grey, punctulated; forehead and ears white; temple, cheeks, throat, underside of the body, and inner side of the legs bright red chestnut; hands and feet grey; tail black, grey-washed; hair of tail pale, with a broad subterminal ring.

Hab. New Granada.

Received from M. Verreaux as *C. discolor* of I. Geoffroy; but that species has red-chestnut hands. It is more like *C. Moloch*, and may be a variety of it; but it differs greatly from Geoffroy and Dahlbom's description.

Callithrix castaneoventris, n. sp.

Fur dark blackish grey, minutely punctulated with grey; outside of the limbs reddish-washed; forehead, hands, and feet black; whiskers, throat, chest, belly, and inside of the limbs dark-red chestnut; tail black, tip washed with white; hair of tail black the whole length, except near the end, where the tips of the hairs are white.

Hab. Brazils.

VI.—*Notulæ Lichenologicæ.* No. I.

By the Rev. W. A. Leighton, B.A., F.L.S.

On the Reaction of Iodine in Lichens and Fungi.

In his earliest writings on Lichens, and down to the present time, Dr. W. Nylander, one of the most accurate and learned of European lichenologists, has shown that the application of an aqueous solution of iodine affords a very useful aid in the examination and determination of Lichens, especially the inferior ones. By a chemical reaction the solution produces a change of colour either in the gelatina hymenea, or the spores, or the thecæ, or the thallus. This reaction is a coloration of these parts, either of a blue colour or of a vinous red (as in *Agyrium rufum*, Fr.); or if at first a blue is produced, it almost immediately changes in some instances into a vinous red. If the reaction does not take place, the parts remain simply colourless or become of a yellow tinge, similar to the colour of the solution itself. This reaction is constant; and although no reliance can be placed on it in the way of an isolated character, still it is highly useful as a valuable and unfailing confirmatory one, when combined with others, either external or internal. Such a chemical difference, however, indicates an organic difference worthy of investigation, and which might be otherwise overlooked.

This chemical reaction occurs just the same, whether the specimen of the lichen be recently or long since gathered.

But the same is not always the case in Fungi; for Dr. Nylander gathered near Helsingfors, in Finland, a specimen of *Peziza Polytrichii*, Schum., which perfectly agreed with the figure in 'Fl. Dan.' t. 1916. fig. 1, in which the gelatina hymenea in a living state became intensely blue with the solution of iodine. But on examining the same specimen two years afterwards, the iodine produced no reaction, the gelatina hymenea remaining colourless, or only becoming yellowish. Such a singular difference arising from desiccation Dr. Nylander has never observed before or elsewhere, nor can he assign any reason why, in a dried and aged state, the chemical nature of the thalamium should become changed.

In many species of the genus *Peziza* the gelatina hymenea becomes blue with iodine. In *P. cochleata*, Huds., and *P. violacea*, Pers., it does so, and the thecæ more intensely so at their extreme apices. In other species the thecæ alone, especially at the apices, are turned blue, as in *P. firma*, Pers., *P. plumbea*, Fr., *P. juncigena*, Nyl., *P. undella*, Fr., *P. cerea*, Sow., *P. repanda*, Wahlenb., and in many others,—thus manifesting that the nature of Fungi differs from that of Lichens. [Summaried from the 'Flora' of Oct. 10, 1865.]

In a letter recently received from Dr. Nylander, he has kindly furnished the proper formula for the solution, viz. :—

Iodine, gr. j.
Iodide of potash, gr. iij.

Dissolve these in 6 oz. of distilled water, and filter for use. The solution should be kept from the light in a black glass bottle, or in one covered with paper. In using it, it is sufficient to apply a drop to the edge of the thin glass covering the dissection, under which it will diffuse itself in the water containing the object.

VII.—*Notulæ Lichenologicæ.* No. II.
By the Rev. W. A. Leighton, B.A., F.L.S.

During the past year Dr. Wm. Nylander has named and characterized the following new British Lichens, in the 'Flora' of January 18th, March 29th, May 6th, and July 29th, 1865.

1. *Collema furfureum*, Nyl.

Thallus fusco-niger (vel niger), statu humido rubricose nigricans (sub microscopio lamina tenui extus rubricose rufescente); apothecia fere urceolariformia; sporæ simplices, ellipsoideæ. Gelatina hymenea iodo vinose rubens.

Discovered by Admiral Jones, on rocks of Ben Lawers, Scotland.

Allied to *Collema granuliforme*, Nyl.

2. *Leptogium rhyparodes*, Nyl.

Thallus fuscus vel sæpe fusco-nigrescens, furfurosus, tenuis, aut subgranulosus, diffusus; apothecia concoloria vel rarius (magis evoluta) rufescentia, parva (latit. 0·2–0·4 millim.), deinde planiuscula et denique biatorina; sporæ (formæ maxime solitæ in hoc genere) ovoideæ (apice infero aut utroque attenuatæ), submurali-divisæ; longit. 0·020–0·030, crassit. 0·011–0·014 millim.; paraphyses gracilescentes. Gelatina hymenea iodo cærulescens.

Discovered by Admiral Jones, on the micaceo-schistose rocks of Ben Lawers, Scotland.

The thallus, when moistened with the aqueous solution of iodine, becomes of a vinous-red tinge.

3. *Pyrenidium actinellum*, Nyl.

Thallus sordide vel obscure olivaceus, adnatus, maculas parvas (latit. vulgo 1–2 millim.) sistens, tenuiter stellato-divisus, radiis vix nisi apicibus attenuatis discretis; apothecia pyrenodea, in centro thalli parce obvia, prominula, perithecio integre nigro (latit. 0·30–0·35 millim.); sporæ 4^{næ}, fuscæ vel fuscescentes, oblongæ, 3-septatæ, longit. 0·020–0·024 millim., crassit. 0·008–0·010 millim.; paraphyses graciles, parcæ vel obsoletæ.

Discovered by Admiral Jones, on the chalk of Bexley Hill, Kent.

Lichen est quam maxime paradoxus. Apotheciis pyrenocarpis et sporis infuscatis distat a *Collemeis*, sed textura thalli accedit ad *Leptogium*. In centro fere cujusvis thalli apothecia inveni; divisiones hujus variant adscendentes vel erectiusculæ (crassit. 0·03–0·09 millim.). Thallus iodo vinose rubescens.

4. *Calicium trajectum*, Nyl.

Thallus vix ullus distinctus; apothecia sicut in *C. eusporo*, sed breviora et nonnihil validiora; sporæ (ut in *Physciis melanocarpis*) oblongo-fusiformes, biloculares (vel 4-loculares), longit. 0·052–0·060 millim., crassit. 0·016–0·021 millim.

Discovered by Rev. T. Salwey, on trees in the New Forest, Hampshire.

5. *Lecanora poriniformis*, Nyl.

Thallus cinereus vel pallide cinereus, firmus, sat tenuis, rimoso-diffractus; apothecia in verrucis convexis (*Pertusariæ* facie), prominulis (latit. 0·5–1·2 millim., altit. 0·6–1·2 mill.), innata, pallida, epithecio (pallido) punctiformi-contracto 1 vel 3–4 in quavis verruca; sporæ 6–8^{næ}, incolores, ellipsoideæ, longit. 0·070–0·080, crassit. 0·034–0·050 millim., paraphyses gracilescentes. Gelatina hymenea iodo cærulescens, deinde lutescens.

Discovered by Admiral Jones, on the micaceous schist of Ben Lawers, Scotland.

Differing from *Pertusaria* by the hymenium, thecæ, and spores. The verrucæ are often pale above. The aspect is altogether that of a *Pertusaria,* but its systematic place is near *L. verrucosa* (stirps *Lecanoræ cinereæ*).

6. *Pertusaria gyrocheila,* Nyl.

Thallus cinerascens, subgranuloso-inæqualis, rimoso-diffractus, mediocris (crass. fere 0·5 mill.); apothecia in tuberculis (altit. fere 2 millim., vulgo latit. 3–5 millim.) thelotremoidea, simplicia aut demum supra subgyrosis e margine thallino crasso subgyroso, epitheciis glypholecine compositis, hymenio pallido; sporæ 8^{næ}, incolores, ellipsoideæ, longit. circiter 0·068–0·070, crassit. 0·036–0·050 millim. Gelatina hymenea et thecæ iodo cærulescentes.

Discovered by Isaac Carroll, Esq., 1864, near the summit of Ben Lawers.

A very singular species, the verrucæ of the apothecia being crateriform.

7. *Pertusaria ophthalmiza,* Nyl.

Sporis usque longit. 0·160–0·205, crassit. 0·080–0·100 millim.

Discovered by Admiral Jones and Mr. I. Carroll, on Pine, Glenfalloch, Scotland.

8. *Lecidea diducens,* Nyl.

Thallus vix ullus; apothecia nigra, mediocria, plana, marginata (margine sæpius flexuoso), intus obscura; sporæ 8[næ], incolores, ellipsoideæ vel oblongæ, longit. 0·008–0·009, crassit. 0·0035–0·0045 millim.; hypothecium fuscum; paraphyses crassæ, distinctæ (crass. circiter 0·0035 millim.), apice clavato, nigro vel nigricante. Gelatina hymenea iodo cærulescens.

Discovered on felspathic rocks in Jersey, by Charles Larbalestier, Esq.

The aggregate apothecia, absence of thallus, small spores, and thick paraphyses keep this species distinct.

9. *Lecidea rhizobola,* Nyl.

Thallus castaneo-fuscus vel lurido-fuscescens, squamosus, squamis rigidis, rotundatis vel rotundato-difformibus (latit. 4–7 millim.), margine crenatis, subtus pallidis vel albidis, inæqualibus, centroque longe radicatis; apothecia nigricantia, mediocria, intus albido-pallida; sporæ 8[næ], oblongo-ellipsoideæ, simplices, longit. 0·012–0·016, crassit. 0·006–0·007 millim.; paraphyses haud bene discretæ. Gelatina hymenea iodo vinose rubens.

Discovered by Admiral Jones, on Ben Lawers, Scotland.

Allied to *Lecidea globifera,* Ach., and conspicuous by the horizontal thalline scales having long and divided roots.

10. *Lecidea luteella*, Nyl.

Thallus albus, tenuissimus vel macula alba indicatus; apothecia lutea (pallido-lutescentia), parva, marginata (vel submarginata, juvenilia gyalectoidea), intus incoloria; sporæ $8^{næ}$, oblongæ vel oblongo-fusiformes, 1-septatæ, longit. 0·016–0·023, crassit. 0·006–0·007 millim.; thecæ apice sæpius crasse solidæ; paraphyses graciles.

Discovered by Admiral Jones, on calcareous stones in Ireland. Its systematic place is after *L. erysiboides*, Nyl.

11. *Lecidea contristans*, Nyl.

Thallus fuscus vel fusco-nigricans, tenuis, granulosus; apothecia nigra (latit. 0·6–0·9 millim.), convexiuscula, immarginata, intus obscura; sporæ $8^{næ}$, incolores, ellipsoideæ vel oblongæ, 1-septatæ, longit. 0·010–0·014, crassit. 0·0045–0·0065 millim.; paraphyses haud discretæ; epithecium nigricans; hypothecium sordide tinctum. Gelatina hymenca iodo cærulescens, dein sordide lutescens.

Discovered by Isaac Carroll, Esq. (1864), on decaying *Andrææ* on the summit of Ben Lawers.

Systematically near *L. melæna*, Nyl.

12. *Lecidea premneoides*, Ach.

Thallus pallido-virescens vel cineraceo-virescens, tenuiter leprosus, effusus; apothecia nigra, mediocria, marginata, plana, epithecio interdum subvirescenti-suffuso; sporæ $8^{næ}$, incolores, oblongæ (obsolete vel tenuiter 3-septatæ), longit. 0·019–0·025, crassit. 0·007–0·008 millim.; paraphyses gracilescentes; hypothecium nigrum. Gelatina hymenea iodo vinose rubens.

Discovered on walls in the island of Jersey, by Charles Larbalestier, Esq.

Allied to *L. aromatica*, Ach., and *L. granosa*, Tuck (thallus albidus vel albido-cinerascens, apothecia minora, &c.), but with the aspect of *L. premnea*, Ach.

13. *Opegrapha lentiginosula*, Nyl.

Thallus vix ullus; apothecia minutula (longit. 0·25 millim.), ellipsoidea (vel raro semel divisa), epithecio rimiformi; sporæ fuscæ, ovoideæ, 1-septatæ (ad septum constrictiusculæ), longit. 0·020–0·023, crassit. 0·010–0·011 millim.; paraphyses vix ullæ; hypothecium in color. Gelatina hymenea iodo vix vel obsolete cærulescens.

Discovered by Isaac Carroll, Esq. (1864), on pine-bark at Glenfalloch, Scotland.

Like *O. lentiginosa,* Lyell, but smaller, though with larger spores.

14. *Verrucaria tristicula,* Nyl.

Thallus fuscus, tenuiter granulosus, effusus; apothecia nigra, perithecio (sensu altitudinis ellipsoideo, latit. 0·4–0·5 millim.) integre nigro firmo ruguloso subconice prominulo, epithecio punctiformi-impresso; thecæ vulgo monosporæ; sporæ fuscæ, murali-divisæ, oblongæ, longit. 0·070–0·120, crassit. 0·023–0·036 millim.; paraphyses nullæ. Gelatina hymenca iodo vinose rubens.

Discovered by Admiral Jones, on mosses (*Weisia*) in Aberdeenshire, Scotland.

A remarkable species, approaching *V. gelatinosa,* Ach.

15. *Verrucaria nigritella,* Nyl.

Thallus niger, magmoideus (forte non proprius, initiis algologicis compositus); apothecia nigra, sat parva (latit. 0·17–0·25 millim.), perithecio integre nigro, nonnihil prominulo, epithecio vix impresso; sporæ fuscæ, ellipsoideæ vel oblongo-ellipsoideæ, varie divisæ, longit. 0·021–0·036, crass. 0·009–0·014 millim.; paraphyses nullæ. Gelatina hymenea iodo vinose rubescens vel fulvescens.

Discovered by Isaac Carroll, Esq. (1864), between the scales of the thallus of *V. tephroides,* Ach., on the earth at the top of Ben Lawers.

The spores are nearly similar to those of *Urceolaria scruposa,* Ach., and are much smaller than those of *V. nigrata,* Nyl.

16. *Verrucaria leptotera,* Nyl.

Thallus obscure olivaceus vel olivaceo-nigrescens, lævis, subnitidiusculus, indeterminatus, sat tenuis; apothecia nigra, minuta, subinnata; sporæ incolores, oblongæ, 1-septatæ (altero apice paullo crassiores), longit. 0·016–0·018, crassit. fere 0·005; paraphyses nullæ.

Discovered by Charles Larbalestier, Esq., on maritime rocks in the island of Jersey.

Externally very similar to *Verrucaria mucosa,* Ach. Possibly only a variety of *V. consequens,* Nyl. (in 'Flora,' 1864, p. 357), differing by the smaller apothecia and narrower spores.

17. *Verrucaria innata,* Nyl.

In thallo *Lecideæ Hookerii,* Schær., innata, minuta, perithecio integre nigro; sporæ $8^{næ}$, incolores, ovoideæ, 1-septatæ, longit. 0·018–0·023, crass. 0·008–0·011 millim.; paraphyses parcæ, irregulares, vel vix ullæ. Gelatina hymenea iodo haud tincta (lutescens).

Discovered by Admiral Jones, on the earth of Ben Lawers, growing with *V. nigrata*, Nyl.

An huc pertineat *Sphæria Schæreri*, Mass. Sulla *Lec. Hook.* p. 82? Sporas multoties minores indicat.

18. *Verrucaria superposita*, Nyl.

Thallus forte nullus proprius; apothecia nigra, turgidula, perithecio (latit. 0·20–0·25 millim.) integre nigro, epithecio impresso; sporæ 8^{nae}, incolores, ovoideæ, 1-septatæ, longit. 0·017–0·019, crass. 0·007–0·008 millim.; paraphyses nullæ. Gelatina hymenea iodo vinose rubens.

Discovered by Admiral Jones and Isaac Carroll, Esq., growing on the thallus and hypothallus of *V. theleodes*, Smrf.; also upon a thin, whitish, opake, granulate thallus, which may be possibly its own.

19. *Verrucaria allogena*, Nyl.

Apothecia demum prominula (latit. 0·25 millim.), perithecio dimidiatim nigro, parte immersa (vel infera ejusdem) subincolore (vel interdum leviter fuscescente); sporæ incolores, 1-septatæ (formæ sicut in *V. epidermidis*, Ach.), longit. 0·023–0·027, crass. 0·008–0·009 millim. (paraphyses fere ut in var. *fallax*, Nyl.).

Discovered by Isaac Carroll, Esq. (1864), on micaceo-schistose rocks on the summit of Ben Lawers, growing on the thallus of *Lecidea excentrica*, Ach.

Only a variety of *V. epidermidis*, Ach.

20. *Verrucaria subintegra*, Nyl.

Thallus pallide cinereo-virescens, tenuis, rimulosus, indeterminatus; apothecia mediocria, convexula, prominula, perithecio integre vel subintegre nigro; sporæ fusiformes, 3-septatæ, longit. 0·020–0·027 millim., crassit. 0·006–0·007 mill.

Discovered by Charles Larbalestier, Esq., on granitic rocks in the island of Jersey.

Scarcely specifically distinct from *V. chlorotica*, Ach.

21. *Verrucaria dubiella*, Nyl.

Thallus cinerascens, cartilagineus, granulato-inæqualis, subcrenatus (an proprius?); apothecia nigra, parvula (latit. 0·2 millim. vel minora), perithecio integre nigro; sporæ 8^{nae}, incolores, oblongæ vel ovoideo-oblongæ, longit. 0·016–0·021, crassit. 0·005–0·007 millim.; paraphyses nullæ. Gelatina hymenea iodo vinose rubens.

Discovered by Isaac Carroll, Esq. (1864), on mosses in the Scottish mountains, Lochna-Cat.

A species well distinguished by its small 3-septate spores. It is probably parasitic.

22. *Verrucaria endococcoidea*, Nyl.

Thallus proprius nullus; apothecia nigra, minuta, endococcoidea, perithecio parte immersa tenui fusca (latit. 0·12–0·16 millim.), parte supera (extus visibili) convexula; sporæ $8^{næ}$, incolores, oblongo-ellipsoideæ, 3-septatæ, longit. 0·016–0·018, crass. 0·006–0·007 millim.; paraphyses nullæ. Gelatina hymenea iodo vinose rubens; sporæ dilute cærulescentes.

Discovered by Admiral Jones growing parasitically on the thallus of *Lecidea excentrica*, Ach., near the summit of Ben Lawers, Scotland.

Apparently allied to *V. dubiella*, Nyl. From others it scarcely differs in the spores becoming blue with iodine.

23. *Verrucaria platypyrenia*, Nyl.

Late effusa; apotheciis planis vel planiusculis (latit. 0·5 millim.), primo hypophlœodeis opacis; sporæ incolores (vel demum vetustate fuscescentes), oblongæ, 3–5-septatæ, longit. 0·023–0·030, crassit. 0·009–0·011 millim.; paraphyses molles, irregulares, vel non distinctæ.

On bark near Cork, Ireland. Discovered by Isaac Carroll, Esq. Probably only a variety of *V. epidermidis*, Ach.

BIBLIOGRAPHICAL NOTICES.

Manual of Geology. By The Rev. Samuel Haughton, M.D., F.R.S., Fellow of Trinity College, Professor of Geology in the University of Dublin. London: Longman & Co., 1865. 8vo. pp. 360, with sixty-six woodcuts.

What is Geology? And what is a Manual of Geology? Some think that they have mastered the science when they know something about the materials of the crust of the earth (Mineralogy and Lithology), about their order of position (Stratification), about the methods and agents of their arrangement (Geological Dynamics), about the fossils representing former animals and plants (Palæontology), about the various distribution of old seas and lands and the successive faunæ and floræ (Theoretical Geology), and about the practical uses of geological knowledge. To get thus far they provide themselves with as limited an acquaintance with chemistry, physics, and biology as is compatible with their task (or such only as they happen to pick up), and take for granted very much of both the observational and hypothetical bases of the science from their teachers and text-books.

But really they have not even then the whole range of the science before them ; for they have been studying the earth's crust and surface, not the earth as a whole. What is known of the earth's phenomena as a planet has been gathered by astronomers and geodetical surveyors, but it does not the less belong to the observational part of geology (Geognosy). What is known of this planet's history is the combined result of astronomical, physical, chemical, and mineralogical research, and belongs to theoretical geology ; for it illustrates the history of the earth in early times. Does any manual, guide-book, class-book, or elementary treatise on geology supply a concise *résumé* of what is known on all the above-mentioned departments of geological science, so that the Student can see what he has to learn and how to learn it, and the Expert feel that he has a real *aide-mémoire,* complete, with additions and corrections to the latest date?

The Rev. Dr. Haughton has added another to the many good geological treatises (by Naumann, Vogt, D'Halloy, Beudant, De la Beche, Phillips, Lyell, Jukes, Hitchcock, Dana, Ansted, Page, and others) already existing; but they are either too special and partial, too diffuse and yet too imperfect, or otherwise ill adapted for ordinary students. Naumann's comprehensive and well-planned 'Lehrbuch' is three-volumed, and much too large for general students. Dana's is a model manual, but it is avowedly systematized on American geology. Thus the student, not training for special or professional geology, but working up a general knowledge of the earth and its history, feels the want of a concise, clear, and trustworthy guide-book for the many-branched science of geology, leading him away from the slough of popular notions and lapsing hypotheses, through the rocky paths of experiment and observation, to the higher ranges commanding a good general view of his subject, without waste of time by devious wanderings into the unknown, or hobby-ridings in the bypaths of an author's favourite fields.

In the book before us Dr. Haughton publishes fifteen Lectures delivered in 1862, and relating chiefly to Palæontology, or the history of the earth's inhabitants. He first treats of the origin of the globe, and the physical conditions necessary to be established on the earth before it could have had any inhabitants at all. First he refers to his acceptation of Laplace's nebular hypothesis, as a basis, in some former lectures on geology, and adopting Durocher's hypothesis of a difference of materials in the first and second incandescent layers under the crust of the cooling globe (the outer, *acid* or granitic magma, and the second, *basic* or trappean magma), arranged by specific gravity, dependent on chemical constitution, changed by oxidation in course of time, and forced out in succession through fissures during the contraction of the earth's crust. The formation of the atmosphere, the salinity of the sea, and some other points complete the subjects of the first Lecture. This has two valuable Appendices. 1. A translation of Durocher's Essay on Comparative Petrology; and 2. Notes on the Origin of Granite, by the author.

Sandstones, schists, and limestones, as types of the aqueous or stratified rocks, their modes of formation, their characters and classification, occupy Lecture II.

Concretions or nodules (including rocksalt and gypsum) in strata are next studied, and, together with modes of fossilization, form the third Lecture. The fourth considers geological time, tests of age in rocks stratified and unstratified (namely, relative position, mineral composition, and characteristic fossils), the thickness of strata, and its relation to time and to the development of organic life (a greater number of species accompanying a given thickness of stratified material at later than at older periods). Appendices on the theories of solar heat, and the calculation of geological time based thereon, accompany Lecture IV. The rate of production of species of crustacea, fishes, reptiles, and mammals in past time, and their relative zoological importance and chronological development, are tabulated and shown by diagrams in Lecture V., which also treats of the classification of animals by Aristotle, Linné, Cuvier, and Lamarck. Dr. Haughton then concisely defines—1. The *Spondylozoa* (Vertebrates); 2. The *Entomozoa* (Annulose animals); 3. The *Malacozoa* (Mollusks); 4. The *Echinozoa* (Echinoderms); 5. The *Cœlenterozoa* (Corals, &c.); and, 6. The *Protozoa*. The Appendices give details of classificatory arrangements by Moses, Aristotle, Linné, and Cuvier. Lecture VI. has the Azoic and Palæozoic rocks for its subject. In 1862 most metamorphic rocks were commonly regarded as being "Azoic;" now, however, more of them are known to be fossiliferous, and nearly all (leaving still some granitic masses to be explained, perhaps by Durocher's theory) are referred to some series or other of the known stratified rocks, the *oldest* groups having, of course, the largest proportion of *altered* rocks. The classification of rocks (based on succession in time and difference of formation) by Linné and Werner, and Hutton's correction of Wernerian notions, are given. The great granitic and gneissose tracts (now regarded mainly as belonging to the Laurentian system) are briefly described. The Lower Palæozoic strata are then referred to—first, as being badly provided with divisional names; secondly, as characterized in the lower group by Mollusks and Crustaceans ("Malacozoic"), and in the upper by Fishes ("Ichthyozoic").

The wide range of species, not only in Palæozoic but in Mesozoic rocks, and the increase of difficulties in regard to the contemporaneity or non-contemporaneity of strata containing similar fossils, are also treated of in this chapter; and the author seems to think that when Ammonites and Ichthyosaurs lived in a warm climate at what are now the Arctic Regions, the equatorial heat must have been unbearable; that as the globe cooled creatures migrated towards the equator from high latitudes to find a congenial temperature, new forms replacing them; and that, hence, strata in different latitudes bearing similar or characteristic fossils are not strictly contemporaneous, but subdivisible into representatives of many periods of time. This last idea, already handled by De la Beche, Forbes, and Huxley, and illustrated by Jenkins, Duncan, and others, seems true enough, whether the climates were influenced by the internal heat of the globe (which we thought to have been disproved by Hopkins), or by steam and carbonic acid of the atmosphere keeping the earth warm in early days: and now we speak of *Homotaxis* ("same arrangement"), and of the Homotaxeous relationship of strata, instead of hypothetical and possibly false *contemporaneity*. In the Appendices to this chapter we have, first, Linné's theory of the formation of rocks; and secondly, the author's views as to the formation of continents and mountain-chains, already known as a bold and ingenious theory, full of worth.

Lecture VII. is preliminary to the study of fossils, being devoted to the explanation of the value of different kinds of symmetry in inorganic and organic nature, more particularly to the geologist, who has rarely anything but the hard parts of a creature to deal with. There is the symmetry of minerals, of plants, and of animals. The first is purely geometrical; and the lower the creature in the scale of organization the more perfect is its subjection to geometrical laws. In the highest development of the animal kingdom "we have the symmetry of form reduced to its simplest condition, that of a bilateral symmetry with reference to a plane, all symmetry with reference to a line having been abandoned." The consideration of this subject, which seems to be a favourite with the author, leads him to treat at length of the cells of bees, and of the opinions of Pappus, Maraldi, Reaumur, and Darwin thereon, the last-named getting but little credit.

The eighth Lecture commences the history of the creatures that lived at various times on the earth's surface, and premises "that there is a general progress in complexity of organization as we follow the history of the globe from the oldest to the newest strata, although there are many exceptions." The *Protozoa, Cœlenterozoa,* and *Entomozoa* are comprised in this lecture. Belonging to the first, the *Foraminifera* are spoken of; but the classification given for them at p. 174 is quite obsolete and superseded by Carpenter's. *Nummulina* is chiefly referred to, and the range of the Nummulitic strata. *Receptaculites* is also also brought forward, and, with *Orbitolites,* shows the geometrical symmetry of the "Spiral of Archimedes." Polycystines and Sponges are also briefly treated of; but even that little might be greatly improved. The Corals (*Hydrozoa* and *Actinozoa*) come next; and their symmetry being related to a *line,* whilst that of Echinoderms is related to a *plane,* is pointed out as one of the reasons for separating the latter, as a higher group, from the Cœlenterates. The Corals are better treated than the Protozoans, as to definition and classification. The *Entomozoa* or *Articulata* (Insects, Myriapods, Arachnids, Crustaceans, and Worms) are then noticed, more especially the Crustacea, including the Cirripedes, which, however, are not true Crustaceans, and among which certainly *Aptychus* has no place. With reference to palæontological laws, the Rev. Dr. Haughton prefers to say "that the Neozoic Crustaceans were superior in organization to the Palæozoic" than "that the Crustaceans progressed as the world grew older."

Fossil fishes occupy Lecture IX. They characterized the Upper Palæozoic (or Ichthyozoic) period. "There can be little doubt," says the author, "that the Palæozoic fishes approach the reptilian type more closely than the Neozoic fishes, and that they are entitled, if on this account alone, to be regarded as possessing a higher organization."

Lecture X. takes in the "Phytozoic Period" (seemingly the same as the "Ichthyozoic"), treating of fossil Plants, especially Conifers and Acrogens, Carboniferous plants, Sigillariæ and Lepidodendra, Calamites and Ferns, and giving special and general remarks thereon. The Appendix contains the author's elaboration of "the Phyllotaxis of Whorls."

Lecture XI. begins the Neozoic Period, and takes up the fossil Reptiles, so abundant as to characterize the "Saurozoic Period." We have a classification of Reptiles; and notes on the Chelonians, Saurians, Pterodactyles, Enaliosaurians (including a limbless tadpole Ichthyosaur! to be seen at Trinity College, Dublin), Labyrinthodonts, Ophidians, and Batrachians, in succession, form a brief history of the group. The monstrous restoration (at p. 275) of *Cheirotherium Anglorum* (why attributed to the *English* we do not know) is enough to frighten even naturalists themselves. We saw it once figuring in some book of popular geology, and shut the book at once. Birds appear in Lecture XII., as far, at least, as the Connecticut foot-prints and the Moa are concerned—not much for 1862, seeing that bird-bones had then been recognized in the Trias (North Carolina), the Stonesfield Oolite, the Wealden, the Upper Greensand, and many Tertiary beds. We must correct two statements made, at p. 282: first, the great fossil foot-prints at Hastings are Reptilian and not Ornithic; secondly, Dr. Mantell found only one or two Wealden bird-bones, not "many." The *Echinozoa* then have a few pages of classification and useful remarks, the Lecture ending with a wholesome caution to those who are fond of theorizing instead of collecting facts; and this seems to be offered by the author especially to those who see any evidence of the progression theory in the early appearance of the fixed Crinoids and the later predominance of the free Asteroids and Echinoids. Students will be glad of Lecture XIII. with its classificatory notices of Cephalopods and Bivalves, short as they are. *Oldhamia*, classed with *Polyzoa* on little or no evidence (it is either a Seaweed or a Sertularian), has more cuts than text; and *Graptolithus* (most probably a Sertularian) is grouped with them, and has but short shrift.

Lecture XIV., on fossil Mammals, has their classification for its basis. The "Mastozoic Epoch" of the author seems to have extended from the so-called Miocene to the Glacial period (*Dinotherium* and *Sivatherium*, the Mammoth and Megaceros, being some of the characteristic mammals). The next epoch is his "Anthropozoic;" and he says that the connecting links between these two epochs "are nowhere to be found." Surely the Camel and Giraffe are fossil in the Sivalik Hills with the Dinothere and Sivathere; surely Man and his works were contemporaneous with the old Elephant and the Irish Elk. Dr. H. Falconer has said that fossil Man will yet be found in Nature's great Sivalik cemetery, and at other places where, together with the great apes, he could exist, whether in Miocene or even earlier times, under tropical or sub-tropical conditions. We must wait. Alas that philosophers cannot profit by the cautions they give to others! Here our author definitely limits Man's existence to the post-Tertiary period, accepting negative evidence, too impatient to wait for coming facts, and more easily impressed with the "vague analogy" of Greek succeeding Assyrian, or the Roman the Hebrew, than willing to see that, as Mammals existed before his "Mastozoic Epoch," so remains of Man may well be looked for in strata older than those of his "Anthropozoic Epoch."

The last Lecture is an honest and "conservative" exposition of the author's views of the history of life on the globe; he compares Combe's 'Vestiges of Creation' with the philosophy of Lamarck and Darwin, and he rejects them all, preferring to "remain contented with the very old-fashioned, but very simple and very satisfactory, hypothesis of a Creator."

Altogether this is a remarkable book, good for geologists to read; by no means a "Manual," it is really a valuable series of Lectures on Palæontology, preceded by some on Geognosy, and enriched with the results of Prof. Haughton's labours in chemical geology, his masterly thoughts on cosmical subjects, his earnest philosophy, his clever mathematical researches, his genuine classical knowledge, and his pains-taking acknowledgment of what is due to the patriarchs of science. There are graces and virtues here which are rare enough in the majority of geological treatises, and which outweigh the deteriorating effect of rather too much egotism. It must have been a strong belief in the value of these lectures, in a philosophic point of view, that induced the author to present them, for the use of students, without even a footnote or an appendix to tell them of the three years' added knowledge. There is no note of the disentanglement of the Metamorphic or so-called "Azoic" rocks, and of the consequent disappearance of the "systems" of slates and gneiss from the geological class-room, no mention of *Archæopteryx* (the reptilian bird), nor any account of fossil works of man; and there are several shortcomings in the author's knowledge of natural history and geology. That additions might have been made, the introduction of the curious, but extremely doubtful, marsupialism of the Dinothere, at p. 333, makes evident; and appendices might have been still added. Possibly a new edition will take a new shape; and, incorporating and correcting, it will certainly form a highly valuable treatise, not so comprehensive as a real manual, not so cosmopolitan and independent of party principles; but, based on good ideas, and imbued with the author's own style of thought, it will treat of the globe as Haughton will have taught us to think of it,—it will treat of life on the globe as represented by the myriads of mingled created forms, distinct and yet united, independent portions of one great whole, related by analogies and homologies, separable in their degrees of symmetry and of complexity, of vital power, of instinct, and of intelligence, and all pointing to one Creative System, by whatever form of words we may try to define it.

Essay on the Trees and Shrubs of the Ancients; being the substance of four Lectures delivered before the University of Oxford. By C. Daubeny, M.D., Professor of Botany and Rural Economy. Oxford, 1865.

The subject to which these lectures were devoted has long excited the curiosity of botanists, from its historical interest and also from its difficulty. The unscientific reader of the classical authors has probably no idea that the identification of the plants there named with those of our own or other northern countries is, to say the least, uncertain and unsatisfactory.

The fruit-trees have perhaps been determined with tolerable correctness, and their names properly translated by the ordinary lexicographers; for they are mostly (as we learn from Pliny) introduced plants even in Italy: the Peach from Persia, the Quince from Crete, the Damson from Damascus, and so on. Even the Cherry is stated by him to have come from Pontus. In most of these cases, doubtless he was correct; and perhaps even the cultivated Cherry may have been introduced, just as the cultivated Hop is in England, the wild Cherry and the wild Hop having in both cases escaped the unobservant people of the periods recorded for their introduction into the respective countries.

Dr. Daubeny seems to think that the only fruits indigenous to Italy were the Mulberry, Apple, Pear, Plum, and Sorb.

It is even more difficult properly to apply the classical names to the forest-trees than to the fruit-trees. Let us take the *Fagus* or Beech as an example. It is stated by Cæsar not to inhabit Britain; and, indeed, Dr. Daubeny seems to consider it to have been introduced to our country not earlier than the Norman conquest; but surely he must have forgotten the extensive woods formed of this tree which now or recently existed in the chalky parts of the country. It is quite likely that Cæsar did not see the Beech in Britain, for he does not seem to have penetrated to the districts wooded by it; and there is also the confusion between the φηγός of Theophrastus and *Fagus* of Pliny to be remembered. The former may have been the *Quercus æsculus*; the latter correspond with the ὀξύη of Theophrastus.

The following extract will show the elaborate and exhaustive manner in which these curious questions are treated in the present book. On the tribe of Firs stated by Pliny to be pitch-bearing Dr. Daubeny says:—

"These Pliny divides into *Abies* and *Pinus*: and modern botanists, having separated the *Abietinæ* into two groups—namely, the one with leaves solitary or in two ranks, the other in clusters of two, three, or five each—place the former under the head of *Abies*, and the latter under that of *Pinus*.

"But we must not suppose that Pliny contemplated any such division. On the contrary, the Spruce Fir, which stands as the very type of the genus *Abies,* is not indigenous either in Italy or Greece. Loudon, therefore, and other botanical writers are in error when they regard the *Abies* of the Latins as the Spruce Fir of Northern nations.

"In order to ascertain what kind of tree Pliny meant by the term *Abies,* and Theophrastus by the corresponding one ἐλάτη, our best method will be to inquire, in the first instance, what are the species indigenous in Greece and Italy.

"In Greece Sibthorp enumerated the following:—

"1. *Pinus sylvestris,* Scotch Fir, which he states to be found in the mountains of Bithynia. As this, however, has not been confirmed by succeeding travellers, it seems doubtful whether he may not have confounded with it the Corsican Pine, *P. Laricio,* which, though omitted by him, is recognized by other botanists (Lambert, 'Genus Pinus,' Gussone, 'Flora Sicula') as existing in all the southern parts of Europe.

"2. *Pinus pinea,* Stone Pine, πίτυς of Dioscorides (i. 86), met with on the sandy shores of Western Peloponnesus.

"3. *Pinus maritima,* Maritime Pine, πεύκη of Dioscorides, found everywhere in the sandy flats of Greece, and especially in Elis. It is probably the same as *P. halepensis,* which Sibthorp omits, but which is stated by other writers as the commonest Fir in Greece, from the sea-shore to a height of about 3000 feet above it.

"*P. picea,* or *Abies pectinata,* the Silver Fir of modern botanists, and the ἐλάτη of Theophrastus, which is met with commonly on the loftier mountains of Greece.

"In Italy the same species occur, and, in addition to them, the *P. pinaster,* or Cluster Pine, is abundant as far south as Genoa, where it gives place to the *Pinus halepensis* already noticed, and, according to Tenore (Flora Neap.) to three others, namely *P. brutia, pumilio,* and *uncinata.*

"In the Alps, too, and the south of France the *Pinus Mugho* or *uncinata* and *Cembra* are abundant; so that the Roman writers may have had in their eye five more species of Fir than those occurring in Greece.

"Now, in order to prove which of the species above assigned is the one designated by Pliny under the name of *Abies,* and by the Greeks under that of ἐλάτη, let us consider the properties assigned to that tree.

"1. It was especially useful in ship-building. Hence in Euripides (Phœn. 208) ἐλάτη is used for a ship.

"2. It grows chiefly on the summits of mountains.

"3. It resembles in form the *P. picea.*

"4. It is chiefly used for beams, and other purposes for which solidity is requisite.

"5. It gives out so much resin that the quality of the wood is often impaired by the quantity emitted, even the warmth of the sun being sufficient to cause an exudation; whereas the same process is even serviceable in the case of the *Picea.*

"6. Lastly, it is inferior in the quality of its timber to the last-named species.

"Now of the *Pinuses* above enumerated as existing in southern Europe, the *Abies pectinata* is the one which seems best to accord with the above description, especially when we add that Pliny (lib. xvi. c. 38) describes it as having its leaves indented like the teeth of a comb, which may be regarded as expressive of one of the generic distinctions between the *Abies* and *Pinus* of modern botanists.

"But we must not expect from this author, or indeed from any of those of antiquity, the same precision as is demanded from modern botanists in such matters. Probably the two lines in Virgil's 7th Eclogue, v. 65—

'Fraxinus in silvis pulcherrima, Pinus in hortis,
Populus in fluviis, Abies in montibus altis,'—

expressed the amount of discrimination which the Romans exercised in such matters; so that not only the *Abies pectinata*, but any other resinous tree, with narrow pointed leaves, growing in mountainous places, attaining to a great height, and serviceable for timber, would have been included by them under the name of *Abies*."

The whole volume consists of similar discussions, and therefore does not admit of extract. It is sure to attract the attention of all who take any interest in the identification of ancient trees with those at present known, and must tend to correct many of the mistaken views now held by scholars concerning them.

The Record of Zoological Literature. 1864. Vol. I. Edited by ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.Z.S., &c. Van Voorst, 1865.

The difficulties which the naturalist has to encounter who is anxious to ascertain what has already been written on any special subject are continually becoming greater. Each year adds enormously to the aggregate of zoological literature; and from the work before us we learn that not less than 25,000 pages were, during the year 1864, devoted to the history of recent Zoology alone. Can we be surprised that genera and species have often again and again been redescribed, and that the lists of synonyms are often so long, when we bear in mind that naturalists engaged in identical pursuits are continually publishing their supposed discoveries in almost every language and every country in the world, and that the descriptions of species are, for the most part, not in monographs of particular sections of Zoology, but in the proceedings of some learned society, or the pages of some little-known periodical. Every zoologist must have frequently felt the great want of some guide, the references in which should act as fingerposts to point to him the directions in which he would be likely to obtain information respecting the object of his inquiry. True he has not been without some such guides; but they have been but inefficient. Engelmann's 'Bibliotheca Historico-Naturalis' and Carus's and Engelmann's 'Bibliotheca Zoologica,' as well as Agassiz's 'Bibliographia Zoologiæ et Geologiæ,' have been and must remain of great value; but they none of them bring the bibliography down to the present time, and, moreover, they only give the titles of books and papers, and, as a general rule, give little or no idea of the contents. The thing which every student must have felt the want of is a synopsis of zoological publications, which should be issued frequently, so as continually to keep pace with the progress of science. Attempts have been made in this direction. The 'Reports on the Progress of Zoology,' at one time published by the Ray Society; the "Notices of Serial Publications," in the first series of the 'Natural History Review,' and the "Zoological Bibliography" of the second series of the same work, and, last but not least, the annual "Bericht" in the 'Archiv für Naturgeschichte,' have all been of greater or less use, but have fallen very short of what was required. At length, however, the desideratum is supplied, and most heartily do we welcome the first volume of 'The Record of Zoological Literature.'

Dr. Günther is so well known, and the care and accuracy which characterize all his writings are so fully acknowledged, that the very mention of his name as Editor of the 'Record' will be a sufficient guarantee to our readers that the work will be energetically and ably conducted. "The object of the 'Record,'" as given in Dr. Günther's own words, "is to give, in an annual volume, reports on, abstracts of, and an index to, the various zoological publications which have appeared in the preceding year; to acquaint zoologists with the progress of every branch of their science in all parts of the globe; and to form a repertory which will retain its value for the student in future years." The editor is aided in the work which he has undertaken by an able staff of coadjutors, each of whom is well versed in that branch of Zoology which is more especially entrusted to his care. The several classes are thus apportioned among the contributors.

The Editor himself reports on the Mammalia, the Reptilia, and the Pisces.

Alfred Newton, M.A., F.L.S., &c., takes charge of the Aves.

Eduard von Martens, M.D., C.M Z.S., the Mollusca.

J. Reay Greene, B.A., the Molluscoida, Rotifera, Annelida, and Echinodermata.

C. Spence Bate, F.R.S., the Crustacea.

W. S. Dallas, F.L.S., &c., the Arachnida, Myriopoda, and Insecta.

T. Spencer Cobbold, F.R.S., the Helminthes.

The gentleman to whom was intrusted the Record of the Cœlenterata and Protozoa failed to keep his engagement; and the report, therefore, on these classes has been, we find, unfortunately deferred to the second volume.

A few rules have been drawn up for the guidance of the contributors, in order to secure a near approach to uniformity in the Records; and as these will further elucidate the aim and scope of the work, we give them here entire.

"1. To commence each Record with a *list of the various publications*, arranged chronologically, systematically, or alphabetically, with such remarks on their object, extent, and nature as cannot well be embodied in the special part of the Record. The student should be fully informed what he may expect to find in the work or memoir, and the Recorder may add any critical remarks which he thinks necessary for the object in view.

"2. To arrange the contents of all the publications *systematically* in the second, *special part* of the Record. This part will contain almost all the abstracts of memoirs and papers, new systematic arrangements, and discoveries. Papers difficult of access to the generality of zoologists to be given more in detail than others.

"3. Of new genera short diagnoses are to be given, if, in the opinion of the Recorder, such genera are likely to take a place in the system, whilst the names only of subgeneric divisions"—those abortions of science!—"are mentioned. All species described as new, with their habitats, and emended descriptions of known ones, are to be enumerated, with exact references to the several works and mention of accompanying illustrations. Diagnoses of new species to be given only when they are described in a journal or work difficult of access.

"4. The titles of anatomical papers to be given; but only those to be more specially treated which have a direct bearing on the classification, specific definition, or the life-history of an animal.

"5. The boundary-line between popular and scientific literature having become of late rather indefinite, such popular publications to be mentioned as deserve attention by their tendency to promote scientific knowledge, directly or indirectly."

The result of the joint labours of the contributors is a thick octavo volume of more than 600 pages, containing an immense amount of well-digested matter. It astonishes us to find the progress which is now being made in the investigation and description of the entire animal kingdom throughout the world. We have skimmed through the pages of this volume for the purpose of ascertaining the number of *genera* which have been described in the year 1864, and we find that they amount to 948. This immense addition to the generic nomenclature is thus distributed among the primary divisions of Zoology:—

Mammalia	26	Insecta:—	
Aves	22	Coleoptera	285
Reptilia	33	Hymenoptera	13
Pisces	43	Lepidoptera	216
Mollusca	47	Diptera	123
Molluscoida	4	Neuroptera	7
Crustacea	25	Orthoptera	13
Arachnida	10	Rhynchota	49
Myriopoda	6		
			706

Rotifera	0
Annelida	20
Helminthes	0
Echinodermata	6

Where all have so well executed the charge taken in hand, we are unwilling to say anything either of praise or blame respecting the individual work of the contributors. We feel bound, however, to suggest that Dr. von Martens should be kept better informed in future as to what has been published on the Mollusca in Great Britain. No allusion whatever is made in his report to the second volume of Jeffreys's 'British Conchology'*, nor to the elaborate "Report of the Mollusca of the West Coast of North America," by Mr. P. Carpenter, published in the 'Reports of the British Association.' Moreover Messrs. Alder and Hancock's anatomical and descriptive account of the "Nudibranchiate Mollusca of India," which is most carefully worked out and beautifully illustrated (Trans. Linn. Soc.), is passed by without a comment; and the reader would suppose, from appended observations, that a much less important paper of Angas and Crosse "On the Nudibranchiata of Port Jackson" was the more valuable contribution to science. We are at a loss, moreover, in Dr. von Martens's report, to know which of the species mentioned are new to science and which are not so.

In undertaking a report on the Insecta, Mr. Dallas bent his back to a giant's labour, and well he has borne it. No less than 256 pages are occupied by his report, and yet no portion of the volume gives evidence of greater care, has its matter in more closely condensed form, or, we may add, is more methodically and clearly analyzed and arranged.

We look upon the production of the present volume as of the very highest importance. It is an honour to the country in which it is published. It reflects still greater honour upon Dr. Günther and his brother labourers who have originated the 'Record.' Let our readers bear in mind that such a work as this is cannot be carried on unless it has a large sale. We do not think that we shall be stating the case too strongly if we say that every one interested in the progress of our science ought to be a purchaser of the 'Zoological Record' as a matter of duty, even if it should not be to him—as it can scarcely fail to be—a matter of self-interest.

Dr. Günther requests in his preface "suggestions which may tend to the improvement and perfection of the 'Record;'" here, then, are one or two trifles:—

1. That the exact date—that is, the month and day—when a paper is read or published should, where practicable, be given. This has been done by some of the contributors, but not by all.

2. That the names of new genera should be printed in a distinctive type, and should always commence a sentence, and not be for the first time introduced in the middle of a paragraph—for example, compare pages 308 and 408.

3. That an index be given of all the new genera described during the year. This would be of great use for the student who wishes to ascertain whether a name which he is about to propose is preoccupied or not.

The Rev. W. A. Leighton, F. L. S., is preparing for publication a Synopsis of British Lichens.

* We have since noticed that this volume, which was published in the middle of the year 1864, nevertheless bears the date 1863 on the title-page. This circumstance may perhaps have misled Dr. von Martens.

MISCELLANEOUS.

Notice of two New Species of Colobus *from Western Africa.* By Dr. J. E. Gray.

The British Museum some time ago received two skins from West Africa with some skins of *Colobi*: one is in a perfect state, with the skull, &c., and is doubtless a *Colobus*; the other, being a flat skin, without head, hands, or feet, can only be referred to that genus with great doubt; but if a *Colobus* or any other genus of Monkey, it is the skin of an animal that has not before occurred to me.

1. *Colobus cristatus.*

Crown of head with short reflexed hair, with two whorls on the forehead, and a narrow, linear, compressed, longitudinal crest behind; fur yellow-brown; front part of body, shoulders, and outside of fore legs greyer; throat, chest, belly, and inside of the limbs and the feet greyish white.

Hab. West Africa. Brit. Mus.

2. *Colobus?? chrysurus.*

Fur soft, blackish, brown-washed on the middle of the back; stripe down outside of the fore legs and along the middle of the upper side of the base of the tail, narrow at the base, but dilated at the end so as to cover the end of the tail, yellow-brown; hair on the sides of the body elongate; the sides of the throat and belly nakedish; hair of the back forming a whorl between the shoulders.

Hab. West Africa. Skin received with furriers' skins of *Colobi* from West Africa.

On Purifying the Water for the purpose of Fish-hatching. By W. H. Ransom, M.D.

It must have been noticed by every one who has attempted to hatch fish-spawn, that the great risk to the young fry is at the last moment, when the egg-covering should burst and the young fish escape. This spring, while hatching some spawn of Perch in a small dish, the water of which was changed daily, I lost a great number just as the young fish began to escape. The cause of the great number of deaths at that particular moment seemed to be the decomposition of those of the eggs which had not been fertilized; these making the surrounding water impure just when the embryos required most vigorously to respire. As I could not pour off the water to change it, for fear of losing the young ones, I added, night and morning, a few drops of a weak solution of permanganate of lime; this had at once the effect of sweetening the water and of supplying oxygen. I lost no more, and for many days I continued to add daily doses to the water in the dish without changing it. The young fry remained healthy, and seemed, although they could not have any food, as vigorous as were those from another batch of the same age which had been hatched in an old actively working aquarium. This fact may be of service to those engaged in fish-culture and in sending Salmon to Australia.—*Transactions of the Midland Scientific Association.*

A Fossil Lizard in Copal. By Prof. Peters.

M. W. Peters presented to the Academy a Gecko (*Hemidactylus*), enclosed in fossil copal-resin, from Zanzibar.

Under the name of copal, various resins occur in commerce, some of which are derived from America, others from the East Indies, New Zealand, and the tropical regions of East and West Africa. The American copal is obtained from *Rhus copallina* and other species of this genus; the Indian or oriental from *Elocecarpus copalifera*; and on the east coast of Africa fresh copal is procured from a tree (*Trachylobium mossambicense*) which I discovered there, and which has been accurately described and figured by Klotzsch*.

Besides this fresh copal, which is prepared principally by the Chinese, according to an unknown method, and is used for lacquering, there is found on the eastern coast of Africa fossil or subfossil copal, which is much dearer, and used for the best varnishes; it occurs, in larger or smaller beds, in the earth, not far from the coast†.

Mr. F. O'Swald, who remained several years in Zanzibar, has brought home a collection of pieces of this fossil or subfossil copal containing animals and plants enclosed within them, the former of which he sent me for examination ‡. Most of them belong to the articulate animals. Among them are not only representatives of all the orders of insects, but also Arachnida; and the species, according to M. Gerstäcker's determination, are unknown, but all referable to genera belonging to the present period §. A single piece only had contained a small lizard, of which, as shown by examination, no trace was left—the impression of its outer surface enclosing a perfectly empty space, on which the entire external figure and the form of the individual parts of the body and scales were so distinctly impressed, that it was easily recognized as belonging to the genus *Hemidactylus*. And, what appears to me to be of special interest,

* M. Peters, Naturwissensch. Reise nach Mossambique, Botanik, p. 21, taf. 2.

† See R. F. Burton, 'The Lake Regions of Central Africa,' vol. ii. p. 403.

‡ According to Mr. O'Swald, this copal is procured from tracts which are at present treeless, occurring from 3 to 9 feet under the surface of the ground. That the tree which has afforded this fossil copal agrees with *Trachylobium* has been proved by a large portion of a leaf being found in it.

§ The accurate determination of these species will be more especially interesting, because the locality from which the species of copal were obtained is known, while the origin of the insects described by J. W. Dalman (Kgl. Vetenskaps Akad. Handlingar för år 1825, Stockholm, 1826, p. 375) was unknown.

it agrees, omitting the paler colour, so accurately with a still living species, which was found by A. Smith at the Cape of Good Hope and by me near Cape Delgado (hence very near this layer of copal), that I see no reason why it should be separated from it. This species is *Hemidactylus capensis*, described and figured by A. Smith (Illustrations of the Zoology of South Africa: Reptiles, pl. 75. fig. 3), and which Dr. J. E. Gray has lately* described as a distinct genus, *Lygodactylus strigatus*.—*Monatsbericht d. Preuss. Akad.* Aug. 1865.

On the Spawn of the Perch. By W. H. Ransom, M.D.

The spawn of the Perch is well known as a gelatinous band, but it is less generally known to be a flattened tube, composed of cohering ova arranged in a network, not unlike a long bead purse. Some highly interesting observations by the late Johann Müller, on the structure of the covering of the eggs, led me to examine them with especial reference to the micropyle, which had not only escaped the scrutiny of that eminent anatomist, but also the search for it afterwards made by Reichert. After finding it I was induced to observe if it had any special relation to the network which the mass of ova forms, and I ascertained that in all cases it is regularly placed facing towards the cavity of the tube, so that by this regularity of the arrangement of the eggs none of them can have the micropyle occluded by their mutual cohesion. It is a matter of interest, and of some difficulty, to conceive how the sperms find their way along this mass of ova, nearly always to the right spot, for in nature very few of the eggs escape impregnation.—*Transactions of the Midland Scientific Association.*

On the Vital Resistance of Encysted Colpodæ. By M. Victor Meunier.

When, in July 1864, M. Coste made known his researches upon the development of ciliated Infusoria in an infusion of hay, M. Milne-Edwards expressed the opinion that the property possessed by encysted animalcules of returning to life in contact with water may throw fresh light upon certain cases of supposed spontaneous generation in infusions which had been boiled. Thus, if the cysts were but slightly permeable to water, the animalcules might remain dry in the midst of that liquid, so that, when boiled, they would be exposed to precisely the same test as if subjected to a dry temperature of 212° F. These remarks of M. Milne-Edwards led the author to make some direct experiments bearing on this point, of which he communicates the results in the following words.

He says, "The dust which is given off by hay when shaken furnished

* Proceedings of the Zool. Soc. London, 1864, p. 59. *Homodactylus Turneri*, which is also there described as a new genus and species, is identical with A. Smith's *Pachydactylus Bibronii* (*l.c.* pl. 50. fig. 1), as anyone may easily convince himself by comparing the figures (pl. 9. fig. 2).

the cysts necessary for my researches. This dust examined under the microscope presented,—1. particles of mineral matters (especially silica) and soot; 2. filaments of cotton, fragments of Diatoms, *débris* of vegetable epidermis, of cellular and ligneous tissue, and of simple or septate hairs, glumes and glumellæ of *Agrostis* and *Poa*, pollen-grains (especially of gramineous plants), spores, starch, and yeast; 3. filaments of wool and silk, scales of Lepidopterous insects, *Acari* of various ages and more or less shrivelled, dead individuals of *Anguillula*, large, contracted Rotifera, and, lastly, numerous cysts of ciliated Microzoa, especially *Colpodæ*, some shrivelled and dead, others capable of resuming active life in contact with water, although at the period when I observed them I had already kept the hay which furnished me with them for fourteen months.

"My plan of investigation consisting in subjecting the specimens of the dust at my disposal to the action of various temperatures, I had a previous question to solve, namely, whether the cysts were so uniformly diffused through the dust that, when the latter was divided into portions of the same weight, it might be regarded as certain that every one of these portions would contain encysted Microzoa. To ascertain this, having divided the dust into portions of 50 centigrammes, I put thirteen of these portions, taken at hazard, into the same number of test-glasses, each of which then received 40 cubic centimetres of filtered water. In less than two hours these thirteen macerations were populated with *Colpodæ*. It seemed to me that this trial authorized me to assume that all the portions still in my possession, if placed in the same conditions as the preceding, would, like them, have furnished revivified *Colpodæ*; and I held it as certain that if the dust was barren under changed conditions, its sterility must be attributed to the conditions in which I should have placed it.

"In all the following experiments there were used, as in the preceding trial, 50 centigrammes of dust, and 40 cubic centimètres of water. The dust and water having been placed in a mattrass for the experiments at 212° F., and in a test-tube suspended in a vessel full of water for those below 212° F., the mattrass or the tube, containing a mercurial thermometer, was immediately subjected to the action of heat. As soon as the desired calorific effect was produced, the tube was removed from the bath, or the mattrass from the fire, and, after cooling, the maceration was poured into a test-glass.

"My experiments were forty-one in number, and in fourteen of them the portions of dust were boiled. In the latter, two mattrasses were kept at 212° F. for ten minutes, eight were kept at 212° F. for five minutes, two were kept at 212° F. for two minutes; lastly, two mattrasses were removed from the fire the moment that temperature was attained. All these experiments prove that the encysted *Colpodæ* are killed by boiling."—*Comptes Rendus*, December 4, 1865, p. 991.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 98. FEBRUARY 1866.

VIII.—*Conchological Gleanings.*

By Dr. E. von Martens.

I. *On the Subdivisions of the genus* Pinna.

Chemnitz, in his well-known work 'Conchylien-Cabinet' (vol. viii. 1785, p. 197), represents the inside of two species of *Pinna*, in order to show, as he expresses himself, the shape of the muscular impressions and the singular outlines of stripes (sonderbare Zeichnung von Streifen) which are to be seen in some species on the inside of the apices. In the one, fig. A, *Pinna incurva*, Gmel., a median straight line is to be seen; in the other, fig. B, *P. nigrina*, Lam., no trace of it.

Lamarck observed in a fossil species, which he therefore named *P. subquadrivalvis*, that the median line of each valve is elevated into an edge and cleft ("valvarum angulo dorsali longitudinaliter fisso").

Dr. J. E. Gray established, as early as 1840, the genus *Atrina* for *P. nigrina*, in the 'Synopsis of the Contents of the British Museum,' but without stating anything about the characters of the new genus.

Mörch (Catalogue of the Collection of Yoldi, 1853, p. 51) distinguished four genera—*Pinna*, *Cyrtopinna*, *Pennaria*, and *Atrina*—also without any indication of the characters.

H. & A. Adams (Genera of recent Mollusca, vol. ii. 1858, p. 529) mention, in the general description of *Pinna*, that the "apical portions are sometimes longitudinally fissured, and the fissure filled up with cartilage;" they admit *Atrina* as a subgenus, and define it in the following words: "Shell with the apical portions of the valves entire." Consequently they seem to regard the fissure as characteristic of the subdivision of the true *Pinnæ*.

My attention was drawn to this subject by Mr. Sadebeck, assistant at the Palæontological Collection at Berlin, who showed me a fossil *Pinna* from the Jura formation (*P. granulata*) in which a part of the fibrous layer, the only one preserved, formed a very striking tongue-like process, pointing towards the apices, and easily to be traced by the lines of growth. He inquired if anything like it was known in the recent species; and on examination of those contained in the Berlin Zoological Museum, we found that in a considerable number of them the nacreous layer is divided in the middle line of each valve by a much narrower, but very distinct, line exhibiting the same appearance as the fibrous layer of the posterior part of the inside. This line is often prolonged very nearly to the apices, but never reaches them; its end gives clear evidence of becoming gradually covered with the same nacreous layer which on both sides of it extends to a much greater distance from the apices. As the described line forms a sinus incurving into the space occupied by the nacreous portion, and beginning just at the side of the large muscular impression, and as the border of the nacreous part itself seems to be the line of slight adherence of the mantle to the shell, corresponding to the pallial line of other bivalves, the above-mentioned incurrent line may be compared to the pallial sinus of the Veneridæ (especially that of *Artemis*) and other families, and may hence be called simply a *sinus*.

In some specimens of *Pinna* preserved in spirits there is to be found a corresponding line in the mantle itself; but I am not prepared to state whether it may be a muscular organ, nor do I find any satisfactory explanation of it in Poli's detailed anatomy of *Pinna*, where, however, the sinus of the inside of the shell is very well figured.

In most specimens provided with this interior sinus, there is to be seen outside near the apices the longitudinal fissure insisted upon by the brothers Adams; nor did I find any specimen provided with this outside fissure wanting the interior sinus. The fissure seems to begin at the apices, and becomes more and more obsolete as its distance increases, *i. e.* during the further growth of the shell. Its situation is outside, just opposite to the internal sinus, or to the prolongation of it towards the apices. The matter which fills up the outside fissure has quite the appearance of the fibrous portion of the shell; and I satisfied myself, by the application of a dilute acid, that it contains carbonate of lime, as also the other constituents of the shell; therefore it should not be named cartilage.

There can be no doubt, I think, about the causal connexion between the inside sinus and the outside fissure, or, rather, a common cause of both, from which results that for some time no nacreous matter is deposited in the middle line of each valve. Taking into consideration all these circumstances, it seems not improbable that the external fissure is nothing else than the inside sinus rendered visible by the destruction of the more external strata of the shell. I have never seen any of these fissured *Pinnæ* in which the apices were not worn off to a greater or less extent; so that nothing can be stated about the apical beginning of the fissure. By the gradual destruction of the shell near the apices, externally, during life, and by the permanent deposition of fresh nacreous matter inside, a stratum must become visible outside which has been formed inside, and must then show what has been the appearance of the inner face at some previous time, when this stratum was inside. This seems to be the explanation of the fact, striking at first, that the outside fissure approaches much nearer to the apices than the inside sinus, and disappears much sooner in the opposite direction. In each individual at each stage of growth there must be observable, therefore, three regions:—

1. A continuous region of fibrous matter, constituting (*a*) alone the abapical or later part of each valve, visible at the inner and outer face; (*b*) the outside or older strata of another part of the shell nearer to the apices, but entirely worn off still nearer to them.

2. A region of nacreous matter on each side divided by the sinus of fibrous matter. This region is visible in the middle part of the inner face and in the apical part of the outer face of the shell, which is explained by the above consideration.

3. A region of continuous nacreous deposition, visible in the apical part of the inner face, worn off generally on the outer face.

All these regions expand with the advancement of growth on the inner face, the following covering the preceding.

The fibrous matter of the sinus seems not only to be a part of the preexisting continuous fibrous layer not covered by nacre, but fibrous matter seems to be deposited here also contemporarily with the nacre on both sides: this is to be concluded from the fibrous matter being on the same level with the nacre, as is clearly shown in the worn-off outside (the fibrous matter filling up the fissure), and further by the lines of growth discernible in the fossil species with a broad sinus, these lines following the outlines of the sinus. Hence it becomes probable that the above line in the mantle, corresponding to the sinus, is is not quite inactive, but secretes fibrous matter instead of nacre, just as the marginal region of the mantle.

The chief difference between this sinus of *Pinna* and the pallial sinus of the Veneridæ, &c., seems to be this,—that in *Pinna* the shelly matter deposited within the pallial line is nacreous; that deposited without, fibrous; whereas in the other bivalves the matter deposited within and without is of the same nature. The pallial sinus, therefore, in changing its place successively with the increment of the whole animal, leaves, in the other bivalves, no trace behind; but in *Pinna* the difference of the shelly matter indicates its position in all preceding stages of growth, as far as the matter formed in this stage is not quite worn off.

There is a difficulty which I am at present unable to explain: in some specimens the outside fissure is visible not only in the denuded nacreous matter, but extends also over a part of the outer fibrous strata. I have seen only few of such specimens, but among them one of extraordinary size and thickness, belonging to *Pinna rugosa*, Sow.

The presence or absence of a sinus is constant, so far as I could ascertain, in all specimens of the same species. Species nearly resembling each other in other characters and in the whole habit, agree also in most cases in respect to the sinus. The external sculpture and the outlines of the whole valve being changed often with age, the sinus remains in each stage of growth. It is visible at first sight at the inside; and in most cases its presence may inferred from the outside of the apical region. I therefore consider it a good character for the systematic arrangement of the species; and such an arrangement will prove a natural one. The species provided with a sinus may be called *Pinnæ fissæ*, and are illustrated by Chemnitz's above-cited fig. A, by Poli's *nobilis*, Lamarck's fossil *Pinna subquadrivalvis*, and the figures 8, 9, 20, 25, 26, 31, 50 of Reeve's monograph. The species without sinus, *Pinnæ integræ* (see Chemnitz's fig. B), correspond to Adams's definition of *Atrina*; but in the list of species given in the 'Genera' either one or two species provided with a sinus have crept in, or the specific names are applied to others than those in Reeve's subsequent monograph. In some of the *Pinnæ integræ* the limitation of the nacreous portion forms a nearly straight line, as in *P. subviridis*; in many others it forms an obtuse angle near the inner side of the muscular impression—a first step to the sinus of the other section (*P. truncata*, *P. vexillum*, &c.).

Pinna saccata, L., so remarkable for its twisted form, differing in each individual, constitutes a third section, the nacre being very reduced, occupying only the muscular impressions and a small region between the larger muscle and the ligamental (dorsal) margin of the valve, while it is almost entirely absent on the opposite (ventral) part of the valve. But as the fibrous portion in this species is more smooth and more glossy than in the rest of the genus, the difference between both is at first sight not so striking. There is no fissure on the outside, and the apices are generally not worn off. While the other *Pinnæ* stand erect upon the ground, the apices being imbedded in gravel, sand, or mud, as is generally known among the fishermen of the Mediterranean, *Pinna saccata* is attached to the sides of rocks or stones, like *Mytilus* or some species of *Arca*; this is stated by Rumph, and confirmed by the relative preservation of the apices, as well as by the twisted form being repeated in some species of *Arca* and *Mytilus*.

In the *Pinnæ integræ* the limitation of the nacre and the position of the larger adductor muscle is generally at a greater relative distance from the apices than in the *Pinnæ fissæ*; and in *P. saccata* this distance is smallest in proportion to the size of the whole valve.

The fossil *Trichites* seem to unite the irregular twisted form and waved sculpture of *Pinna saccata* with the size and thickness of the living *P. rugosa*, Sow. A specimen of the latter in the Berlin Museum, 382 millims. long, has a thickness amounting to 12 millims., and each valve weighs about 2 lbs.

The attempt to arrive at a fixed opinion as to the specific value of some forms of *Pinnæ* known only from single museum specimens, or from the figures of Reeve, would be an almost hopeless task. In the following list, therefore, the several forms which have received specific names are placed near each other, as much as possible, according to their apparent natural affinity; and where the specific value seems to be open to doubt, they are connected by ⏞. Every one who has had occasion to examine a number of individuals of *Pinna* collected at the same locality will have found that there is some amount of variation in sculpture and in the general outlines of the shape, individually as well as according to the stages of age; but this seems to be greater in some species (for example, *P. vexillum, P. nobilis*) than in others.

In both the larger sections some subordinate groups may be distinguished, according to the prevailing outlines and colouring of the whole shell; but these groups are closely connected to each other by intermediate species.

The species marked with an asterisk (*) I have had occasion to examine myself with regard to the sinus.

I. *Pinnæ integræ.*

(*a.*) *Of pale colour and rather trapezoidal form.* (Pennaria, *Mörch.*)

{ *pectinata*, auct. (Linn.?), Reeve, Conchol. Icon. vol. xi. fig. 42; *pectinata*, var. *b*, Lam. Encycl. Méth. pl. 200. f. 5. *P. rudis*, Poli, Test. utr. Sic. 33. 3; Jeffreys, Brit. Conchol. vol. ii. frontisp. Europe.

**truncata*, Philippi, Enum. Moll. Sicil. ii. 16. 1; Gualt. 79 A; Reeve, 35. Mediterranean.

ingens, Pennant, Reeve, 53. Britain. }

Hanleyi, Reeve, 15; *pectinata*, Chemnitz, vol. viii. fig. 770. Coromandel, Amboyna.
**japonica*, Hanley (see below, Note 1). Japan.
penna, Reeve, 39. Philippines.
serra, Reeve, 43. Moreton Bay, Australia.
serrata, Solander, Reeve, 65. West Indies.
**Chemnitzii*, Hanley, Reeve, 1 & 55. Philippines.
assimilis, Hanley, Reeve, 59. Torres Straits.
lanceolata, Sow., Reeve, 58. Pacific coast of Central America.
{ **ramulosa*, Reeve, 52; *nobilis* (non L.), Chemnitz, 775. *Pennaria muricata*, Mörch. West Indies.
{ *Orbignyi*, Hanley, Reeve, 49. West Indies.
papyracea, Chemnitz (?), Reeve.
lurida, Reeve, 24. Philippines.
**seminuda*, Lam. Encycl. Méth. 199. 4; Reeve, 2 (South Carolina); *inflata*, Chemnitz, 771; Reeve, 5 (Nicobar and Philippine islands); *Zeelandica*, Gray, Reeve, 13 (New Zealand). This species forms, by its dark colour, a passage to the next group.

(*b.*) *Of blackish colour and more triangular form.* (Atrina, *Gray.*)

**adusta*, Chemn. 782; *exusta*, Gmel. Indian Ocean.
Gouldii, Reeve, 21.
**rigida*, Dillwyn, Reeve, 7. Red Sea. (Ehrenberg.)
tuberculosa, Sow., Reeve, 48. Panama.
fimbriatula, Reeve, 62. Japan.
alta, Sow., Reeve, 11. Honduras.
Cumingii, Hanley, Reeve 29. Australia.
{ **subviridis*, Reeve, 32. South Carolina.
{ *carolinensis*, Hanley, Reeve, 66. South Carolina.
**nigrina*, Lam. (see Note 2), Rumph. 46 L.?; Gualtieri, pl. 81; Chemn. 774, Encycl. Méth. 199. 1; Reeve, 4. Red Sea (Indian Ocean?).
deltodes, Menke, Reeve, 40. West coast of New Holland.
{ **vexillum*, Born, Mus. Cæs. Vind. 7, 8; Chemn. 783; Reeve, 36. Moluccas.
{ *Strangei*, Hanley, Reeve, 52. Moreton Bay.

II. *Pinnæ fissæ.*

(*a.*) *Of red colour and rather lanceolate form.*

{ **rudis*, L., Chemn. 773, Encycl. 199. 3; Reeve 19. West Indies (and Guinea?).
{ **varicosa*, Lam.; *bullata*, Swains., Reeve, 16. West Indies. (See Note 3.)
{ *pernula*, Chemn. 785; Reeve, 22. West Indies; Canarian islands.

**nobilis*, L., Poli, 34. 1, 35. 5; Gualt. 78 A; Chem. 787 = *rotundata*, Gmel. Encycl. 200. 2 = *squamosa*, Lam. Mediterranean.
aculeatosquamosa, Chemn. 777; *nobilis*, Lam. Encycl. Méth. 200. 1; Reeve, 10 & 57. *P. muricata*, Poli, 33. 4. Mediterranean.
**obeliscus*, Chemn. 784 = *squamosa*, Gmel., *rotundata*, Reeve, 3. Mediterranean.
electrina, Reeve, 25. Moluccas.

(*b.*) *Of elongate triangular form, both long sides being nearly equal.*

flabellum, Lam., Reeve, 18. *P. haud ignobilis*, Chemn. 769 (? *carnea*, Gmel., Desh.). West Indies.
**muricata*, L., Reeve, 23 (Chemn. 181?). West Indies.
semicostata, Reeve, 30. Philippines.
**hystrix*, Reeve, 60; *saccata*, Chemnitz, 779 (non L.). Amboyna.
angustana, Lam., Reeve, 51.
fumata, Hanley, Reeve, 27 (28?). Philippines.
**rugosa*, Sow., Reeve, 50. Panama.
virgata, Menke, Reeve, 45. Philippines.
Philippensis, Reeve, 20. Philippines. (See Note 3.)
**atropurpurea*, Reeve, 41.
regia, Reeve, 56. Amboyna. (See Note 3.)
vespertina, Reeve, 44. (See Note 3.)
Menkei, Reeve, 34.
**euglypta*, Hanley, Reeve, 37, 38. Amboyna.
Zebuensis, Reeve, 26. Philippines.

The last forms a close passage to the next group.

(*c.*) *Of elongated arcuated form.* (Cyrtopinna, *Mörch.*)

**bicolor*, Chemn. 780; Reeve, 17; *dolabrata*, Lam., Encycl. Méth. 200. 3. Malacca.
madida, Reeve, 31. Port Essington.
**incurva*, Gmel., Gualt. 80; Chemn. 778 (see Note 2); Reeve, 8. Indian Ocean.
Rumphii, Hanley, Reeve, 9. Moluccas.
Philippinarum, Hanley, Reeve, 20. Philippines.
attenuata, Reeve, 46. Moluccas.
Stutchburyi, Reeve, 64. Moreton Bay.

III. *Pinnæ contortæ.*

**saccata*, L., Rumph, 46 N., Encycl. 200. 4; Reeve, 6. Red Sea, Moluccas, Philippines.
elongata, Conrad, Reeve, 6^b. Sandwich Islands.

The following nominal species seem to be founded on young specimens, the adult states of which are either unknown or described under other names:—*P. bullata*, Gmel. = *P. marginata*, Lam., Gualt. 79 C; *P. sanguinea*, Gmel., Gualt. 79 B; *P. vitrea*, Gmel.; *P. papyracea*, Chemn. 786; *P. sanguinea*, Reeve, 62.

Note 1.—The specimen figured by Reeve (probably the same as that upon which the species was based) seems to be the young of a larger species very near to *P. truncata*, which I obtained in Japan and deposited in the Berlin Museum. The greater part of the outside is smooth, the radiating striæ of the young shell disappearing totally in the later parts of the shell; but the concentric striæ of growth are repeated throughout very distinctly. The ligamental (dorsal) margin is nearly straight, the opposite one near the apices concave, then convex, the margin opposite to the apices nearly straight. The colour of the shell is a dull greenish grey; some yellow black-edged spots, visible at the outside, prove, by inspection of the inside, to be caused by an abnormal deposit of shelly matter, containing holes, and occasioned probably by the intrusion of some parasite. Length 300, breadth 150 millims.

Note 2.—Some recent authors name this species *P. nigra*, Chemn. Chemnitz himself, however, called it *P. nigra fumigata* (the "black smoked ham"), in opposition to his "red ham" (*P. rudis*, L.). It ought to be remembered that Chemnitz uses names agreeing with the Linnean rules only for a part of his species, chiefly in the later volumes; but for others he uses names of three or four words, which cannot be admitted in our nomenclature. It is true that the name and the diagnosis are generally united by him in one body; but one can almost in every case recognize what he intended to be the name and what the diagnosis,—first, by the first comma being placed between the last word of the name and the first of the diagnosis; secondly, by the list of species, preceding for each genus the descriptions of the single species and repeating the names but not the diagnoses of them. The same remarks apply to *Pinna incurva*, which was named originally by Chemnitz *P. incurvata glabra*, for which Gmelin substituted the simple word *incurva*.

Note 3.—The margin opposite to the apices seems to be very different in the figures placed here together; but it is not improbable that in the originals of some of them, especially those which appear transversely truncated, the margin is not entire, but was broken and has been quasi reintegrated by application of the file; at least there are many specimens treated in this manner in old collections. The first glance at the lines of growth will always detect this artifice in a specimen, but not always in a figure.

[To be continued.]

IX.—*Synopsis of the Genera of* Vespertilionidæ *and* Noctilionidæ. By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

The Insectivorous Bats without any nose-leaf may be divided into two families by the shape of the intermaxillary bones and the position of the upper cutting-teeth.

The skulls of these Bats have generally a well-developed intermaxillary separating the upper canines by a well-marked space. In Noctilionidæ the intermaxillary bones are united to the front, and the upper cutting-teeth are on the sides of the central suture, in the middle of the space between the canines. In Vespertilionidæ the intermaxillaries are separated by a notch in front, and the cutting-teeth are separated into two groups by this notch, and placed more or less near to the canines.

These Bats have three grinders in each jaw on each side, and from one to three false grinders; the fore ones are often very small and rudimentary, and the front one is often placed behind the canines, within the tooth-line, so that it cannot be seen from the outside. The genus *Vespertilio* has been divided, according to the number of these false grinders, into sections, and M. Gervais and Dr. Peters have formed several genera on the number of these false grinders. Thus, for example, three species of *Plecotus* have been formed into three genera, and placed in different sections of the family, on these characters; and the two species of North American *Lasiuri* differ in the number of these teeth, and ought, according to this system, to be similarly separated.

I can only regard such characters as of secondary importance; and I believe that the form of the tragus and antitragus would even form better characters for the separation of the species of the genus into sections.

Dr. Peters, in the 'Proceedings of the Berlin Academy' for 1865, has published a list of the genera of Bats; but he does not give any characters either for the tribes or the genera.

Family Vespertilionidæ.

Face simple. Nostrils on the front of the nose, simple. The cutting-teeth separated in the middle by a space, and placed near the canines. Grinders acutely tubercular, three on each side in each jaw, the hinder one short and broad; with one, two, or three false grinders in front of them. Intermaxillaries separate from one another in the front of the palate, leaving a notch between the cutting-teeth.

I. *Tail elongate, enclosed, and extended to the end of the elongated and produced interfemoral membrane.*

1. *Ears separate, lateral; the face short, broad, nearly bald; fore-*

head flat; skull thick; brain-case oblong, scarcely raised above the face.

(1.) *Scotophilina.* The nostrils simple, pierced in the front of the nose, with a very short groove behind them.

* *Upper cutting-teeth close together towards the canines.*

1. Scotophilus. Wings to the ankles; interfemoral membrane nearly bald.
   Upper cutting-teeth 2.2; false grinders $\frac{1}{1}.\frac{1}{1}$. *Scotophilus.*
   Upper cutting-teeth 2.2; false grinders $\frac{2}{2}$. *Vesperugo.*
   Upper cutting-teeth 1.1; false grinders $\frac{2}{2}$. *Philocryptus.*

2. Atalapha. Wings to the ankles; interfemoral membrane very hairy above. Upper cutting-teeth 1.1.
   Upper cutting-teeth 1.1; false grinders $\frac{1}{2}$. *Lasiurus.*
   Upper cutting-teeth 1.1; false grinders $\frac{2}{2}$. *Atalapha.*

3. Vesperus. Wings to the base of the toes.
   Upper cutting-teeth 2.2; false grinders $\frac{1}{1}$. *Vesperus.*
   Upper cutting-teeth 2.2; false grinders $\frac{2}{2}$. *Pipistrellus.*
   Upper cutting-teeth 1.1; false grinders $\frac{1}{2}$. *Nycticejus.*

** *Upper cutting-teeth separate from the canines and also in front.*

4. Pachyomus. *Scotophilus pachyomus,* Tomes.

(2.) *Romiciana.* Nostrils in front of long, simple-edged grooves, which converge and unite behind on the centre of the nose between the swollen cheeks.

5. Romicia.

2. *Ears separate, lateral; face elongate, narrow, hairy; forehead convex, hairy; skull with a swollen brain-case and narrow face.*

(3.) *Vespertilionina.* Cutting-teeth close to the canines.

6. Tralatitius. Wings to the upper part of ankles; feet large, free. Upper cutting-teeth 2.2; false grinders $\frac{3}{3}$.
   Interfemoral membrane nearly bald. *Tralatitius.*
   Interfemoral membrane very hairy. *Capaccinus.*

7. Vespertilio. Wings to the base of the toes; feet bald. Upper cutting-teeth 2.2; false grinders $\frac{3}{3}$.

8. Harpyiocephalus. Wings to the base of the toes; feet and interfemoral membrane hairy; nostrils rather produced; false grinders $\frac{1}{2}$ adult, $\frac{2}{2}$ young.

9. Kerivoula. Wings to the base of the toes; feet hairy above. Upper cutting-teeth 2.2; false grinders $\frac{3}{3}$.

10. Murina. Wings to the tips of the toes; nostrils rather prominent. Upper cutting-teeth 2.2; false grinders $\frac{2}{2}$.

(4.) *Natalinia.* Upper cutting-teeth in pairs, separated from the canines by a space. Palate of skull not reaching beyond the last molar.

11. NATALUS. Wings to upper part of ankles. Upper cutting-teeth 2 . 2; false grinders?

12. MINIOPTERIS. Wings to upper part of ankles. False grinders $\frac{3}{3}$.

13. FURIELLA. Wings to ankles; heel-bone very long. Upper cutting-teeth 2 . 2; false grinders $\frac{2}{2}$. (*Furia*, Temm., *Furipterus*, Tomes, not Bonap.)

14. THYROPTERA. Wings to the end of the toes; thumbs and toes with suctorial disks =*Hyonycteris*, Tomes.

(5.) ? *Nycticellina.* "Upper cutting-teeth separate, equidistant. Palate without any notch in front." An aberrant form.

15. NYCTICELLUS, Gervais.

3. *Ears close together, in front, elongate, often united; face elongate, narrow, hairy; forehead convex; nose with a naked space; skull with a swollen brain-case, and narrow face.*

(6.) *Plecotina.* Nostrils with a short lunate groove behind them; the forehead with a bald longitudinal line.

16. BARBASTELLUS. Ears large, broad, quadrate, folded down on the forehead; bald space on forehead broad.

17. PLECOTUS. Ears very large, elongate; tragus very long, bald frontal streak linear.

Upper cutting-teeth 2 . 2; grinders $\frac{5}{5}.\frac{5}{5}$. *Plecotus.*
Upper cutting-teeth 2 . 2; grinders $\frac{4}{5}.\frac{4}{5}$. *Histiotus.*
Upper cutting-teeth 1 . 1; grinders $\frac{4}{5}.\frac{4}{5}$. *Otonycteris.*

(7.) *Nyctophilina.* Nostrils in front of lunate grooves united together behind by a membranaceous crest extending across the forehead; forehead with a bare, central, longitudinal furrow with inflexed edges.

18. NYCTOPHILUS.

Artrozous of Allen seems to be nearly allied to this genus.

(8.) *Nyctericina.* Nostrils in front of a groove; forehead with a large, deep, naked groove, covered over with the subspiral edges of its sides; tail-end forked.

19. NYCTERIS. Ears united in front on the forehead.

20. PETALIA. Ears close, not united.

II. *Tail short, enclosed in the base of the large interfemoral membrane, with the tip on the upper surface.*

(9.) *Furipterina.* Face short, broad; forehead very convex;

skull thin; brain-case large, swollen; orbital pit narrow, without postorbital process; face suddenly narrow and bent up.

21. Furipterus, Bonap. and Gervais, not Tomes = *Mosia*, Gray, *Furia*, F. Cuv.

(10.) *Emballonurina*. Face conical, hairy; forehead convex; skull solid; forehead flattish; face short, broad, swollen at the sides, with a prominent postorbital process.

* *Upper cutting-teeth distinct. Interfemoral membrane produced.*

22. Centronycteris. Upper cutting-teeth 2.2. Interfemoral membrane conical, produced.

** *Upper cutting-teeth distinct. Interfemoral membrane truncated.*

23. Emballonura. Upper cutting-teeth 1.1. Wings simple.

24. Saccopteryx. Upper cutting-teeth 2.2. Wings with a pouch at the inside of the arm-bones.

25. Proboscidea. Nose produced, truncated obliquely. Upper cutting-teeth 1.1; "side of the face swollen; postorbital process very prominent."

*** *Upper cutting-teeth none. Interfemoral membrane truncated.*

26. Urocryptus. Upper cutting-teeth none. Forehead flat. Wings simple.

27. Taphozous. Forehead with a deep concavity; chin without any large transverse fold.

28. Saccolaimus. Forehead with a deep concavity; chin with a large transverse fold.

(11.) *Diclidurina*. Face short, broad, hairy; forehead flat. Tail with last joint valvular. Wings broad.

29. Diclidurus.

Family **Noctilionidæ**.

The nostrils on the sides of the nose. The cutting-teeth in the middle of the interspace between the canine teeth. Canines wide apart in front. The grinders acutely tubercular, three in each jaw on each side, the hinder upper short and broad, with one or two small false grinders in front of them. Skull thick; forehead flat; intermaxillaries small, close in front.

I. *Tail short, enclosed in the large truncated interfemoral membrane, with the tip in the upper surface.*

(1.) *Noctilionina*. Face simple. Tail simple.

1. Noctilio. Face cōnical, tubercular; upper lip dependent. Cutting-teeth large, conical.

2. Mystacina. Face conical, hairy; nose rather produced. Upper cutting-teeth large, conical; lower truncated.

(2.) *Mormopsina.* Face and chin ornamented with erect membranaceous ridges. Wings large; ears large.

3. Mormops.

II. *Tail elongate to the edge of the large truncated interfemoral membrane; heel-bone elongate.*

(3.) *Phyllodiana.* Interfemoral membrane truncated; nose crested; chin with one or two membranaceous ridges.

4. Phyllodia. Nose with a fleshy elevation above; chin with a single cross fold. Wings from sides.

5. Chilonycteris. Nose fringed on the edge; chin with two cross folds. Wings from sides.

6. Pteronotus. Nose fringed on the edge; chin with two cross folds. Wings from the middle of the back.

(4.) ?*Spectrellina.* "Interfemoral membrane produced; chin and nose simple."

7. Spectrellum.

III. *Tail elongate, thick, enclosed in and produced beyond the transversely folded interfemoral membrane.*

(5.) *Molossina.*

* *Ears lateral, separate. Cutting-teeth* $\frac{2}{2}$.

8. Myopteris. Muzzle blunt.
9. Cheiromeles. Muzzle obliquely truncated.

** *Ears close, folded down on forehead.*

10. Nyctinomus. Muzzle oblique, truncated; lips transversely grooved. Grinders $\frac{5}{5}$; cutting-teeth $\frac{2}{4}$ or $\frac{2}{6}$.
Lower cutting-teeth 4. *Nyctinomus.*
Lower cutting-teeth 6. *Tadarida.*

11. Molossus. Muzzle rounded; lips swollen, hairy.
False grinders $\frac{1}{2}$; cutting-teeth $\frac{2}{2}$. *Molossus.*
False grinders $\frac{1}{2}$; cutting-teeth $\frac{2}{2}$. *Mormopterus.*
False grinders $\frac{1}{2}$; cutting-teeth $\frac{2}{4}$. *Promops.*

Is *Aëllo*, Leach, separate from this genus? But it is described as having a short tail; may it not have been partially withdrawn?

X.—*Preliminary Account of a new Cetacean captured on the shore at Buenos Ayres.* By Dr. Hermann Burmeister*.

[Plate III.]

On the 8th of August of the present year, at 9 o'clock in the morning, a large whale was observed by the boatmen of Señor D. Juan Antonio Nuñez, near the Custom-House Wharf. It was seen near the shore, raising itself from time to time out of the water and then disappearing for some moments, during which it spouted a stream of water with much vehemence. The men approached this animal in a boat and fired two shots at it, which appeared to take no effect; however, urged by curiosity, they came so near that a son of Señor Nuñez was able to give the animal two stabs in the throat. On this it spouted a violent stream of blood, and died after struggling for two hours. Dragging it first to their ship, the men afterwards took it to the wharf, where it was landed by the steamboat-crane, put into a cart, and transported to the Museum, being generously presented to that establishment by Señor Nuñez.

The scientific study of this animal, which I immediately commenced, showed me that it belongs to a new group of the Dolphins, very near the genus *Ziphius* of Cuvier (*Delphinorhynchus* of Blainville and Dumortier), but differing in the position of the large teeth of the lower jaw, placed, not in the centre of each side of the jaw, but at the very point, as in the genus *Hyperoodon*†.

The animal, belonging thus to a group intermediate between *Hyperoodon* and *Ziphius*, I propose should be named *Ziphiorrhynchus cryptodon*, placing it, in the natural classification, before *Ziphius* and after *Hyperoodon*. I subjoin a general description in order to acquaint the scientific public with its special and distinctive characteristics.

Ziphiorrhynchus cryptodon, Pl. III.

The general external form of the animal exactly resembles that of *Ziphius*; the head not much raised in front, the belly rather thick, the fins small, and the snout sharply pointed; but the form of the tail, inclined with the point backwards, is remarkable and very singular for this group of Dolphins.

The animal measures 3·95 metres in length, and 2 metres in circumference at the middle of the body. The snout is short,

* Communicated by Dr. J. E. Gray, F.R.S. &c.

† [This animal is evidently allied to *Epiodon cavirostris* of the Mediterranean and *Petrorhynchus capensis* of the Cape seas. Figures of the skulls of these animals have been sent to Dr. Burmeister for comparison.—J. E. Gray.]

a little curved backwards; the mouth on each side is 21 centimetres in length, and the small eye is 22 centimetres distant from the posterior angle of the mouth. The ear is a very small opening, 1 millim. in breadth, situated 10·5 centim. behind the eye; the aperture of the nose is a transverse arched fissure, 10·5 centim. in breadth, on the top of the head, 45 centim. distant from the point of the snout. There are two remarkable diverging plaits, 24 centim. long, on the throat; two small fins, 35 centim. long, on each side of the breast, about half a metre distant from the eye; and another smaller, of a curved shape and 17 centim. high in the posterior part of the back, about 2 metres distant from the nostril. To this fin corresponds, in the under part of the body, the position of the posterior openings, the sexual aperture being a little before the fin, and the anal aperture a little behind it. Both are longitudinal fissures, the first 16 centim. broad and the second 9; at the commencement of the second are seen two other small fissures of 3 centim., one on each side, which indicate the teats. As far as these apertures and as the posterior fin the body is round; but beyond them, where the tail begins, its shape changes to a compressed lamina with sharp edge above as well as below. Thus the tail diminishes quickly, descending at first, and afterwards ascending in a direction inclined backwards until the point, where there is a large horizontal fin of a metre in breadth, semilunar in shape, but without incision in the middle, this part being little more prominent than those on either side, near the central portion of the tail. This is a remarkable feature in the animal, as likewise the upward inclination of the tail. The whole body is of a clear grey colour, a little yellowish, but darker on the back and lighter on the stomach; the fins are darker, almost black, and the large fin of the tail has an irregular white spot underneath.

In studying the internal parts I began with the mouth, seeking for teeth, but not meeting with any; the gum consisted of a narrow callus, a little raised on each side of the mandible, rather wider in the lower one, especially at the point of the mandible. Opening this callus with my anatomical knife, I was much surprised to find, inside of the gum, a large number of very small teeth, each enclosed in a little bag, to which it was fastened at its two points, as well above as below. These teeth are about 3 to 5 millim. long, of conical shape, and slightly enlarged at the upper part. I counted 25 teeth in the gum on each side of the upper mandible, and from 30 to 32 in the lower. There are besides two very large teeth at the point of the lower jaw, of very pointed conical shape, also imbedded in the gum. These two teeth are found in the same manner in the genus *Hyperoodon*, as well as those in the gums; but as the skull is without the elevated crests at each side of the snout in the bones of the upper jaw, it does not seem possible to unite this species with *Hyperoodon*, the shape of the head being exactly that of *Ziphius*. However, *Ziphius* (at least in the male) has two large teeth visible in the middle of the lower jaw; and as the specimen examined by me is also a male and has not these teeth, but wider ones, as in *Hyperoodon*, at the tip of the mandible, I am obliged to make a new genus for the animal here described. In dissecting it the other day I examined all its internal structure and made drawings of the principal parts, in order to describe its organization afterwards in the Annals of our Museum. I give here a preliminary description from the examination made.

The tongue is flat, of elliptic shape, and attached to the mandible, having no free motion; there are 26 papillæ, placed in two rows on the back of the tongue. The pharynx has a rather small opening inclined backwards where it joins the larynx, which has an epiglottis much prolonged above, like a curved cone, which enters the posterior aperture of the nose. The trachea is rather short, 26 centim. long and 8 broad, and has a third bronchus on the right side, smaller, and placed more behind, before its final division into the two regular bronchi.

There are three principal parts in the lungs—one on the left side of the body, and two, very unequal, on the right. The heart is tolerably large, but broader and flatter than in the terrestrial Mammalia. The internal structure is not different from the general type, but the distribution of the nutritive veins on the whole surface is very remarkable. There is a single opening of the nutritive vein in the right auricle, whence issues a large vein which descends in the lower longitudinal furrow as far as the tip of the heart, forming there a rather broad sac, from which issues, on the other side, another vein, ascending in the upper longitudinal furrow to the base of the ventricle.

As to the digestive viscera, the œsophagus is internally covered with many folds; these folds descend into the first stomach, which is very large, of a remarkable sinuous shape, and in two unequal parts, of which the second part is the smallest and of a coarser and more muscular texture. Behind the first stomach there are seven others, of which the last is the largest, larger even than the first; the other six are very small, particularly the second, third, sixth, and seventh; the eighth is 34 centim. long, and the first 29 centim. The duodenum is very narrow, hardly 2·5 centim. wide, and the ilium very long, measuring 17·5 metres. Its interior surface is covered with many folds, which form small bags at the sides. The colon is of twice the width, but much shorter, hardly 2 metres long; its internal surface has not so many folds and bags as the duodenum and ilium. There is no cæcum, as is always the case in the true Cetaceans.

No food of any kind was found in the intestines, only a mucous yellow fluid in the small intestine, and a fluid of a black colour, like pitch, in the large one. Probably the animal had fasted for a long time; and there is no doubt that the heavy storm from which Montevideo had suffered two days before had forced him to take refuge in the mouth of the Rio de la Plata.

The liver is situated on the right side of the last stomach, covering it with its lower part, which is the smoother of the two into which it is divided. There is no gall-bladder, but a wide duct entering the duodenum by the side of the pancreatic duct. The pancreas is large and of regular construction, situated between the curvatures of the eight stomachs. The spleen is a thin mass, small, of triangular shape, behind the first stomach, and closely attached to its upper part. The kidneys are large, 40 centim. long, spindle-shaped, fastened to the centre of the belly above the other intestines, and composed of numerous divisions, of the shape and size of a large nut. The urinary channel is a metre, more or less, long; the bladder very large and of thick substance.

The sexual organs are not perfected—proving, as does the soft and spongy texture of the bones, that the animal was still young.

The body consists of a large mass of very dark, almost black, flesh, and over this, covering the whole surface, a layer of whitish fat, of 5 centim. thick. The skin is thin, closely united to the fat, and is composed of two layers, the inner one soft and black, the outer hard and grey. Over this skin extends a fine but hard and very smooth epidermis, which gives a shining appearance to the animal. It is said that the inner skin of the Anarnac (*Hyperoodon*) is considered a delicacy by the inhabitants of Greenland and Iceland, in the seas of which these animals abound.

I cannot enter into a detailed description of the skeleton, since its preparation has not been concluded. I can only give a few general details of the shape of the skull and of the number of the vertebræ and ribs. The skull is exactly similar to that in the genus *Ziphius*, and has not the smallest resemblance to that of *Hyperoodon*. The upper part, with the opening of the nose, is much arched, and the right side is much larger than the left. The zygomatic bones are extremely thin, and are free behind, and the os petrosum is united to the skull very firmly. Of the seven vertebræ of the neck, the first three are united in one piece, the others are free. There are ten dorsal vertebræ, with ten pairs of ribs, of which six are directly joined with the sternum. The number of the lumbar vertebræ is twelve, and of the vertebræ of the tail twenty-five, of which the first eleven have large inferior spines between them, the first spine being incomplete and composed of two parts entirely separate. In the pectoral fins all the bones are well formed, as well as the little bones of the carpus, which are not cartilaginous; only the last phalanges of the fingers are formed of this substance.

XI.—*Description of some new Species of Butterflies belonging to the Genus* Athyma *in the Collection of the British Museum.* By Arthur G. Butler, F.Z.S., Assistant, Zoological Department, British Museum.

1. *Athyma lactaria*, n. sp.

Upperside—*front wings* dark olive-brown; the discoidal streak broadly divided into three parts, white; two small white spots near the costa, placed obliquely halfway between the cell and the apex; a large white spot between the end of the cell and the anal angle, divided by the second median branch; a submarginal row of five small white spots, the three upper ones subapical, placed obliquely: *hind wings* dark olive-brown; costa and inner margin paler, a broad transverse central white band broadest between the discoidal nervules, narrowest at the inner margin; a submarginal row of eight small white spots, equidistant except at the anal angle.

Underside—*front wings* olive-brown; the discoidal streak as above but better defined; three oblique subapical rows of elongate white spots, the two outer rows approximating, the outermost row sometimes continued along the outer margin; a large white spot between the end of the cell and the anal angle; three submarginal white spots along the anal outer margin, the lowest one obscure, the centre one large, oblong: *hind wings* white; base and front margin dark olive-brown; a white spot at the base, a second similar spot near the base of the cell, and an elongate bluish white streak above the cell; outer margin olive-brown, with a very narrow submarginal white line and a row of eight large white spots.

Body brown; palpi, two lateral streaks on the abdomen, and coxæ pale ochreous.

Expanse of wings $2\frac{3}{8}$–2 inches.

Hab. Aru Islands.

Allied to *A. Venilia*, Linn. (Oceania), but the markings of the upperside more nearly resemble those of *Neptis Jumbah*, Moore.

1 a. *A. lactaria,* var. with a narrower band on the hind wings.
Expanse of wings $2\frac{5}{16}$ inches.
Hab. Dory.

2. *Athyma Astræa,* n. sp.

Upperside brownish black: *front wings* with two obliquely-placed large subapical white spots; two larger spots on the middle of the disk; an elongate white spot with a small streak above it on the interior margin; a submarginal row of small white spots; a second outer very indistinct row, pale brown: *hind wings* with a broad white transverse band from beyond the middle of the interior to the middle of the abdominal margin; three dark-brown marginal bands increasing in width towards the middle of the wing.

Underside brown, glossed with pink: *front wings*—inner margin pale olive-brown; base of costal margin orange; a narrow discoidal streak indistinctly divided in its centre and broadly near its outer termination; spots on the disk as above but larger; outer margin with four submarginal white bands, the third from the margin broad and almost divided into spots at the nervures: *hind wings*—base of costal margin white; an indistinct white streak from the base to near the middle of the costal nervure; central band as above but broader; hind margin with four submarginal white bands, the three outer ones approximating, the innermost one indistinct, lunulate; a brown dash across the submarginal bands above the middle of the disk.

Body brown; legs, palpi, and abdomen pale.

Expanse of wings $2\frac{5}{8}$–$2\frac{1}{8}$ inches.

Hab. Aru Islands.

Allied to *A. Kasa,* Moore (Philippine Islands), but, on the upperside, closely resembling *Neptis Shepherdi,* Moore, excepting in the absence of the discoidal streak.

3. *Athyma Cerne,* n. sp.

Upperside brownish black: *front wings* with a pale green spot in the centre and a similar larger spot at the end of the cell; two large greenish, oblong, obliquely-placed subapical spots; a large spot, divided above the middle by the second median branch, on the middle of the disk; two small obliquely-placed submarginal spots near the apex: *hind wings* with a central transverse greenish band tinted with pink at each end, interrupted by the nervures; two pale brown submarginal bands near the outer margin.

Body brown; antennæ tipped with orange.

Underside paler brown: *front wings* as above, except that all the large spots are white, and the hind margin has two submarginal bands of pinkish spots: *hind wings* with central band as above; costa dark brown; hind margin dark brown, with two submarginal lines and an inner submarginal row of oblong spots pinkish.

Body brown; abdomen with a central yellow streak; palpi and tibiæ pale greenish.

Expanse of wings $2\frac{5}{8}$–$2\frac{7}{8}$ inches.

Hab. Amboina.

Allied to the preceding species.

4. *Athyma Badoura* ♀, n. sp.

Upperside black, markings ferruginous: *front wings* with a long discoidal streak extending to beyond the middle of the first median nervule, divided in the middle and broadest beyond the middle, tapering at both extremities; a black ring upon the streak at the middle of the cell; an oblique band from the front to near the middle of the outer margin, and joining a band of four irregular spots between the median nervules near the outer margin; an oblique narrow subapical band, beginning at the costa, recurved and tapering at its lower end; an outer row of three small subapical spots near the margin; a large spot below the middle of the disk, and an oblique band running to the middle of the interior margin; a submarginal pale brown line along the outer margin: *hind wings* with a transverse band near the base and a similar band near the hind margin; a central and a submarginal band narrow, pale brown.

Body brown, a greenish collar and a pale ferruginous band across the base of abdomen; antennæ tipped with orange.

Underside reddish ochreous, with central black patches between the nervures except near the outer margins; all the ferruginous markings superseded by white ones.

Body pale ochreous; antennæ ferruginous.

Expanse of wings $3\frac{5}{8}$ inches.

Hab. Celebes.

Allied to *A. Cama* ♀, Moore (North India).

XII.—*Remarks on* M. de Quatrefages's "*Note on the Classification of the Annelides.*" By E. Claparède*.

After a series of varied anatomical investigations upon numerous types of the class of Annelides, M. de Quatrefages was probably in a better position than any one else for attempting a revision of the classification of those worms. The last systematic

* Translated by W. S. Dallas, F.L.S. &c., from the 'Bibliothèque Universelle,' tome xxii., Bull. Scient. pp. 346–355, April 20, 1865.

work upon this class, that of M. Grube, is dated as far back as 1851; and numerous investigations have since come to enrich our knowledge of the group; the work of the French *savant* will therefore fill a sensible gap in our zoological literature. At present we only possess an insufficient summary of this important work. The book is in the press, and its author has published in advance the table of the orders, families, and genera adopted by him, in order, as he himself says, to elicit from his *confrères* some observations of which he may be able to make use.

This kind of appeal to the public authorizes us to present, without any previous apology, some remarks on the classification of M. de Quatrefages, even before the publication of the work announced by him. This publication will, no doubt, nullify some of our criticisms; but others will perhaps be sustained, or even find favour with the illustrious academician.

As in 1859, the author continues to eliminate from the class of Annelides the *Hirudinea*, the *Gephyrea*, and the *Oligochæta* (*Erythrèmes*, Quatref.). This elimination, made at a time when other authors are endeavouring, on the contrary, to place the *Gephyrea* among the Annelides, from which they have been so long excluded, appears to be justifiable for, at least, a portion of these animals, but can hardly be extended to the *Oligochæta*. These worms are certainly true Annelides, and differ much less from most of the families left in the class by M. Quatrefages than *Phoronis*, Wright (*Crepina*, Ben.); and yet the author assigns this singular form a place among the *Serpulacea*.

The reason, moreover, which leads M. Quatrefages to exclude the *Oligochæta* from the class of Annelides is of comparatively little weight. This naturalist distinguishes in the division VERMES two series of classes—one diœcious, the other monœcious. The monœcious classes are the *Oligochæta*, the *Bdellea*, the *Turbellaria*, and the *Cestoïdea*; the diœcious classes are the *Annelida*, the *Rotatoria*, the *Gephyrea*, the *Malacobdellea*, the *Myocœlea*, and the *Nematoda*. Now the character of androgyny, or of the separation of the sexes, is a secondary character, which cannot serve for the distinction of classes. Several genera of *Serpulacea* include monœcious species, and M. Quatrefages does not any the less on this account assign them a place among his diœcious Annelides. Nor does he exclude the hermaphrodite Nematoda from his diœcious class Nematoda any more than the diœcious *Planariæ* from his monœcious class Turbellaria, or certain diœcious Cestode worms from his monœcious class Cestoïda. At every step in other divisions of the animal kingdom we find monœcia and diœcia side by side in the same class, the same family, and sometimes in the same genus. We therefore do not hesitate to think that M. Quatrefages attaches too much importance to the character of the distribution of the sexes in his division of the Vermes into classes. The Oligochæta, setting their monœciousness on one side, are Annelides in every respect, and they will remain in that class notwithstanding their monœcious character. On the other hand, the Branchiobdellea are identical with the Oligochæta in so many respects, that the reunion of the whole series of the Bdellea (*i. e.* the Hirudinea) with the class of Annelida appears to become a desideratum of science.

Having restricted the class Annelida to the group of *Annelida Polychæta* of Grube, M. Quatrefages, like Audouin and Milne-Edwards, subdivides them into two orders—the *Annelida errantia* and *A. sedentaria.* In their general features these two orders are very natural; for, under different names, they have been admitted by all authors. But the manner in which M. Quatrefages characterizes them will give rise to criticisms, because it leads to some consequences which are evidently forced. Thus he arranges the family *Nerinea* among the Errantia, and the *Leucodorea* among the Sedentaria. Now these two families contain worms so closely related to each other that they evidently form a single natural family. This is so true, that this family has already been established by Sars, who has characterized it with much care under the name of *Spiodea.* The celebrated Norwegian naturalist, in the establishment of this family, has certainly furnished a fresh proof of the truth of his zoological intuition, which has been so often experienced. In a general way it is to him that we are indebted for the best recent works on the classification of the Annelides,—works which, it is to be hoped, M. Quatrefages will take more notice of in his work than would be supposed from the note which we have before us. The best evidence that the distinction between the two families *Nerinea* and *Leucodorea* rests upon an artificial foundation is that the author places *Nerine* in one and *Spio* in the other, or at least in an appendix to the other. Now these two genera are identical, as has been shown by Sars. That M. Quatrefages had good grounds for effecting a separation in the family *Ariciea,* in which Grube placed the *Leucodoræ* and the *Nerinæ,* few will absolutely dispute. But this separation had already been made in a very judicious manner. The true distinction to be made is that between the *Ariciea* and the *Leucodorea* or *Spiodea*; but then we must place in the latter family the genera *Spio, Pygospio, Nerine,* and the other *Nerinea* of M. Quatrefages, including the genus *Aonis,* which, it may be remarked in passing, appears to be founded only on some *Nerinæ* with the antennæ torn off*.

* The genus *Polydore* of Bosc, admitted by Quatrefages, is synonymous with *Leucodore.*

The position assigned to the *Tomopteridea* among the Sedentary Annelides also appears fitted to call up some objections. The name in any case is ill applied to the *Tomopterides,* which, with the *Amphinomea,* are, as regards their mode of life, the *errant* Annelides *par excellence.* However, the *Tomopteridea* constitute so anomalous and degraded a type that they agree but ill with any of the orders of Annelides, although still remaing incontestably Annelides.

With the exceptions just indicated, the division of the Annelides into twenty-six families proposed by M. Quatrefages leads to natural groups; nevertheless there exists a great number of genera, often sufficiently well known, which the author has not been able to bring into any of the divisions of his classification. He enumerates these in appendices to the families with which the genera in question seem to him to have most affinity, under the name of "genera *incertæ sedis.*" The number of these genera of uncertain position is considerable: there are 64 out of a total number of 245. It is evident that M. Quatrefages deserves praise for the prudence with which he has proceeded, preferring to leave an open question (*garder protocole ouvert*) in all cases of uncertainty than to assign, as is generally done, an arbitrary position to anomalous genera. There are, however, cases in which the author's uncertainty seems to arise from an insufficient acquaintance with the animals in question.

We may cite a few examples of this. The genus *Zygolobus* of Grube, as to the position of which the author is uncertain, is as typical a *Lumbrinerean* as possible, in the sense that M. Quatrefages gives to that family*. The *Spiones* are beyond any doubt *Leucodorea*; the *Mageloneæ* (placed at the end of the *Ariciea,* no doubt by mistake) are also *Leucodorea*; the *Polycirri* are degraded *Terebellea,* probably identical with the genus *Apneumea* of M. Quatrefages; the *Halimedæ* of Rathke are true *Hesionea,* generically identical with *Psamathe,* Johnst., which the author places without hesitation in that family, &c. &c.

Sometimes we seem to remark in M. Quatrefages's table errors of synonymy combined with astonishing approximations. Thus the author places *Spinther,* Johnst., as a genus *incertæ sedis* at the end of the *Chloræmea,* and *Cryptonotus,* Stimps., also as *incertæ sedis,* at the conclusion of the *Amphinomea.* Now these two genera are synonymous with each other and also with the genus *Oniscosoma,* Sars, which the author has for some reason left out of his nomenclature. Moreover the investigations of

* We may say, in passing, that we doubt whether the separation of the family *Eunicea,* as hitherto understood, into two distinct families, according to the presence (*Eunicea*) or absence (*Lumbrinerea*) of branchiæ, is always practically applicable.

Mr. Stimpson, and especially the very detailed researches of M. Sars, have taught us that *Spinther* is very nearly related to *Euphrosyne*, and consequently enters the family of the *Amphinomea*.

M. Quatrefages places the genus *Eumenia*, Œrst., at the end (*incertæ sedis*) of the *Phyllodocea*. We can, however, scarcely doubt, especially after the investigations of M. Sars, that the natural place of this genus is in the family *Arenicolea*. To make up for this, M. Quatrefages leaves the genus *Dasybranchus* in the family *Arenicolea*, where Grube originally placed it, whilst he enumerates the genera *Capitella*, Blainv., and *Notomastus*, Sars, among the genera *incertæ sedis* at the end of the *Clymenea*. Now the favour with which the family *Capitellacea*, formed at a later period by M. Grube (for the genera *Capitella*, *Notomastus*, and *Dasybranchus*), has been generally received is sufficient evidence that this family cannot be rejected without good reasons. We believe that there are few families of Annelides so natural as that of the *Capitellacea*. The very exceptional characters of the subulate setæ, which are very different (in all the rows) in the anterior region and in the following segments, joined to a disappearance of the vessels as complete as in the *Glyceræ*, and the appearance of coloured blood-globules in the perivisceral cavity, are sufficient to prove the relationship of these three genera. The mutual affinities of these three genera are, moreover, manifested in a multitude of other points. When M. Quatrefages removes the *Dasybranchi* with ventral branchiæ from the abranchiate *Capitellæ* and *Notomasti*, to approximate them to the *Arenicolæ* with dorsal branchiæ, he seems to attach an exaggerated importance to the *existence* of branchiæ. One might remind him that he himself has found in the genus *Glycere* abranchiate species and species provided with branchiæ. Moreover dorsal branchiæ into which vessels pass (*Arenicola*) cannot be the homologues of ventral branchiæ destitute of vessels (*Dasybranchus*).

The family to the study of which M. Quatrefages has certainly devoted the most care is that of the *Syllidea*. Who has not in mind his beautiful investigations on the reproduction of those animals? The number of new genera established in this family is also considerable. We may remark, however, that the characters employed by the author are not always very certain,—such as the number of eye-spots, which is often variable in the same species. Other characters, on the contrary, are excellent; thus M. Quatrefages justly groups the genera according as their gizzard is armed or unarmed. But, curiously enough, his application does not always appear to be in conformity with his principle. Thus several genera (*Syllis*, *Exogone*, *Autolytus*, *Sphæro-*

syllis) enumerated by the side of genera with the gizzard really unarmed (*Tetraglene*?) as furnished with an unarmed gizzard, have the gizzard really armed. One of them (*Autolytus*) even presents perhaps the most formidable armature to be found among the *Syllidea*. The genus *Heterosyllis* is enumerated twice, first among the *Syllidea* with the gizzard armed, and then among those with an unarmed gizzard. No doubt we may here suspect a *lapsus calami*, which has led in one case to the introduction of the name *Heterosyllis* in place of some other.

But the greatest reproach that can be made against the classification of the *Syllidea* by M. Quatrefages is that of admitting a certain number of genera which, in the present state of science, must undoubtedly be cancelled. It is well known, and M. Quatrefages was one of the first to demonstrate the fact, that certain *Syllidea* present an alternation of generations—that is to say, a regular alternation of sexual and asexual generations. The asexual generations appear always to have an armed gizzard*, and the sexual generations an unarmed one; or rather, to speak more accurately, the latter have no gizzard.

Hence for a long time the sexual generations have been referred to other genera than the asexual generations. In the list of genera adopted by M. Quatrefages we remark the genera *Tetraglene, Ioida, Polybostrichus, Sacconereïs,* and *Diploceræa* (perhaps also *Macrochæta* and *Polynice*), which are formed by sexual generations; the others (at least those with which we are acquainted) represent asexual generations. The admission of all these genera consequently necessitates that a single species may be cited under three different names. Thus the asexual form of such a species will belong to the genus *Autolytus,* the male sexual form to the genus *Polybostrichus,* and the female sexual form to *Sacconereïs.* If necessary, we might assign to this species a fourth place, as the genus *Diploceræa* of Grube appears to be synonymous with *Polybostrichus,* Œrst. Finally, this inconvenience becomes extreme when M. Quatrefages places among the *Hesionea* the genus *Pseudosyllis,* Grube, consisting of asexual worms of which the sexual form (the genus *Tetraglene,* Grube) is placed by him in the family *Syllidea.*

* We here borrow the terminology of M. Quatrefages. By many authors the name *gizzard* is used in quite a different sense. It is there applied, not to the anterior part of the digestive tube, which is armed with teeth, but to the glandular vesicle which follows this. Perhaps, however, the inconsistencies in the application of the principle to which we have adverted above may be owing to M. Quatrefages considering all those gizzards to be unarmed which have not a pair of jaws properly so called. In this case he would take no account of the formidable armature of teeth which is presented by certain genera, and which furnishes excellent characters for classification.

If M. Quatrefages has introduced into his table a considerable number of new genera, which we shall not know until the publication of the work itself, he has omitted a great number of others. In most cases, no doubt, he has been perfectly right. He appears to us to have systematically eliminated nearly all the names of M. Kinberg. The genera *Aphrogenia, Halosydna, Antinoë, Harmothoë,* and *Hermadion* do not figure in the family *Aphroditea* any more than the genera *Eupompe, Panthalis,* and *Leanira.* The genera added by M. Kinberg to the family of the *Amphinomea*—such as *Lirione, Hermodice,* and *Eurythoë*—are likewise eliminated. We repeat, M. Quatrefages has, no doubt, in the majority of cases, been right in uniting these genera to others; and he might even, in our opinion, have still further simplified his classification in some instances, as, for example, by uniting *Polynoë* and *Lepidonotus,* which pass insensibly into one another. Nevertheless the suppression of some genera has surprised us. Thus, among the genera which we have just enumerated, *Eurythoë* appears to have more right to existence than the others. *Dasychone,* Sars, among the *Serpulea,* and *Ophiodromus,* Sars, among the *Phyllodocea,* also appear to be good genera. The same is perhaps true of *Phyllochætopterus,* Grube. No genus of *Syllidea* appears to be so clearly characterized as *Pterosyllis,* which is not even mentioned. *Thysanoplea,* Schm., and *Drilidium,* F. Müll., are nowhere named; but it is true that M. Quatrefages may not perhaps include them in the class of Annelides, the limits of which he restricts as much as possible. All these gaps are, no doubt, only apparent, and will be explained on the publication of the complete work. It is possible, indeed, that certain names, the absence of which has struck us, may have been eliminated for sufficient reasons, and may be replaced by one or other of the numerous new denominations which figure in the table.

The work of M. Quatrefages will not be restricted to the Annelides, in the sense which the author attaches to that word. It will also include a revision of the Gephyrea. One thing has particularly struck us in the portion of the table relating to the latter worms. In the family *Sipunculea* the author distinguishes only two genera—*Sipunculus,* with simple buccal cirri, and *Dendrostomum,* with ramified or pinnate cirri. It would appear, therefore, that the author, rejecting the generic name *Phascolosoma* of Leuckart, replaces it with that of *Sipunculus,* and that he unites to the genus *Dendrostomum,* Grube, all the *Sipunculi* of modern zoology. We can hardly understand by what arguments this revolution can be justified. The complete work will, we hope, furnish sufficient reasons in its support.

* * * * * *

XIII.—*On the Classification of the Annelides.* By A. de Quatrefages.

[Concluded from p. 24.]

The appeal which I addressed to my brother naturalists when I published in the 'Comptes Rendus' the tables here reproduced, has brought me, from M. Claparède, some written observations, accompanied by his 'Glanures Zootomiques' and an article published in the 'Bibliothèque Universelle de Genève.' I received these important documents at the very moment when I was correcting the proofs of the present notice. Pressed for time and by imperative occupations, I have been unable to devote myself to the studies which would have been required to enable me to appreciate all their value, and to introduce into the present publication the modifications to which they will perhaps give rise. The 'Glanures Zootomiques' in particular contain a great number of new facts of which I must take careful account, and in my book I shall certainly give this important work the place which of right belongs to it. The article from the 'Bibliothèque Universelle' is especially a work of criticism. The author has rapidly appreciated my general ideas, as also the application which I have made of them, and has added some remarks on a certain number of special points. It is to this that I would here reply in a few words.

I am sorry to see that on many points I am but little in accord with M. Claparède. Perhaps these differences of opinion may be due in part, as he himself indicates, to the fact that the tables isolated from the text, of which they are a summary, may lead to mistakes, and in any case show no trace of the reasons which have led me to certain conclusions. But still there are some questions as to which no doubt can remain, and with respect to which I cannot, to my great regret, adopt the views of my learned *confrère,* although he is far from always standing alone in his opinions, and I find side by side with him men who have deservedly the highest authority in zoology.

Such is the question of the union in a single class of the Annelides with the *Lumbrici* and allied groups (*Oligochæta, Erythrèmes,* Quatr.) and the *Bdellea* (*Hirudinea*). "The Oligochæta," says M. Claparède, "are certainly true Annelides." And further on he adds, "The Oligochæta, apart from their monœcious character, are Annelides in every respect." I must declare that I cannot subscribe to these propositions; and the more I have reflected upon this question, the more difficult has it seemed to me to maintain this union.

Let us first of all say a word about the monœciousness to which M. Claparède attaches no value. What I have previously said of *reciprocal terms* will perhaps some day explain some of the facts upon which the Genevese philosopher depends for the support of his opinion. Perhaps, also, in other groups than those with which we have to do here, we must definitively admit that the union or separation of the sexes has really no great importance with regard to affinities.

But the value of characters is very far from being constantly the same in the animal series, as I have already remarked; and in this case the monœcious or diœcious character appears to me to be in relation to so many other facts, that it seems impossible not to give it great weight. We do not yet, I believe, know any Erythræmatous worm with the sexes separate; and only three exceptions to the diœciousness of the Annelides have been indicated*: these three exceptions have been observed in groups which are still very imperfectly known, and which every consideration leads me to regard as exceptional in many other respects. In a group with so variable a type as that of the Annelides, to find variations even in the characters of the class is far less extraordinary than elsewhere. But none the less does this fact appear to me more important than that presented by the species of *Phoronis* (*Crepina,* Van Ben.). These, which M. Claparède regards as further removed from the Annelides than the Erythræmata in general, are, in my eyes, evidently only *Sabellea—very degraded,* no doubt, but in which the general type of the Annelides is recognized at the first glance; and this M. Van Beneden has not failed to perceive.

The discovery of the segmental organ (Williams) in the Annelides has certainly established an additional relation between them and the Erythræmata. But I do not know how far the presence of this organ is constant in the former of the two classes. Ehlers and Claparède have found it in *Syllis*; but their descriptions, always very succinct and often not very complete, and their figures, which leave scarcely less to be desired, although adding to what the English *savant* has taught us on this subject, still leave room, it seems to me, for well-grounded doubts. In any case it appears from them that this apparatus in the Annelides has neither the development nor the constancy which it presents in the Erythræmata.

On the other hand, no Annelide possesses a *typhlosolis*; and although I found upon the anterior vascular trunks of certain *Arenicolæ* (and in the *Arenicolæ alone*) something resembling the *chloragogena,* I was at the same time able to prove that in this case there was only a similitude of aspect.

* In the introduction to my book I have only mentioned the fact discovered by Huxley. The observations of Pagenstecher had escaped me, and M. Claparède had not yet discovered his *Amphiglene.*

Again, as far as I know, we never find in an Erythræmatous worm the foot, which is so characteristic of the Annelides. Their setæ indeed resemble those of certain Sedentaria; they are set in motion by an analogous mechanism, and they are developed nearly in the same way. But here the resemblance ends. The *foot, as a well-marked and distinct organ,* never makes its appearance.

No Erythræmatous worm has ever presented true branchiæ comparable, even distantly, with those presented by so many Annelides.

If we compare the nervous system of the *Lumbrici* with that of the Annelides, selecting species in which it is at once most developed and best known, we ascertain considerable typical differences in the stomatogastric portion of these apparatus. As to the ventral chain, it cannot but present much similarity in Annulosa which continue faithful to the general type.

To tell the truth, I can only find the vascular apparatus which can be seriously adduced in support of the proposed approximation, although, indeed, there must be some resemblances between the two groups, as otherwise no one would have dreamed of confounding them.

Thus we have genuine resemblances upon some points and profound differences upon others; and this, in sum, is what is presented by the Annelides and the Erythræmata when we take as terms of comparison their highest and most perfect representatives. This apparent contradiction seems to me to be a general and decisive argument in favour of my opinion, which may be summed as follows:—the differences between the two groups depend on a want of real *affinities;* the resemblances spring from *analogies;* the class of Erythræmata and that of Annelida are the *corresponding terms* or *analogues* of each other in two distinct series.

That these two groups approach still more closely by some inferior *derivative types,* by some *degraded species,* I am far from denying. But do we not observe this even among the Vertebrata?

So much for the Erythræmata. But M. Claparède goes further, and would have the *Hirudinea* also placed in the class of Annelides. He is not the only person, as is well known, who holds this opinion. But in this case my opinion seems to me to be still more easy to defend. I shall only remind the reader that the resemblances existing between the Annelides and the Erythræmata, as regards the vascular and nervous apparatus, disappear when we come to the Leeches. Nothing in the Annelides answers to the great lateral trunks of the latter; and the stomatogastric nervous system of the Leeches resembles that of the Insects rather than that of the other Vermes. Apart from the question of monœciousness or diœciousness, the *Hirudinea* must, in any case, it appears to me, form a distinct class.

I have discussed in haste, but at some length, this portion of M. Claparède's article, because it relates to a general question. I shall be very brief upon some points of detail, to which, however, I think it necessary to reply. Being pressed for time, I ask permission to examine them in the same order in which the author has presented his remarks.

1. M. Claparède rather severely criticises the manner in which I have regarded the relations existing between the genera *Nerine, Leucodore, Polydore,* and *Spio.* As regards the last, there will be found in my book a short discussion, giving the reasons for its place among the *incertæ sedis.* The second and third, which M. Claparède declares only form one genus, are certainly very distinct. The table itself indicates a character which appears to me to be very prominent, and which is in accordance with others.

As to the approximation of *Nerine* and *Leucodore,* it is absolutely impossible for me to accept it. I have studied these two types in the living state, and they are completely different. The law of repetition of segments is very exactly observed in all the *Nerinea;* it is very little followed in the *Leucodorea.* By itself this character justifies, in my eyes, the position which I have assigned to the two groups. There are plenty of other differences which I cannot detail here; but this, it appears to me, suffices in any case to prevent the union of two such different types in the same family. Notwithstanding the high authority of Sars, I shall therefore persist in my opinion, and must beg my *confrères* to delay their judgment until they have before them the necessary evidence—that is to say, my book and my plates.

2. Contrary to the opinion of M. Claparède, the *Aonides,* which I have been able to observe in the living and perfect state since the publication of my first note upon them, in the 'Magasin de Zoologie,' 1843, are very distinct from *Nerine,* although furnished with the large tentacles which appear to characterize the family, and which *alone* may perhaps give them some resemblance to the *Leucodorea.*

3. I agree with M. Claparède in the objections which might be raised against the place which I assign to *Tomopteris,* and I have taken care to state this in my text. This position is probably only provisional; but in the present state of science I do not very well know where we can place these species, belonging to a type in the highest degree aberrant. Moreover, M. Claparède in criticising my opinion, has not made known his own.

4. M. Claparède attributes my uncertainty, and the course that I have frequently taken of putting a certain number of

genera among the *incertæ sedis*, to *an insufficient knowledge of the animals in question.* I do not for a moment hesitate to admit the justice of this observation. When the zoological relations did not appear clear to me, I thought it my duty not to dissemble my doubts. Now this has frequently happened, as I have already stated, *even with well-known species.* In this case I have not placed them. With still better reason I have acted in the same way when it seemed to me that some important character was imperfectly described, or that its very existence was not perfectly demonstrated. This is the case with the genus *Zygolobus* (Grube), which M. Claparède cites as a blameable example of my mode of acting. *With me, as with him,* this genus belongs incontestably to the family of the *Lumbrinerea.* But my learned critic seems not to have remarked that, from the description of Grube, it *appears* to follow that here the feet are *biramose* ("*Pinnæ . . . . . lobis obtusis duobus, posteriore longiore, digitiformi*"). If this be the case, the genus *Zygolobus* would constitute a *unique* exception in the family, and among all the representatives of the *Eunice* type. Such a fact seems to me to require more exact details. Moreover Grube says nothing about the dorsal cirri, the presence or absence of which has served me for characterizing certain genera. For these two principal reasons I have left the genus *Zygolobus* among the *incertæ sedis,* adding, "I think this species requires to be reexamined." But I have placed it in the family *Lumbrinerea,* where it will certainly remain. I think that in this way I have acted more wisely than if I had at once admitted the existence of a Lumbrinerean with biramose feet, when it may very well be that a simple transformation of one of the two cirri has produced the appearance indicated by Grube.

From this example it will be seen what has been my mode of proceeding; and what I have just said may excuse me from dwelling upon some analogous criticisms addressed to me by my learned *confrère.*

5. A little further on, M. Claparède says that *one seems to remark, in my table, errors of synonymy combined with surprising approximations.* He cites, as an example, that I have placed *Spinther* of Johnston among the *incertæ sedis* of the family *Chloræmea,* and *Cryptonota* (M. Claparède writes *Cryptonotus*) of Stimpson also in the *incertæ sedis* of the family *Amphinomea.* According to him, these two genera are synonymous.

In this particular I can hardly understand the opinion put forth by M. Claparède. To unite *Cryptonota* and *Spinther* in a single genus seems to me to be impossible. Stimpson, in characterizing the former, speaks of its *branchiæ,* adding that they are undoubtedly similar to those of *Euphrosyne.* Johnston does not even mention the word branchiæ, and his figures present no trace of such organs. The *Cryptonotæ* have the back covered with long setæ, which cross each other almost in the median line; the *Spintheres,* on the contrary, have the back entirely naked, ridged transversely by thirty little edges, roughened by bristles which scarcely pass beyond the surface of the skin—characters which are presented by some *Chloræmea.* The feet are biramose in *Cryptonota*; in *Spinther* they are uniramose. Far from presenting, in the latter, setæ long and numerous enough to cover the entire back with the exception of a narrow median line, they have only short and straight setæ; among these setæ there are some which terminate in an appendage completely resembling that of some *Chloræmea*; finally, they are coated with an albuminous matter as in the true *Chloræmea*; and this is a very exceptional character, of which Stimpson says nothing in connexion with his *Cryptonota.*

These contrasts are sufficient, I think, to enable my readers to judge between M. Claparède and me. They have seen what is the opinion of my learned opponent. Mine may be summed up in few words.

The *Cryptonotæ* are incontestably *Amphinomea*; but is the genus to be retained or combined with *Euphrosyne,* which Stimpson himself recognized as very nearly allied to it? I cannot answer this question, for want of sufficient details. Stimpson states that he had only a single specimen of his *C. citrina,* and that he could not describe it with all the details desirable. I have therefore left the genus among the *incertæ sedis.*

To determine the position belonging to *Spinther* is by no means so easy. Johnston makes it an Aphroditean, although recognizing its want of the most essential characters of the family. Grube, although leaving it in that family, states that he thinks it more nearly allied to *Amphinome* or *Siphostomum* (*Chloræmea*). Everything seems to me to be in favour of the latter collocation. Thus the form of the composite setæ, the existence of an apparently mucous matter on the feet, and the very short hairs with which the back is roughened, were three characters which at least established some relationship between this type and some *Chloræmea.* But the exceptional form of the inferior appendages of the feet, and the *absence of many details,* prevented me from assigning it a place in the systematic series of the family. I therefore left it among the *incertæ sedis,* whilst placing it in the group from which it appeared to me *to depart the least.*

6. I believe I have justified my course in this particular case. Is this to say that I absolutely repel the charge of having committed errors of synonymy? By no means. On the contrary, I have a too painful conviction that, in spite of all my efforts, more than one must have escaped me. I must here confine my-

self to an appeal for the indulgence of those of my brother naturalists who have essayed the difficult task of coordinating in a general work that immense mass of frequently very heterogeneous materials which results from the isolated labour of a great number of naturalists.

7. The observations addressed to me in a letter by M. Claparède, and a rapid examination of his 'Glanures,' had already called my attention to the family of the *Capitellacea*. The new facts which I thus learnt, and especially the positive confirmation of the position and nature of the branchiæ, the absence of blood-vessels, &c., lead me to remove the *Dasybranchi* from the family *Arenicolea*, and to accept their collocation with the *Capitellæ* and *Notomasti*. But can the family *Capitellacea* be at once placed in the systematic framework of the class? Can we understand its affinities? M. Claparède tells us nothing on this subject; and, for my part, I do not believe we can. I shall therefore leave this singular family among the *incertæ sedis*; for I cannot yet form a distinct idea of its relations with the other groups, which is perhaps due to my not having myself studied any of its representatives.

8. The family *Syllidea* has really engaged much of my attention, as M. Claparède supposes. But during my visits to the sea-shore, I had scarcely ever looked at it from the point of view of a classification of the species. I merely studied in detail certain types, especially from an anatomical point of view. The proof of this will, I hope, be found in my book. When I had to seek to unite all the species described by different authors, I found a great difficulty, which will be understood by every one who has attempted to do the same. The generic denominations, here more than elsewhere perhaps, were not founded upon any uniform rule; the nature and the value of the characters adopted presented nothing fixed. I have sought to introduce as much precision as possible into their appreciation, and it is true that I have taken much trouble to find a method which enables the genera and species to be characterized without much trouble. I thought I had succeeded by distinguishing, as far as it could be done, the *tentacles* from the *antennæ* and *tentacular cirri*, three sorts of appendages which have been habitually confounded, and then by ascribing a generic value to the number of these different appendages. The modifications of the foot have likewise furnished me with characters of the first importance. By thus adding fresh data to those already employed by my predecessors, I believe I have succeeded in preparing a very natural series, in which the new species may take their places without violence. The essays which I have had to make since the period (already distant) when this table was first prepared by me authorize me,

I think, to adhere to my opinion. It is, however, very natural that M. Claparède should prefer the classification which he has published in his 'Glanures.' When one has dwelt for a certain time upon a collection of ideas, such as that which is summarized in a classification, it is very difficult to substitute another suddenly for it. I cannot but be in this position myself; and our *confrères* alone can judge between us.

It is certain that M. Claparède and myself have been guided by very different considerations in the establishment of our genera. I have generally confined myself to the employment, for their characterization, of considerations derived from the external forms. The only exception that I have made has been the *armature of the gizzard,* to which I shall return presently.

M. Claparède, on the contrary, has had recourse to various anatomical considerations, such as the length of the trunk, the absence or presence of the glands which I have called *salivary glands,* the armature of the *pharynx,* &c. He has even characterized his genera by the mode of reproduction—that is to say, by essentially temporary physiological phenomena, which are consequently impossible to ascertain at certain seasons of the year. I see serious inconveniences in this course.

On the other hand, my honourable critic seems to me to have sometimes given too much importance to certain details in considering them generic characters. Thus, in his opinion, the *mode of union of the frontal lobes* is a generic character. It seems to me to be only specific. I shall say as much, and with still more reason, of the following character ascribed to his genus *Pterosyllis*:—(*char. emend.*) "Ventral cirri pinniform, *except those of the penultimate segments, which are moniliform.*" For my own part, I should not hesitate to arrange in the genus in question every Syllidian which had all the other characters of *Pterosyllis,* but of which the penultimate segment had a pinniform ventral segment like the preceding ones.

I know that criticism is easy; and moreover, in this case, I am judge in my own cause. I would not, therefore, dwell too particularly upon the present question. Nevetheless I believe I may indicate that my table gives prominence to a certain number of general results which do not appear to me to follow so clearly from M. Claparède's table. I think, moreover, that I can adduce a consideration which, I believe, would have been decisive for any naturalist placed in my position.

M. Claparède in arranging his table has given his particular attention to the species which he knew thoroughly from having well studied them. For my part, *I had to take into account all the species described by my various* confrères, *past or present.* Now a very great number of these are known to us only by summary descriptions and imperfect figures. If I had attached as much importance as M. Claparède to the armature of the anterior portion of the trunk (*pharynx*), I should have run the risk of not knowing where to place many species to which their external characters, as far as they are known to us, allow a place to be assigned. Still more should I have found myself in this position if, like my honourable critic, I had placed the existence or absence of *alternant generations* among the number of generic characters.

9. I have yet another remark to make with regard to the observations of M. Claparède upon the *Syllidea*. The Genevese *savant* thinks that I have given the name of *gizzard* to the anterior region of the trunk; but in this he has mistaken me. With me, as with my predecessors and with M. Claparède himself, the gizzard is the median, inflated portion which is so characteristic in the *Syllidea*. The anterior portion I call the *pharynx* or the *pharyngeal region*. It is the armature of the gizzard, a region of the trunk which is here almost constantly unarmed, that it has seemed to me useful to introduce into the list of characters. As to the *denticles, styles*, &c., which so frequently arm the *pharynx*, I have mentioned them in the description of the species, but could not ascribe to them the same value as M. Claparède, for the reason just indicated.

However, if I had been placed in the same position as M. Claparède, I should perhaps the more easily have been led to ascribe a value to the *pharyngeal* armature, which will probably be conferred upon it hereafter, as this armature itself appears to me something very exceptional. Upon this point, again, I regret that I cannot agree with my learned *confrère*. Indeed, in his 'Glanures,' to justify the importance which he attaches to this character, M. Claparède adds, "In this I only follow the rule generally applied in the other families of Annelides, in which the pharyngeal armature is regarded as of great value even as a generic character."

These expressions evidently suppose that the armature in question is situated in the same region of the trunk in the *Syllidea* and in the *Nereïdes* or *Eunice*. Now it is impossible for me to accept this conclusion, so far as it relates to the *styles* and *denticles* which arm the *anterior* portion of the trunk of the *Syllidea*. It is evident that they cannot be the representatives of the *jaws* placed in the *median region* of the trunk in the *Nereïdes* and *Eunice*.

The distinction which I here establish between the different regions of the trunk is by no means artificial. I may refer to the fact that it rests not only upon the general form of the organ, the distribution of the muscular masses, &c., but also upon a minute investigation of the nervous system in the *Nereïdes* and allied genera*.

What the *Syllidea* present which is very remarkable from the point of view here under consideration is, that in them the armature usually belongs precisely to a portion of the trunk which is unarmed almost everywhere else, and that the *median portion,* the essentially *dentary portion* in the best-armed Annelides, is, on the contrary, unarmed in them, with the exception of the few species indicated in my table.

10. Moreover, and I have taken care to insist upon this consideration in my general remarks on the family *Syllidea,* my work relative to this group can only be regarded as provisional on many points. We have here a complete little special world, in which the variability of characters increases more than anywhere else, which appears to obey certain physiological laws which manifest themselves very rarely in the *class,* and always in very small species and in groups which are exceptional in other respects,—*distinction of sexes, geneagenesis.* I long for the moment when some naturalist will make a special study of this little world; and notwithstanding what M. Claparède has lately written to me, I like to hope that he will fulfil this difficult task, for which no living naturalist appears to me so well qualified as the author of the 'Beobachtungen' and 'Glanures.'

11. I have still to reply to a serious observation of my learned critic. M. Claparède thinks that I have retained with the same value all the genera the representatives of which have been for some years recognized as being only different forms of one and the same species. The perusal of my book will absolve me on this point. I have taken account of all the discoveries of this kind known to me, and especially of the work of A. Agassiz upon *Autolytus;* but I did not think it was yet time to come to a conclusion. We have here (at least in my opinion) an entire series of facts which science has only as yet touched upon, and which still require numerous and probably patient investigation. I have my doubts as to some of the results announced with most certainty; but even if all that has been said upon this subject were correct, *this all* is still very little. It therefore appeared to me to be wiser to postpone conclusions which facts may contradict to-morrow; and I have accordingly, in general, left these genera among the *incertæ sedis* and in the quality of mere indications, as several of them will no doubt have to disappear, while some will *perhaps* remain to science.

12. But I have not, as M. Claparède thinks, gone so far as to place one form in one family, and another form of the same

* "Mémoire sur le système nerveux des Annélides" (Ann. des Sci. Nat. 3e sér. tome ix.).

species in another family. The example cited by the Genevese *savant,* that of *Tetraglene* and *Pseudosyllis,* is due to a misunderstanding easy to explain.

Grube had described in the same work, and figured on the same plate, the *asexual* and *sexual* forms of a Syllidean. To the former he gave the name of *Pseudosyllis,* to the second that of *Tetraglene.* Ehlers, justly uniting the two forms under a common name, chose the expression *Tetraglene.* I have acted like him. The name *Pseudosyllis* consequently remained unemployed, and, as I thought it a very good one, I applied it to a small genus, not indeed of *Syllidea,* but of *Hesionea.*

This is what has caused a misunderstanding between M. Claparède and myself, for which my honourable *confrère* has already testified his regret. Perhaps I might be reproached for having adopted a name proposed by another author, giving it a new signification. If this is an error, I have fallen into it more than once in my book. He who passes in review the whole of a totality of works frequently has, by this means, data which were wanting to the authors of isolated researches; he looks at many questions from a different point of view. The characterization, the limitation, and the distribution of genera sometimes seem to him to require some modifications. Shall he therefore proceed to abolish the *names* proposed by his fellow labourers? I have not thought it necessary to act thus. As far as possible, I have retained the old denominations, and I have avoided introducing new ones. A few words of explanation suffice in such cases to prevent confusion. In the present case mistake was less to be dreaded, it seems to me, as two different families were in question, and, apart from all other indications, the *biramose feet* and the number of *eight antennæ* indicated in the table would forbid any one to suppose that I meant to speak of *Pseudosyllis,* Grube, which has the *feet uniramose* and only *three antennæ* on the head.

13. M. Claparède calls attention to the fact that the genus *Heterosyllis* figures twice in my table. To complete his observation, he might have added that the genus *Pterosyllis* is not named. This is the double result of a printer's error, which I should have avoided by correcting my proofs better, but which, fortunately, does not recur in the table forming part of my book.

14. The observations of M. Claparède relate principally to the Annelides; he says but little of my table of the Gephyrea, and confines himself to the assertion of an opinion which is not well founded. I thought it right to suppress as a genus the group *Phascolosoma,* as to the characters of which authors did not seem to me to be agreed (see, among others, the works of

Leuckart, Alder, Diesing, and Keferstein); but I have distributed its species in the sections of the great genus *Sipunculus.* I admit, however, that the latter must be sooner or later broken up; but, in the present state of science, I do not yet know exactly what organs would furnish readily appreciable characters for this division. This is the smallest portion of the task which I leave for my successors.

XIV.—*A Synopsis of the Species of the Genus* Collocalia, *with Descriptions of new Species.* By George Robert Gray, F.R.S., F.L.S. &c.

The object of this synopsis is to exhibit the number of the species at present known, and at the same time to show their relative position in a geographical point of view.

a. Malay Group. India.

Collocalia nidifica.

Hirundo esculenta (Osbeck?), Horsf.
—— *fuciphaga*, Thunb.
—— *esculenta*, var., Lath.
Collocalia nidifica, G. R. Gr.
—— *fuciphaga*, Bp.

Top of head, wings, and tail greenish metallic fuscous black; back deep bronzy brown, slightly lighter on rump; beneath the body and sides of the neck brownish mouse-colour, tinted with rusty; tail rather forked, and immaculate.

Length 4″ 10‴, wings 4″ 9‴, tail 2″ 3‴.

Java, Sumatra, and other islands of the Eastern Archipelago.

It is probably the nest of this species that was noticed by Bontius in 1568, Kæmpfer in 1712, Osbeck in 1750, and Hoogman in 1780, as it is much employed for culinary purposes.

Var. *a.* With the rump of a lighter colour; beneath the body greyish mouse-colour.

Length 5″, wings 4″ 6‴ to 4″ 9‴, tail 2″ 3‴.

Hirundo brevirostris, M'Clell.
—— *unicolor*, Jerd.
Cypselus unicolor, Jerd.
—— *concolor*, Bl.
Cotyle brevirostris, Boie.
—— *concolor*, Boie.
Collocalia brevirostris, Strickl.
—— *nidifica*, p., Bl.
—— *fuciphaga*, p., Bp.

Neilgherries, Himalaya, Sikkim, Assam, Ceylon, and western coast of the Indian peninsula, &c.

The nest represented by Olearius in 1674 was found in Coromandel, and probably belonged to this variety.

Var. *b*. Smaller, with the rump scarcely lighter than the back.

Length 4″ 3‴, wings 4″ 7‴, tail 2″.

Borneo.

It is probably the nest of this variety that was referred to by Beeckman in 1718.

Collocalia Linchi.

Hirundo fuciphaga, Horsf.
Collocalia fuciphaga, G. R. Gr.
—— *Linchi*, Horsf.
Cypselus (*Collocalia*) *esculenta*, Bernstein.
Hemiprocne fucivora, Streub.!

Upper surface metallic black; throat, cheeks, sides of neck and breast brownish fuliginous, with each feather slightly margined with white; abdomen white; tail metallic black and immaculate; under tail-coverts metallic black, with the smaller ones margined with white.

Length 3″ 6‴, wings 3″ 11‴, tail 1″ 6‴.

Java, Malacca, Nicobar Islands, Archipelago of Mergui, &c.

The nest of this species, like that of the former, is much used for culinary purposes.

b. Philippine Group.

Collocalia troglodytes.

Collocalia troglodytes, G. R. Gr.

Upper surface bronzy black; beneath the body fuliginous, with the feathers of the throat, abdomen, and vent broadly margined with greyish white; a narrow transverse band of white on the rump, with the shaft and a patch at the tip of each feather fuscous black; tail and upper tail-coverts black, with the former rather pale at the base; under tail-coverts fuscous black.

Length 3″ 3‴, wings 3″ 11‴, tail 1″ 6‴.

Philippine Islands.

The edible nest of the Philippine Islands was noticed by Camel in 1702, and may probably be referred to this species.

c. Papuan Group. Celebes?

Collocalia nidifica, var.

Collocalia nidifica, var., G. R. Gr.

Var. *c*. Beneath the body very pale brownish mouse-colour, especially on the throat.

Length 5″, wings 4″ 10‴, tail 2″ 3‴.

Louisiade Islands; Celebes?

Collocalia hypoleuca.

Collocalia hypoleuca, G. R. Gr.
—— *esculenta*, p., Wall.

Upper surface metallic black; sides of head, throat, and breast fuscous black, with the feathers margined with white; abdomen pure white; tail metallic black, with a prominent white space on the inner web of each lateral feather near the base; under tail-coverts metallic black, with the smaller ones broadly margined with white.

Length 4″, wings 4″ 1‴, tail 1″ 9‴.

Aru Islands, island of Mysol, coast of New Guinea, and Celebes?

The Mysol specimens exhibit the white space on the first three tail-feathers, and a spot only on the fourth. This latter spot I am unable to find in the Aru example, as the tail is imperfect.

It may be observed that the white space on the tail-feathers of the Celebes specimen appears to be further removed from the tip of the feather; but the tail is imperfect in the single specimen contained in Mr. Wallace's collection. When lent to me on a former occasion, I had remarked that it differed from the Aru example, and I had therefore written on the label "n. sp. *viridinitens*;" but I did not adopt it at the time, as I thought it might be better to await the arrival of other examples before describing it. At present I have placed it, with a doubt, with the Aru example.

d. Molucca Group.

Collocalia nidifica, var.

Upper surface darker, especially on top of head, with a purplish tint; and altogether of a smaller size than any of the other varieties.

Length 4″ 5‴, wings 4″, tail 2″.

Morty Islands.

Collocalia spilura.

Collocalia hypoleuca, p., G. R. Gr.
—— *esculenta*, Wall. (nec L.).
—— *spilura*, G. R. Gr.

Upper surface metallic black; cheek, sides of neck, and throat deep fuliginous; breast and beneath the body fuliginous, with the feathers broadly margined with greyish white; tail metallic black, with a white spot on each of the lateral feathers near the middle of the inner web, that on the outer feather very small; under tail-coverts metallic black, the smaller ones margined with white.

Length 3″ 6‴, wings 3″ 9‴, tail 1″ 9‴.

Batchian, and probably on the other Molucca Islands.

The spot on the first and fourth feathers is not so prominent as that on the second and third. Sometimes it is hardly visible on the first feather.

e. Timor Group.

Collocalia nidifica, var.

Upper surface like that of *C. nidifica*, but the lower surface appears to be of a greyish colour.

Length 4″ 9‴, wings 4″ 3‴, tail 2″ 3‴.

Timor (Coupang).

Collocalia neglecta *.

Hirundo esculenta, var., Less.
Collocalia esculenta, Bp.
—— ——, p., Wall.
—— *neglecta*, G. R. Gr.

Upper surface æneous plumbeous, with the shafts of the feathers darker; feathers of the rump narrowly margined with white; upper tail-coverts metallic black; throat and cheeks fuliginous; breast and abdomen white, especially the latter; tail metallic black, with a lengthened white space at the base of the inner web of each lateral feather; under tail-coverts metallic black, with the smaller ones white, having the shafts black.

Length 4″, wings 3″ 10‴, tail 1″ 8‴.

East Timor.

* Mr. Wallace having, since the above characters of the three small species *C. hypoleuca*, *C. spilura*, and *C. neglecta* were drawn up, kindly lent me his specimens of this interesting group, I have been enabled to verify the correctness of the views I had formed on the four specimens from three localities that I had the opportunity of examining, viz. that the white extends in a lengthened form on the inner web of the lateral tail-feathers, in the Aru, Mysol, and Timor (and it is also the case in that of Celebes) examples, while the white forms only a small spot on the inner web of the lateral feathers, somewhat removed from the base, in those of Batchian and Matabello, and probably also of the other Molucca Islands.

The specimens of Mr. Wallace also exhibit the same characters, proving I was right in considering that there existed at least two, if not three, species, and I am therefore still induced to refrain from following him in placing all the examples from various localities (Celebes, Timor, Moluccas, and Aru Islands) under what I consider to be the erroneous name of *esculenta*.

Mr. Wallace's example of the Timor bird is like in all points to the two specimens previously examined. In its upper surface it is totally different from those of the other localities, and it is also of a more pure white on the under surface.

f. Mascarenhas Group. Madagascar?

Collocalia francica.

Hirundo francica, Gmel.
Collocalia francica, G. R. Gr. & Bp.
Hirundo virescens, Vieill.
Cotyle francica, Boie.
Collocalia spodiopygia, p.? Cass.
—— *fuciphaga*, p., Wall.

Top of head, wings, and tail shining æneous black; upper part of back deep bronzy brown; rump with a broad band of brownish white; beneath the body pale mouse-colour, growing lighter on the abdomen; sides of head and back of neck dark æneous brown; under tail-coverts pale æneous brown.

Length 4″ 6‴, wing 4″ 5‴, tail 2″ 1‴.

Isle of France; Madagascar.

g. Feejee and Samoan Groups.

Collocalia spodiopygia.

Macropteryx spodiopygius, Peale.
Collocalia spodiopygius, Cass.
Hirundo francica, Cass.?
Cypselus spodiopygius, Bp.

Upper surface æneous black; cheeks and sides of neck fuliginous; mentum fuliginous, with the feathers slightly margined with white; rump very pale brownish mouse-colour, slightly varied with white, and with the shafts of the feathers fuliginous black; beneath the body pale greyish mouse-colour, lighter on the abdomen; under tail-coverts dark mouse-colour, slightly margined with greyish white.

Length 4″ 7‴, wings 4″ 6‴, tail 1″ 1‴.

Feejee and Samoan Islands.

This species appears to be represented in Ellis's unpublished 'Icones,' 96 (which were made during the third voyage of Capt. Cook, between the years 1776 and 1779), from an example obtained at the Friendly Islands.

h. New-Caledonia Group.

Collocalia leucopygia.

Collocalia Linchi, Verr. & Murs.
—— *troglodytes*, Bp.
—— *leucopygia*, Wall.

Upper surface black, with the top of head, wings, and tail shining æneous black; a broad band of white across the rump, with the shaft of each feather fuscous black; throat and sides of neck fuscous; beneath the body ashy white, with a fuscous line down the shaft of each feather; under tail-coverts fuscous, margined with white.

Length 4″, wings 4″ 6‴, tail 1″ 9‴.

New Caledonia.

i. Santa-Cruz Group.

? *Collocalia vanikorensis.*

Hirundo vanikorensis, Quoy & Gaim.
Cotyle vanikorensis, Boie.
Atticoria? vanikorensis, G. R. Gr.
Collocalia fuciphaga, p.? Bp.
—— *vanikorensis*, G. R. Gr.

Black, with the throat greyish brown; abdomen fuliginous.

Length 5″ (wings 4″ 5‴, tail 2″ 1‴ ex fig.).

Santa Cruz Islands (Vanikoro).

I only know this bird by the above specific description and figure, which induce me to suppose that it must be distinct from any of the other species of *Collocalia*, in which genus it was first placed by Prince Bonaparte.

The figure in the 'Voyage de l'Astrolabe' represents the bird as fuliginous, with the head, upper part of back, wings, and tail shining metallic black. The habits of this bird and the formation of its nest are unknown, which is also the case with the next three species.

j. New-Hebrides Group.

Collocalia uropygialis.

Collocalia leucopygia, p., Wall.
—— *uropygialis*, G. R. Gr.

Upper surface metallic black, with a broad band of pure white on the rump; throat and breast greyish white; abdomen pure white; under tail-coverts greenish metallic black, with the smaller ones margined with white; quills and tail-feathers above greenish metallic black, the latter with a white spot on the inner web of each of the three lateral feathers, that on the first and third less in size, sometimes only found on the second and third lateral feathers; under wing-coverts greenish metallic black, with the larger ones margined with white.

Length 4″, wings 3″ 9‴, tail 1″ 9‴.

New Hebrides (Aneiteum, where it is called by the natives "Nahawpgap"). It is perfectly distinct from the species named *leucopygia*.

k. Society Group.

?*Collocalia Forsteri.*

Hirundo peruviana, p., Forst.
—— *cinerea*, p., Gmel.

Hirundo cinerea, Licht.
Herse peruviana, Hartl.
—— *Forsteri,* Hartl.
Salangana fuciphaga, p., Bp.

Upper surface shining black; beneath the body and rump ashy fuliginous; quills and tail-feathers tipped with obscure white; tail rather bifid.

Length 4″ 9‴, wings 4″ 6‴, tail 2″ 6‴.

Otaheite, where it is called "Hopèā," while in the Marquesas it is known as "Kopeha."

The above specific description is taken from Forster's 'Descriptions;' otherwise I am unacquainted with the bird. It differs materially from the following description of Mr. Peale.

?*Collocalia leucophæa.*

Macropteryx leucophæus, Peale.
Collocalia cinerea, Cass.
Cypselus leucophæus, Bp.
Collocalia fuciphaga, p., Wall.

Upper surface pale soot-colour, beneath lighter; crown, wings, and tail darkest; webs of the greater wing-coverts undulated; tail slightly forked.

Length $5\frac{1}{10}$, wings $5\frac{3}{10}$, tail $2\frac{4}{10}$ inches.

Island of Tahiti (Otaheite).

Until specimens are obtained, it is difficult to say whether these two specific descriptions can refer to the same Otaheitan bird. Prince Bonaparte and Mr. Wallace considered the species of this locality to be the same as *C. nidifica* (*fuciphaga*); but I think this idea wants further confirmation before it can be adopted.

Distribution of the Species of Collocalia.

Indian regions	*Collocalia nidifica,* var. (*brevirostris,* M'Cl.)
Malay regions	*Collocalia nidifica* (*gelatinosa,* Streub.??)
	Collocalia Linchi. (*malaisia,* Streub.??)
Philippine group	*Collocalia troglodytes.* (*philippina,* Streub.??)
Celebes	*Collocalia nidifica,* var.
	—— *hypoleuca?*
Molucca group	—— *nidifica,* var.
	—— *spilura.*
Papuan ,, ...	—— *nidifica,* var.
	—— *hypoleuca.*
Timor ,, ...	—— *nidifica,* var.
	—— *neglecta.*

Distribution of the Species of Collocalia (*continued*).

Micropolynesian regions.	
Caroline Islands	*Collocalia nidifica* ? (apud Garnot). (*ualensis*, Streub.??)
Marianne Island	*Collocalia nidifica* ? (apud Freycinet).
Polynesian regions.	
Santa-Cruz group	*Collocalia vanikorensis.*
New-Hebrides group	—— *uropygialis.*
New-Caledonia ,, ...	—— *leucopygia.*
Feejee group	—— *spodiopygia.*
Samoan ,, ...	—— ——.
Society group	—— *Forsteri.*
Marquesas ,, ...	—— *leucophæa.*
Mascarenhas group......	*Collocalia francica.*

A species is also said to be found in the Sooloo archipelago (*apud* Forster).

This table shows that they are chiefly found within the tropics, except in North India and Madagascar.

I have refrained from adopting the specific name of *esculenta* for any of the preceding species, as has been proposed by some authors; and I subjoin the following history of this specific name in explanation of my reasons for its non-adoption.

It is to be observed, in the first place, that the name of *Hirundo esculenta* was only founded (as was pointed out by the late Mr. Strickland) by Osbeck in 1750 on an edible nest obtained in China, to which country they are generally taken from the Malay Islands.

The name was also employed by Linnæus in the 10th edition of the 'Systema Naturæ,' published in 1758. He refers to the works of Bontius (1568), Olearius (1674), and Rumphius (1750). The first authors described the nest only, while the last referred both to a bird and nest.

It appears that Linnæus overlooked the first published description and figure of the Swallow and edible nest, which were given by Valentyn in 1726, in his 'Oud en nieuw Oost-Indien' iii. Diel, p. 328, pl. opp. p. 300, f. W. This author speaks of a bird between 4 and 5 inches in length; of an entirely bluish black, with the tail of a lighter colour, and having a white spot before the eye as large as the eye itself. He further tells us that it was obtained at Ternate; but he refers to other localities for similar birds, as Gilolo, Celebes, and Oma in Amboina.

In 1750, Burman's edition of Rumphius contains the nest and a rather more defined account of the bird than that which was published in Valentyn's work. He says, in reference to the bird, "Ipsarum color plerumque niger et cum cæruleo fulgore, sique caudæ plumæ separantur, in quavis penna alba conspicitur macula. Pectus et albo et nigro colore variegatus et maculatus est."

This author enters much into the general history of the Edible Swallows, and he records many more localities for this kind of bird than does Valentyn, viz. Java, Madura, Baley, Borneo, islands of Sean and Sanger, Siam, Cambodia, Cochinchina, China; and he also refers to Ternate, Amboina, and Ceram*.

If we are to regard the remark which Thunberg made in 1772 as well-founded, there seems to be some confusion between the description just quoted and the figure given in the same work. He says that the former meant *esculenta*, and that Rumphius's son, who drew the figure, had *fuciphaga* for his pattern.

Dr. Horsfield observes "that the only authority for the specific character of Linnæus was that of Rumphius," which one might easily suppose if we take into consideration that it was the only work referred to by Linnæus that contained the description of a bird in conjunction with the edible nest.

Mr. Wallace, in 1863, adopts Dr. Horsfield's view, and endeavours to show that Rumphius's description and the characters of Linnæus refer to one and the same bird; and he further states, they "are so clear and precise that there can be no doubt whatever about the identification of the species." But I cannot agree that this identification of the description with any of the known species is as yet "so satisfactorily determined," because Rumphius speaks of the concealed white spots on the tail-feathers

* It will be seen by this arrangement of habitats that Rumphius does not imply that his bird was from Ternate (as Valentyn does), nor, in fact, does he give any peculiar locality, but rather seems to record a number of places as the abode of this kind of Swallow. He appears to give the preference to the Malay Islands, &c., and then after them he records three of the Molucca Islands. Now the small bird of the Malay Islands is not furnished with spots, as is mentioned in the description, but has a uniform-coloured tail. It is probable, therefore, that Rumphius may have had in view that of the Moluccas, as spots are only found on the tails of those birds obtained from the last three localities mentioned by him.

Though Valentyn states that his example was obtained at Ternate, yet he appears to have overlooked the spots; for they are not mentioned in his description.

With regard to the other localities mentioned, I believe it may be right to state that the birds have not been recorded of late as found in Siam, Cambodia, Cochinchina, and China, but that the nests have been carried to those places from the Malay Islands as an article of commerce.

as if there were one on each; and the same conclusion is exemplified by the characters promulgated in the 'Systema Naturæ,' viz. "rectricibus *omnibus* macula alba notatis;" while in every one of the known species of *Collocalia* which have white spots on the tail-feathers, they exist only on the *lateral* feathers, the *central* feathers being without any sign of them. We may therefore safely conclude that the supposed "long-lost bird" which was laid before the Zoological Society was not in reality the *Hirundo esculenta* of Linnæus.

On the other hand, I may remark that Brisson in 1760 gave a description and figure of a bird (from a drawing of M. Poivre) that has been considered by some writers equally to be the *Hirundo esculenta* of Linnæus. In this figure *all* the tail-feathers are spotted (at the top) with white, thus agreeing with that author's characters. But Brisson's description and figure could not have been the one referred to, as it was not published until two years after the 10th edition of the 'Systema Naturæ' had appeared. It was in the 12th edition, which appeared in 1766, that Linnæus first referred to Brisson's work. Yet we find Thunberg in 1772, Latham in 1783 and 1823, Boie in 1844, and other authors regarding Brisson's description and figure as the typical representation of the Linnæan species. Latham, however, notices that the figure in Brisson "represents the ends of wings reaching but a little further than the rump;" and we also find that the late Mr. Strickland considered this figure "to belong to some other family than the Swifts or Swallows, or to be grossly inaccurate;" and lately Mr. Wallace has pronounced decidedly "that the figure is not a *Collocalia* at all, not even a Swift or a Swallow."

In 1855 the late Prince Bonaparte applied the specific name of *esculenta* to the bird obtained at Timor and the more remote oceanic islands; while in 1857 Bernstein, in an interesting anatomical paper on *Collocalia*, says of *C. esculenta* et *C. nidifica* (=*fuciphaga*) "op Java gevonden worden." We may suppose, I think, from this remark, that he refers the first name to the species called *C. Linchi* by the late Dr. Horsfield.

After the various opinions expressed, I may still venture to consider the *Hirundo esculenta* of Linnæus to be enveloped in much doubt as to its typical representative among the known species of *Collocalia*; and therefore I think myself justified in not employing this name (first used by Osbeck) for any of the species noticed in this synopsis, and right in bestowing the new name *hypoleuca* on one of the species, which bird, or even the other allied examples, cannot certainly be reconciled with any of the descriptions published by the older authors.

I may observe before closing these remarks, that the name of *esculenta* has been changed by Streubel into that of *salangana*, as it is not the bird, but the nest, that is applied to culinary purposes. Some part of the description that he gives, however, of his *salangana* (which he implies is equal to the *H. esculenta* of Linnæus) conveys a doubt as to the bird described by him being really a *Collocalia*, on the very same ground as Brisson's bird, viz. the shortness of its wings, as M. Streubel remarks that "the wings almost overreach the extremity of the tail." This character alone makes it difficult to reconcile it with what is thought to be the *C. esculenta*, or indeed with any of the species mentioned in the foregoing Synopsis.

XV.—*On the* Menispermaceæ. By John Miers, F.R.S., F.L.S. &c.

[Continued from vol. xiv. p. 374.]

25. Cissampelos.

This extensive and cosmopolitan genus is one of the oldest of the *Menispermaceæ*. The plants, for the most part, are slender climbers, with woody branches; but among the South American species there are several low shrubs with erect stems, scarcely more than 1 or 2 feet high, covered with imbricated leaves. The leaves seldom exceed a mediocre size, and are sometimes small; they are generally more or less orbicular, often reniformly cordate, and are either peltate or palate, rarely quite glabrous, with petioles either elongated or very short. The male infloresence is usually in slender axillary panicles, variously divided, often 3 or 4 fasciculated in each axil, where they are frequently accompanied by an elongated raceme with alternate axils, each bearing similar, but much shorter, fasciculated panicles, and bare of leaves, or having only a minute bract in their place: this raceme-like development is, properly speaking, a young floriferous branch with abortive leaves, as is proved by the frequent presence of regular leaves diminishing gradually to the size of minute bracts. The female raceme is elongated, generally solitary, or geminate in each axil, with a number of approximated large orbicular bracts (appearing like young leaves as they really are), each bearing in its axil from three to ten fasciculated pedicellated flowers; sometimes, however, these leaflets are wanting, when their place is supplied by diminutive bracteoles. The male flowers, always minute in size, consist of four, rarely five or six, oblong sepals, a single cup-shaped petal, and a single stamen in the centre, with its anther usually 4-lobed, or where the lobes are constricted and 2-celled it appears 8-lobed, or by suppression of some of them 5–6-lobed, all the lobes fixed on the margin of a peltiform connective supported on a short slender filament. The female flower, also minute in size, has only one oblong sepal, with a shorter petal attached to its claw, both fixed extrorsely at the base of a solitary ovary, which grows into a small fleshy drupe. The species are numerous and often difficult to determine; for, owing to the extreme simplicity of the floral parts and their minute size, they afford few discriminating characters; the principal differential features therefore rest chiefly on the habit of the plant, on the form of the leaves, the comparative length of the petiole, the point of its insertion, and on the inflorescence: these offer many good and constant characters.

The authors of the 'Flora Indica' (p. 200), in their attempt to determine the Indian species of *Cissampelos*, came to the extraordinary conclusion that all the Asiatic, most of the African, and nearly all those belonging to the New World constitute one single species, and they fix upon *Cissampelos Pareira* of Linnæus, a native of the Antilles, as the representative of this common type. In their view it does not signify whether the leaves be deeply or only slightly peltate or whether the petiole be inserted on the margin of the blade—whether they be cordate, or otherwise; let them be acute, round, or elongated, whether upon very long petioles or nearly sessile, however various be the form or extent of the inflorescence, whether bracts be present or absent—all these differences, which are regarded as of great specific importance by botanists in general, are of no value whatever in their consideration. Such an unprecedented annihilation of about fifty dissimilar kinds of *Cissampelos*, which have long been recognized in various botanical works, and to which distinct characters have been assigned, ought to be viewed with distrust, in the absence of good reasons; a repudiation of such vast extent, even on the part of botanists of deservedly high repute, will induce most botanists to pause before they assent to so sweeping a conclusion, and must diminish the reliance that would otherwise be placed in the value of their decisions where, as I have shown, they have endeavoured to nullify not only good species, but valid genera. Messrs. Bentham and Hooker, in their 'Genera Plantarum,' do not go quite the length of the authors of the 'Flora Indica' in regard to *Cissampelos*; but, as might be expected, they indorse their decision to a great extent; for they recognize only twelve species as belonging to tropical America, five African (including those of *Antizoma* in the number), and only another solitary species, which, according to their view, is widely distributed over the rest of the world, and known to botanists under names which they regard only as synonyms of *Cissampelos Pareira*. However convenient this method may be for the easy determination and laconic description of plants, it tends to force back the science of botany to the state in which it existed in the time of Linnæus, when it was ruled that any diversified number of plants which responded to a short diagnosis comprised within twelve words should be held to form a single species. If this method were again adopted, as now attempted in *Cissampelos*, it would nullify the great aim of modern botanists, who seek for the greatest number of differential characters in the determination of each individual; and it would restrict us to the employment of two or three leading features, in the discrimination of a species, that might perhaps be common to a great many different kinds.

Nothing in the shape of sustainable evidence has been offered to prove that the fifty or more described species of this genus are descended from *Cissampelos Pareira*; it is not an inference drawn from facts, but an assumption in direct contradiction to all the simple truths which nature discloses. Nevertheless, suppose we grant for an instant that, in an immeasurable course of time, and under the influence of "natural selection," the imagined type has undergone the modifications and preserved the varieties of form now exhibited, the inference to be drawn from this admission is, that if such modifications be now permanent, each confined within a limited range of distribution, and we can assign to them severally constant and determinable characters, then clearly, according to the rules of science, they ought to be considered distinct and valid species. In determining different kinds of plants the practical botanist should not be guided by any theory of the distant "origin of species," but should regard them in their present forms. Under this conviction I have opposed the the doctrine in question, and have diligently attempted to fix certain characters to upwards of seventy species of *Cissampelos*. The specific characters I shall give are long, but not longer than is necessary in the first instance to particularize each species; for it must not be forgotten that this preliminary labour is chiefly intended to collect the materials for future monographers of this difficult family. It is not unlikely that I may have erred in some instances, especially where the loan of specimens to compare with others has been impossible; the only plan within my reach has been to make careful tracings of every specimen in the different herbaria within my reach, marking each feature, examining the flowers, and preserving drawings of their analyses: by this method the elaboration of *Cissampelos* alone has demanded more than twelve months of continued investigation. In vindication of those botanists who have renounced in utter despair a task like this, it is right to mention the hopeless confusion that exists in all herbaria that I have seen, especially among Asiatic plants of this genus. Specimens of the same species are there referred to different names and numbers, or the same names and numbers are given to dissimilar plants; and different species, sometimes with plants of other genera, are fixed on the same sheet as being identical; in short, an almost inextricable perplexity exists. In addition to this, the want of good typical specimens and the imperfect short diagnoses on record have rendered it difficult to recognize any plant with precision; so that when a predisposition has existed to annihilate existing species, the opportunity has been very favourable for that purpose. I confess that I have often been disheartened by this perplexity; and it has only been by renewed exertion and a large amount of patience that I have been able to arrive at the conclusions now brought together.

In this issue, I regret to find myself at variance with botanists of the highest repute, whose opinions, from the extent of their labours and the amount of their knowledge, deservedly command universal respect; but, after many years of study, I cannot renounce the strong belief that the very extreme views they have entertained, not only in regard to *Cissampelos*, but to other genera of the *Menispermaceæ*, cannot hold ground against the body of evidence I have been able to bring together.

It is to be deeply regretted that, in a work of such great importance as the 'Flora Brasiliana' of Prof. von Martius, Dr. Eichler, the erudite author of the monograph upon Brazilian *Menispermaceæ*, should have been so fascinated by the extreme views of the learned authors of the 'Flora Indica' and the 'Genera Plantarum' as to have followed their example. I cannot believe that a botanist of such acknowledged merit would have adopted this course if he had carefully worked out his materials. In regard to *Cissampelos*, it will be seen that he has embodied all the erect shrubs, together with some climbing plants, amounting to fourteen species, into *C. ovalifolia*, and has amalgamated no less than thirty-six of the other published species of the genus, belonging to the Old and New World, as synonyms of *C. Pareira*, acknowledging only five old and two new species, all Brazilian; but why he should have selected these five Brazilian cases only, in two of which he has mistaken their identity, and why he passed over others, which are equally remarkable for the differential characters they oppose to his type, it is very difficult to conceive. I am glad to have the opportunity of remarking that the plates in the work above mentioned, mostly from drawings by Dr. Eichler, are beautifully executed; his review of the family, and his observations on its general structure and the economic uses of its plants, are deserving of high commendation.

It is worthy of remark that, with very few exceptions, each genus of the *Menispermaceæ* is confined to a comparatively limited range; and it is a singular coincidence that, out of fifty known genera, only three original ones, *Cissampelos*, *Cocculus*, and *Menispermum*, occur in both hemispheres. The area of distribution of each of the many species of *Cissampelos* here enumerated is very limited, so that they may be said to be nearly local—a character which almost universally prevails throughout the family. The species here collated have been divided into three groups, American, African, and Asian: these again are subdivided into peltate, subpeltate, and palate sections, according to the different modes of insertion of the petiole upon the blade of the leaf. This plan, though arbitrary, happens to agree with the local distribution of the species, and has been adopted solely with the view of affording facility to others in studying the species and in the more easy determination of the individuals. When the results here obtained have been examined and confirmed, it will be easy to arrange the species methodically into groups and sections marked by separate characters which will tend greatly to abbreviate the respective diagnoses.

The plants throughout the genus are diœcious, the sexes being always distinct in different plants, except in two or three instances where monœcious flowers occur: in one the sexes are found in distinct racemes in the same individual; in another male and female flowers are seen in the same raceme; but, as they accord in the usual number of their floral parts, these exceptions have (like those in *Tiliacora*) been retained in the genus; on the other hand, where a different number and disposition of the floral parts occur which, from their constancy, cannot be attributed to metamorphism, the species have been excluded, in order to preserve the uniformity and universality of the characters of *Cissampelos*. Thus, following the example of *Cyclea, Clypea, Antizoma,* &c., where this uniformity is disturbed I have formed the genus *Dissopetalum,* in which two petals are always present in the female flower, and also *Peraphora,* where the petal in the same sex is sometimes wanting, and where the floral envelopes are two deep bursiform sepals, and the putamen is echinated in a manner different from that of *Cissampelos*. *Clambus* is also constituted as a genus distinct from *Cissampelos,* not only because it has six sepals and six petals in the male flower, but on account of the very different habit of its species, and the peculiar mode of venation of their leaves.

Cissampelos, Linn.—*Flores* dioici, rarius monoici. *Masc. Sepala* 4, rarius 5 vel 6, spathulato-obovata, vel sublanceolata, submembranacea, sæpe eroso-denticulata et extus pilosa, patula, æstivatione imbricata. *Petalum* unicum, cyathiforme, interdum poculiforme, margine crenato, 4-lobum, carnosulum aut membranaceum. *Stamen* unicum, centrale; *filamentum* breve, filiforme, apice *connectivum* plus minusve disciforme peltatum margine antheriferum fulciens; *anthera* e cellulis 4 vel pluribus in annulum circumcingentem coalitis, rima horizontali bivalvatim hiantibus.—*Fœm.* *Sepalum* unicum, ovatum vel oblongum, subconcavum. *Petalum* unicum, sepalo antepositum et multo minus. *Stamina* nulla. *Ovarium* solitarium, gibbum, 1-loculare, *ovulo* unico ad angulum ventralem appenso; *stylus* brevis, excentricus; *stigma* tripartitum, laciniis aristæformibus, divaricatis, sæpe uncinatis. *Drupa* ovata, carnosula, stylo persistente ad hilum proximo notata; *putamen* obovatum, compressum, 1-loculare, loculo hippocrepiforme, extus liris plurimis interstitiisque sulcatis radiatim crenato, intus semini conforme; *condylus* loculo circumdatus, excentricus, disciformis, extus utrinque subconvexus, intus ad hilum marginalem pro introitu vasorum tantum pervius. *Semen* hippocrepiforme vel lunatum, compressum; *integumentum* tenue, linea longitudinali in fissuram condyli infixa; *embryo* in *albumine* simplici carnoso, hippocrepiformis, teres, tenuiter elongatus, *cotyledonibus* incumbentibus, *radicula* supera, tereti, iis æquilonga et æquilata, ad stylum spectante.

Frutices *aut* suffrutices *sæpius alte scandentes, interdum repentes, rarius erecti, plerumque inter tropicos totius orbis crescentes;* folia *alterna, integra, sæpius cordato-orbicularia, petiolata,* petiolo *rarius palatim, sæpius plus minusve intra marginem inserto:* paniculæ ♂ *axillares, composite ramosæ, sæpe cymosæ, multifloræ, vel e ramulo novello aphyllo aut bracteato plurimæ, hoc modo racemum floriferum efformantes;* flores *minuti:* racemi ♀ *axillares, longiusculi, sæpe ramiformes;* bracteis *plurimis, sæpius majusculis, foliolosis, suborbicularibus, alternatim approximatis aut imbricatis;* flores *minimi, pedicellati, plurimi, in axillis bractearum fasciculati et absconditi.*

The characters of all the following species are fully detailed in the third volume of the 'Contributions to Botany:'—

Div. 1. Americanæ.

* Folia peltata; frutices scandentes.

1. *Cissampelos tropæolifolia,* DC.;—v. s. in hb. Boissier. ♂ & ♀, Cuchero (Pavon); in hb. DC. ♂, Bahia (Blanchet, 290); in hb. Mus. Brit. ♂, Crato (Gardner, 1444); in hb. Hook. ♂, Peru (Matthews, 2057); Antioquia (Jervise).
2. —— *glaberrima,* St. Hil.;—C. clematidea, *Presl.*—v. v. et sic. in hb. meo, ♂ & ♀, mont. Organ. et Valença; in hb. Mus. Brit. et Hook. ♀, Pernambuco (Gardner); in hb. Hook., Brazil (hb. Vienn. 1303).
3. —— *grandifolia,* Tr. & Pl.;—v. s. in hb. Hook. ♂, Maumer (Hayes, 168); ♀, La Paila (Holton, 667).
4. —— *sympodialis,* Eichl.;—v. s. in hb. Mus. Brit. et Hook.

♂ & ♀, Traipu (Gardner, 1233–1234); ♀, Paranagua (Gardner, 2472–2474).

5. *Cissampelos fluminensis,* Eichl.—Amazonas.
6. —— *errabunda,* nob.;—v. s. in hb. Hook. ♂, Brasilia (Swainson).
7. —— *longipes,* nob.;—v. s. in hb. Mus. Brit. ♂, Martinica (Rohr, 158); in hb. Lindl. et Hook. ♂ & ♀, Surinam (Hostmann, 19); in hb. Hook., Venezuela (Fendler, 14).
8. —— *Pareira,* Linn.;—v. s. in hb. DC. ♂ & ♀, San Domingo (Poiteau); in hb. Lindl., Trinidad; in hb. Hook., inter multis aliis, Panama (Seemann, 313); Jalapa (Linden, 926); ♂ & ♀, S. Vincent. (Guilding); in hb. Mus. Brit. nonnulla e variis locis.
9. —— *acuta,* Tr. & Pl.;—Triana, v. s. in hb. Boissier., Peru (Pavon).
10. —— *orinocensis,* H. B. K.;—v. s. in hb. Lindley., Coro del Tigre (Oelbe, 1882).
11. —— *testudinaria,* nob.;—v. s. in hb. Hook. ♂ & ♀, Galapagos (Darwin, 239).
12. —— *limbata,* nob.;—v. s. in hb. DC. ♂ & ♀, Cuchero (Pavon); in hb. Hook. ♂, Mexico (Beechey); ♀, Ibague, Nov. Granada (Holton, 668), Chagres, Panama (Fendler, 4), Minas Geraës (Claussen).

** Folia subpeltata; frutices scandentes.

13. —— *Benthamiana,* nob.;—v. s. in hb. Hook. et alior. ♂ & ♀, Mexico (Hartwegg, 445).
14. —— *heterophylla,* DC.;—v. s. in hb. meo, ♂, Jamaica (Heward); in hb. Hook. ♂, Jamaica (Distan), ♀, Trinidad (Schach).
15. —— *scutigera,* Tr. & Pl.;—Bogota; v. s. in hb. Hook., ♀, Panama (Hayes, 186).
16. —— *littoralis,* St. Hil.;—v. s. in hb. meo, Piauhy (Gardner, 2475); ♂ & ♀, Brasilia (hb. Vienn. 1302).
17. —— *gracilis,* St. Hil.;—v. s. in hb. Soc. Reg. Hort. ♂, San Paulo (Weir, 420).
18. —— *microcarpa,* DC.;—v. s. in hb. DC. ♀, Cuba (Sagra); in hb. Lindl. ♂, Cuba (Wright, 22); in hb. Hook. ♂ & ♀, Cuba (Wright, 21, 22); ♂ & ♀, Jamaica (Marsh, 19); ♂, Venezuela (Fendler, 13).
19. —— *Hænckeana,* Presl;—v. s. in hb. Boissier., ♂ & ♀, Cuchero (Pavon).
20. —— *hirsutissima,* Presl;—v. s. in hb. DC. et Boissier., ♂ & ♀, Icanozo (Goudot); ♀, Peru (Pavon).
21. —— *tomentosa,* DC.;—v. s. in hb. DC. ♂, Cuba (Linden, 1809); in hb. Mus. Brit., Jamaica (Shakespeare).

22. *Cissampelos canescens*, Miq.;—v. s. in hb. Hook. et Lindl. ♀, Zimapan (Coulter, 659); in hb. Lindl. ♂, Orizaba (Brotero, 569).
23. —— *glaucescens*, Tr. & Pl.;—v. s. in hb. DC. ♂, Chiquitos (D'Orbigny, 774), Brazil (Claussen); in hb. Hook., Ecuador (Horton).
24. —— *guayaquilensis*, H. B. K.;—v. s. in hb. Mus. Brit. et Hook. ♂, Guayaquil (Jameson, 335); ♂ & ♀, Guayaquil (Spruce, 6322); in hb. DC. ♀, Mexico (Pavon), Cuba (Pöppig).
25. —— *tamoides*, DC.;— ♀, Minas Geraës (St. Hil.); v. s. in hb. Hook. ♂, ins. S. Catherina (Tweedie).
26. —— *australis*, St. Hil.;—v. s. in hb. Lindl. ♂, Uruguay (Tweedie); ♀, Uruguay (Tweedie, 1278).
27. —— *monoica*, St. Hil.;—Curitiba, Brazil (St. Hil.).
28. —— *myriocarpa*, Tr. & Pl.;—v. s. in hb. Hook. ♀, Mesitas Ecuador (Triana).
29. —— *auriculata*, nob.;—v. s. in hb. Hook. ♂ & ♀, Entre Rios (Tweedie).
30. —— *hederacea*, nob.;—v. s. in hb. Hook., Prov. Argentinas (Tweedie).
31. —— *argentea*, H. B. K.;—Rio Magdalena.
32. —— *subreniformis*, Tr. & Pl.;—Ecuador (Triana); v. s. in hb. Mus. Brit. ♂, Goyaz (Gardner, 3002).
33. —— *andromorpha*, DC. (non Eichler);—C. denudata, *nob.*; C. fasciculata, *Benth.*;—C. caapeba, *Vell.* (*non Linn.*);—v. v. ♂ in mont. Organens.; v. s. in hb. DC. ♂, Bahia (Blanchet, 3947); in hb. Lindley, ♂ & ♀, Bahia (Salzmann); in hb. Hook., Rio Janeiro (M'Gillivray, 297); ♂ & ♀, Guiana Brit. (Schomb. 677), Guian. Gall. (Sagot, 18); ♂, Obidos et Santarem (Spruce), Veraguas (Seemann, 1156).
34. —— *ramiflora*, nob.;—C. andromorpha, *Eichl.* (*non DC.*); —v. s. in hb. variis ♂, Rio Casiquiare (Spruce, 3165), Panuré (Spruce, 2463), San Gabriel (Spruce, 2166).
35. —— *floribunda*, nob.;—v. s. in hb. DC. ♂, Peru (Pöppig).

*** Folia palata; frutices scandentes.

36. —— *Caäpeba*, Linn.;—C. eriocarpa, *Tr. & Pl.*;—v. s. in hb. DC. ♂, Peru (Pöppig, 1293); ♀, Mexico? (Pavon); in hb. Hook. et alior. ♂, Tarapota (Spruce, 4409); ♀, Chonana, Guayaquil (Spruce, 6538).
   Var. *biloba*, nob.;—in hb. Boissier., Guayaquil (Pavon); in hb. Hook. Guayaquil (Pavon).
37. —— *consociata*, nob.;—v. s. in hb. Hook. ♂ & ♀, Jamaica (Wilson).

38. *Cissampelos diffusa*, nob.;—v. s. in hb. Hook., Antilles (Gouan), Jamaica (Wilson); ♂ & ♀, Jamaica (Marsh, 18).

**** Frutices humiles, erecti; folia palata aut rarius subpeltata.

39. —— *crenata*, DC.;—C. ovalifolia, *Eichl.* (*non DC.*);—v. s. in hb. variis ♂ & ♀, Guiana Brit. (Schomb. 124).
40. —— *mallophylla*, nob.;—v. s. in hb. DC. ♂ & ♀, America tropica.
41. —— *ovalifolia*, DC.;—Minas Geraës (St. Hil.); v. s. in hb. DC. ♂ & ♀, Cuyaba; in hb. meo ♂, Ceará (Gardner, 1445); in hb. Hook. ♂, Entre Rios (Tweedie).
42. —— *communis*, St. Hil.; ♂ & ♀, prov. S. Paulo.
43. —— *velutina*, St. Hil.;—v. s. in hb. Mus. Brit. ♂, Minas Geraës (Claussen); in hb. Hook. ♀, Venezuela (Fendler, 1890); in hb. meo, Caraccas.
44. —— *vestita*, Tr. & Pl.;—v. s. in hb. Hook. ♂ & ♀, Tovar (Funcke, 171); ♀, Sa. Martha (Purdie).
45. —— *suborbicularis*, St. Hil.;—C. assimilis, *nob.*;—C. ebracteata, *St. Hil.*;—v. s. in hb. variis ♂, Amazonas (Spruce); in hb. Hook. ♂, Goyaz (Gardner, 2999), Ceará (Gardner, 1445 *bis*).
46. —— *amazonica*, nob.;—v. s. in hb. variis ♂ & ♀, Santarem (Spruce).

Div. 2. Africanæ.

* Folia peltata; frutices scandentes.

47. —— *owariensis*, Beauv.;—v. s. in hb. Mus. Brit. ♂, Cape Coast (Brass); in hb. Lindley. ♀, Owaree (Beauv.); in hb. Hook. ♀, Niger (Baxter, 3345), Lagos (Baxter, 20156), Fernando Po (Mann, 180).
48. —— *insolita*, nob.;—v. s. in hb. Hook. ♂, Corisco Bay (Mann, 1870).
49. —— *hirta*, nob.;—v. s. in hb. Mus. Brit. ♂ & ♀, Congo (C. Smith).

** Folia subpeltata; frutices scandentes.

50. —— *zairensis*, nob.;—v. s. in hb. Mus. Brit. ♂ & ♀, Congo (C. Smith).
51. —— *madagascariensis*, nob.;—v. s. in hb. Mus. Brit., Madagascar (Thompson); in hb. DC. ♂, Bourbon (ex. hb. Linn. fil.); in hb. Boiss., Bourbon (e Mus. Paris.); in hb. Hook. ♂ & ♀, Madagascar (Blackburn).
52. —— *Bojeriana*, nob.;—v. s. in hb. Lindl. ♂, Mauritius ex hb. Lambert.); in hb. Hook. ♂, Mauritius (Bouton).

53. *Cissampelos mucronata*, A. Rich.;—C. apiculata, *Hochst.*;—C. Vogelii, *nob.*;—C. comata, *nob.*;—C. cordifolia, *Bojer*;—v. s. in hb. Mus. Brit. Hook. et Lindley., ♂ & ♀, Fazokel, Abyssinia (Kotschky, 504); in hb. Hook., Walo, Senegambia (Heudelot); ♂ & ♀, Attah and Dagore (Vogel), Shupanga, Zambesi (Kirk), Riv. Luabo (Kirk); in hb. Lindl. ♂, Natal (Gueinsius, 165); in hb. Mus. Brit. et Hook. ♂, Natal (Krauss, 252); ♂ & ♀, Mauritius (Wallich).

54. —— *nephrophylla*, Boj.;—v. s. in hb. Hook. ♂, Madagascar (Bojer); ♀, Madagascar (Lyall, 89), Senegal (Römer).

*** Folia palata aut obsolete subpeltata; frutices scandentes aut subproni ramosi, ramis rarius erectis.

55. —— *tamnifolia*, nob.;—v. s. in hb. Lindl. ♂, Delagoa Bay (Forbes, 11).

56. —— *torulosa*, E. Mey.;—Menispermum capense, *Linn.*;—v. s. in hb. Hook. ♂, Uitenhage (Harvey, 679), Adow, Algoa Bay, Brit. Caffraria (Cooper, 120), Natal (Saunderson, 393), Norambello, lat. 14° 19′ (Kirk), Krysna (Bowie), D'Urban (Macken, 644); ♀, Katrivier, Cafferland (Drège).

57. —— *capensis*, Thunb.;—C. fruticosa, *Thunb.*;—C. humilis, *Poiret*;—v. s. in hb. variis ♂ & ♀. In colonia Capensi.

Div. 3. Asiaticæ.

* Folia peltata; frutices scandentes.

58. —— *diversa*, nob.;—v. s. in hb. Hook. ♀, Khasya (Hook. & Th.).

59. —— *elata*, nob.;—v. s. in hb. DC., Nepal (Wallich); in hb. Mus. Brit., ins. Honimon (Smith); in hb. Hook. ♂, Nepal (Wallich); ♀, Simla (Dalhousie); Buschir, Sutlej (Jacquemont, 1093); ♀, Soane River (Burelli); ♂, Gurwahl (Falconer, 90).

60. —— *grallatoria*, nob.;—v. s. in hb. Soc. Linn. ♂ & ♀, Goyalpoor (Wall. Cat. 4979 B, *a*; 4977 A, *b*); ♂ & ♀, Segain, Prome (Wall. Cat. 4977 G); in hb. DC. ♂ & ♀, Prome (Wallich, 1291, in parte); in hb. Lemann. ♂ & ♀, Bhootan (Griffiths, 1730); ♀, Himalaya (Griffiths); in hb. Hook. ♂ & ♀, Khasya (Hook. & Th.); ♀, Punjab; ♀, Sikhim (Hook. & Th.); ♀, Bengal (Griffiths); ♂, Assam (Griffiths).

61. —— *Cumingiana*, nob.;—in hb. variis ♂ & ♀, ins. Philipp. (Cuming, 691); ♂, ins. Malay. (Cuming, 1613).

62. —— *hirsuta*, Buchan.;—v. s. in hb. Mus. Brit. ♂, Sembu, Nepal (Buchanan); in hb. Mus. Brit. et Lindl. ♀, Neil-

gherry (Hook. & Th.); in hb. Hook. ♀, Almora, Kumaon (Stach. & Wint.); in hb. meo ♀, Coimbatore (Gardner).

63. *Cissampelos discolor*, DC.;—C. cardiophylla, *A. Gray*;—v. s. in hb. Mus. Brit. et alior. ♂, ins. Philipp. (Cuming, 1440); ♂, Moulmein (Wallich, 1291, in parte).

64. —— *eriantha*, nob.;—v. s. in hb. Lindl., Ind. Penins. (Wight, 39); in hb. Soc. Linn. ♂, Kumaon (Wall. Cat. 4979 G, *a*, 4977 C); in hb. Hook. ♂, Jainia, Himalaya (Hook. & Th.); in hb. Mus. Brit., Punjab (Hook. & Th.).

65. —— *obtecta*, Wall.;—v. s. in hb. Soc. Linn. ♂, Nepal (Wall. Cat. 4981 A, non B, C; id. 4980 A, *c*); ♀ (id. 4979 G, *b*); ♀, Ladak, Moorcroft (Wall. Cat. 4979 D); in hb. Mus. Brit. ♂, Nepal (Wallich).

66. —— *convolvulacea*, Willd.;—C. tetrandra, *Roxb.*;—C. mauritiana, *Wall.* (*non Thouars*);—C. pareiroides, *DC.*;—C. septemnervis, *Wall.*;—v. s. in hb. Soc. Linn. ♂, Ind. or. (Wall. Cat. 4979 B, *a*; id. 4979 D, *b*); ♀ cult. Calcutta (id. 4979), Dendygal (id. 4979 et 4979 B, *b*), Ragmohl (id. 4979 H), Mungyar (id. 4979 J, in parte); in hb. Mus. Brit. ♀, Calc. cult. (Wallich), Ind. or. (König), Fort Victoria (Hove), Ind. or. (Wight, 39); in hb. Hook. plurima e variis locis.

67. —— *subpeltata*, Thwaites;—v. s. in hb. Mus. Brit., Ind. or. (Soc. Fratr.); ♀, Kandy (König, 146); in hb. Mus. Brit. et Hook. ♂ & ♀, Ceylon (Thwaites, 168); ♂ & ♀, ib. (Thw. 169); in hb. Hook. ♂, Ceylon (Gardner, 34); ♀, Ceylon (Walker); in hb. Lindl., Kandy (Macrae, 113); in hb. DC. ♂, Cotallam (Leschenault); in hb. Soc. Linn., Mungyar (Wall. Cat. 4979 J, in parte).

** Folia palata aut vix subpeltata; frutices scandentes.

68. —— *orbiculata*, DC.;—C. Caäpéba, *Roxb.* (*non Willd.*);—C. convolvulacea, *Wall. in parte* (*non Willd.*);—Cocculus orbiculatus, *DC.*;—Batta Valle, *Rheede*;—v. s. in hb. Soc. Linn. ♂ & ♀, Sylhet (Wall. Cat. 4979), Dendygal (id. 4979 A, *a*; id. 4979 B); ♂, Madras (id. 4979 F); ♀, Nepal (id. 4977 G *b*, 1), Nepal (id. 4981 A, *b*), Sylhet (id. 4981 B), Oude (id. 4981 C); in hb. Lindley., Moulmein; in hb. Hook., Madras (Hunter), Punjab (Hook. & Th.); ♀, Assam (Griffiths, 569), Rangoon (M'Clelland).

69. —— *delicatula*, nob.;—v. s. in hb. Hook. ♂ & ♀, Kurg (Madras Coll. 60); ♂, Ind. or. (sub *Clypea Wightii*, No. 37); in hb. Soc. Linn. ♂, Hatowdah, Nepal (Wall. Cat. 4981 A, *b*); in hb. Heward., Ceylon.

[To be continued.]

XVI.—*On the Muscular Force of Insects.* By Félix Plateau *.

The measurement of the strength of invertebrate animals, and especially of Insects, appears never to have been the object of any investigations; and yet, as will be seen hereafter, how much does this strength, compared with the weight of the animal, exceed that of Man and the Mammalia. Here and there only, in the writings of some authors, we find indications which prove that this extraordinary strength has not completely escaped observation. In this respect I shall cite two sentences of Pliny. In the first place, speaking of insects in general, he says, "In his tam parvis atque tam nullis, quæ ratio, quanta vis, quam inextricabilis perfectio!" and again, with regard to the ants, "ac si quis comparet onera corporibus earum, fateatur nullis, portione vires esse majores." Lastly, I find the following passage in one of Sir Walter Scott's novels (Peveril of the Peak, chap. xxxv.):—"Hence the smallest creatures are frequently the strongest. Place a beetle under a tall candlestick, and the insect will move it by its efforts to get out; which is, in point of comparative strength, as if one of us should shake his Majesty's prison of Newgate by similar struggles."

What, relatively to the weight of the animal, is the muscular force in different species of insects? how many grammes, on an average, can one of these species move by traction, or pushing, or during flight? and is this force subject to any law? Such are the various questions that I have sought to solve by experiments, which are certainly very simple, but the results of which cannot but be interesting when compared with those furnished by researches of the same kind made upon the human subject and the horse.

Before proceeding further, I will sum up in a few words the processes which I have employed. I ascertained the force of traction by making an insect draw horizontally a thread passing over a pulley and having at its other extremity a pan containing weights, which are increased up to the maximum that the insect can move.

Pushing is effected by burrowing insects on one of the extremities of a horizontal lever moving upon a vertical axis, the other extremity of which raises weights by means of a thread passing over a pulley as in the preceding case.

Lastly, the force developed in flight is measured by attaching to the two posterior legs of the insect a small mass of wax,

* Bullet. de l'Acad. de Belgique, 2me sér. tom. xx. Communicated by the author.

which is at first too large for it to move, and is then diminished until the insect can barely support it in the air by the movement of its wings.

In these three kinds of experiments the muscular force of a species is represented by the relation between the mean maximum weight moved individually by a certain number of insects of the species in question and the mean weight of the insects.

The deductions which I draw from the results taken in their totality are as follows:—

1. *Leaving flight out of consideration, insects have, relatively to their weight, an enormous strength in comparison with Vertebrata.* Thus, from experiments made with draught-horses, these animals, the average weight of which is about 600 kilogrammes, can only exert for a few moments a force of traction equivalent to 400 kilogrammes, that is to say, two-thirds of their own weight; but I have found that the common Cockchafer (*Melolontha vulgaris*) and *Donacia nymphææ* exert a force equal respectively to fourteen times and forty-two times their own weight.

The pushing led to analogous results; but, in general, the weights raised by insects during flight are much less, which might be expected, as these little animals have never to transport considerable burdens through the air, as is done especially by the Rapacious Birds*.

2. The weight of insects and the ratios representing their muscular force are connected by what appears to be a general law, at least according to the numerous experiments that I have made. The following is the law, which is clearly manifested both in the case of flight, and in those of traction and pushing:—*If in the same group* (family or tribe) *of insects we examine two species which differ considerably in weight, the smallest and lightest will exhibit the greatest force*; in other words, in the same group the force, always measured by the relation of the weight moved to that of the animal, varies from species to species in an inverse ratio to the latter weight.

In connexion with this I will give a few examples taken from the tables of my memoir. These tables contain for each species, besides the mean ratios expressing the force of that species, the maximum of the isolated ratios furnished by the different individuals experimented on; and the law is manifested therein, not only in the mean ratios, but also in the individual maximum just mentioned.

[* M. Plateau seems here to have forgotten the Sand-Wasps, many of which carry caterpillars of comparatively large size to their burrows.—W. S. D.]

	Mean weights of species.	Mean weights moved.	Mean ratios.	Individual maximum ratios.
	TRACTION.			
Melolontha vulgaris	0·940 gr.	13·456 gr.	14·3	23·2
Anomala Frischii	0·153 ,,	3·721 ,,	24·3	66·4
	PUSHING.			
Oryctes nasicornis	2·117 gr.	6·702 gr.	3·2	4·2
Geotrupes stercorarius ..	0·492 ,,	8·298 ,,	16·9	28·4
Onthophagus nuchicornis	0·056 ,,	4·457 ,,	79·6	92·9
	FLIGHT.			
Bombus terrestris	0·214 gr.	0·134 gr.	0·63	0.87
Apis mellifica..........	0·083 ,,	0·065 ,,	0·78	1·00

The comparative examination of the locomotive limbs in most of the species experimented on has shown me that the volume of the muscles of these organs appears in general to decrease more rapidly in proportion than the weight; it seems, therefore, that we must attribute the greater strength of the small species to a greater muscular activity or energy. The reason of this difference in favour of insects of small size is, perhaps, beside all anatomical or physiological considerations: thus the hardness of the ground in the case of burrowing insects, the objects which impede their progress in simple locomotion, and the inertia of the air in flight, form resistances to be overcome which are the same for the large and small species; now to avoid giving a useless excess of force to the former, or fatally depriving the latter, nature must endow the smaller species with a greater muscular energy. Considerations of the same kind may, in my opinion, be applied to the first of the principal facts deduced from my investigations, namely the enormous strength of insects in comparison with vertebrate animals; for if the reasoning appears just when applied to two insects of different sizes and weights, it must be admitted, I think, with still more reason, when an insect is compared with a mammal.

XVII.—*Descriptions of several Species of* Trichopterygidæ *found by* Dr. H. Schaum *in various parts of North America and Brazil.* By the Rev. A. Matthews.

[Plate V.]

The insects described in the following pages were collected in various parts of North America and in Brazil by Dr. Schaum, of Berlin, to whose kindness I am indebted both for the privilege of thus introducing them to the notice of entomologists, and also for his liberal donation of examples of every species, including even those of which but one specimen has yet been found.

In investigating the nomenclature of these insects I have been much impeded by the difficulty of obtaining reference to a paper published by Mr. Haldeman in the 'Journal of the Natural History Society of Philadelphia,' in which he has described six American species of this family. After searching in vain for this publication in the Library of the British Museum, and in other places both in this country and on the Continent, I met with it at last, through the kind assistance of Dr. Power, in the University Library at Cambridge.

All the species described by Mr. Haldeman appear to be represented among the captures of Dr. Schaum. But I regret to say that his descriptions are so extremely vague that I much doubt whether some of the references which I have made are really correct. If they are correct, it becomes necessary to alter two of Mr. Haldeman's names, viz. *T. rotundata* and *T. fuscipennis,* since the former of these was previously used by M. von Motschulsky for another species of the same genus described by him in the 'Bulletin de la Soc. Imp. de Moscou,' in 1845, and the latter (*T. fuscipennis*) by Gillmeister, also in 1845, in Sturm's 'Deutschlands Fauna,' to designate what he supposed to be a variety of *T. atomaria.* For the sake of avoiding confusion, I have therefore substituted other names for these two species. The first I have called *T. glabricollis,* as indicative of a specific difference; and to the other I have assigned the name of *cursitans,* used by M. Nietner for a species of *Trichopteryx* taken in Ceylon, and described in these 'Annals' for 1856. With this description, and also with types received from M. Nietner, Dr. Schaum's insects agree in every particular. The same remark is equally true with regard to *Ptenidium macrocephalum,* another species found by M. Nietner in Ceylon, and also by Dr. Schaum in America. Of the remaining four described by Mr. Haldeman, *T. discolor* and *T. aspera* appear to be distinct and well-marked species; *T. abrupta* seems to be identical with *T. fascicularis,* Herbst; and *Ptenidium terminale,* according to his description, agrees in every point with *P. apicale,* Erichson.

Three of the species taken by Dr. Schaum are new and undescribed, all of them distinct and very interesting, especially the one which I have called *T. Schaumii* in honour of its captor; this insect bears a considerable resemblance to the curious *Astatopteryx laticollis* of M. Perris in the excessive development of its thorax. The other seven approach so closely to European forms already well known, that I have assigned to them the names now in use. Although some of these differ slightly from the European type in size or intensity of colour, yet I do not consider the difference sufficient to justify their separation, especially since the superficial sculpture (so important in determining the species of this family) remains the same.

Trichopteryx Schaumii, n. sp. Pl. V. fig. 1.

T. rufo-castanea, nitidissima, convexa, pilis brevibus sparse vestita, tuberculis nullis; pronoto validissime dilato; elytris brevibus, valde attenuatis; abdomine elongato. Long. corp. $\frac{5}{8}$ lin.

Caput modicum, sat elongatum, leviter remoteque punctatum, nitidissimum, palpis atque antennis flavis, his ad apices fuscescentibus.

Pronotum validissime dilatatum, elytris permulto latius; angulis anticis productis, acutis; margine posteriore arcuatao, angulis latis, valde elongatis, partem quartam elytrorum amplexis; nitidissimum, punctis minutis, longe segregatis notatum, marginibus lateralibus atque angulis posticis dilutioribus.

Scutellum magnum, triangulare, elongatum, fortiter punctatum, aut potius asperatum.

Elytra brevia, validissime attenuata, fortius ac seriatim punctata vel asperata, apicibus rectis; læte rufo-castanea, ad suturam dilutiora.

Abdomen elongatum, valde attenuatum, segmentis sex apertis, modice punctatum.

Pedes læte flavi.

Subtus castanea; ore, coxis atque segmentis ultimis abdominis flavis.

Habitat Americam septentrionalem, exemplo unico in Louisiana capto.

Species præclara, distinctissima, ab omnibus facillime cognita.

Trichopteryx glabricollis, Matthews. Pl. V. fig. 2.

Trichopteryx rotundata, Haldeman.

T. nigra, nitida, elytris rufo-piceis, brevis, lata, valde convexa, tuberculis nullis, pilis pallidis sparse vestita. Long. corp. vix $\frac{1}{2}$ lin.

Caput magnum, latum, indistincte leviter punctatum, nigrum; antennis pallide flavis, ad apices fuscescentibus.

Pronotum latum, quam convexissimum, levissime punctatum, postice sat dilatatum, angulis valde productis elytrorum humeros tenaciter amplexis; nigrum, angulis posticis piceis.

Scutellum magnum, triangulare, nigrum, profunde asperatum.

Elytra brevia, quadrata, fortius asperata, rufo-picea, sutura dilutiore.

Abdomen longius exsertum, rufo-piceum.

Pedes pallide flavi.

Subtus castanea; ore, coxis atque apice abdominis flavis.

Habitat Americam septentrionalem, in provincia New York capta.

Hæc species forma rotundata, convexissima differt ab omnibus hujusce generis nisi *T. Matthewsii*, Wollaston (Cat. Col. Can. p. 103), ab hac facile potest distingui antennis multo brevioribus, atque capite et pronoto glabris, nitidis, dum partes eædem alterius tuberculis elevatis atque lineis reticulatis ornatæ sint.

Nomen "*rotundata*" in hoc genere prius usitatum fuit a D. Motschulsky, Bull. Moscou, 1845.

Trichopteryx cursitans, Nietner. Pl. V. fig. 3.

Trichopteryx fuscipennis, Haldeman.

T. sat convexa, nigra, nitida, elytris rufo-fuscis, tuberculis parvis, fere seriatim dispositis, interstitiisque alutaceis obtecta, pube densa valde sericea per totum corpus vestita. Long. corp. $\frac{3}{8}$–$\frac{1}{2}$ lin.

Caput breve, latum; antennis modicis, testaceis, ad apices fuscescentibus.

Pronotum ad modum *T. atomariæ* dilatatum, margine posteriore sinuato, angulis sat productis elytrorum humeros amplexis, disco plus minusve denudato; nigrum, angulis posticis late testaceis.

Scutellum modicum, triangulare.

Elytra pronoto angustiora, leviter confertissime asperata, sat depressa, parum attenuata, apicibus parum rotundatis; rufo-fusca, lateribus atque sutura in nonnullis nigrescentibus.

Abdomen nigrum, sat exsertum.

Pedes testacei.

Subtus picea; ore, coxis, metasterno, atque apice abdominis flavis.

Habitat Americam septentrionalem, in provincia New York capta.

Obs. In loco "*fuscipennis*," sæpe a D. Motschulsky atque aliis usitatæ, nomen "*cursitans*" adhibendum censeo.

Trichopteryx crassicollis, n. sp. Pl. V. fig. 4.

T. nigra, oblonga, convexior, tuberculis sat magnis ornata, interstitiis rugosis, pilis brevibus fulvis vestita. Long. corp. $\frac{5}{8}$ lin.

Caput magnum, prominulum; antennis læte flavis.

Pronotum latum, convexissimum, vix postice dilatatum, lateribus valde rotundatis, tuberculis sat magnis fere transverse seriatim dispositis ornatum; margine posteriore depresso, leviter marginato, sinuato, angulis parum productis.

Scutellum magnum, triangulare, fortiter asperatum.

Elytra oblonga, haud postice attenuata; piceo-nigra, apicibus dilutioribus, fere rectis.

Abdomen sat exsertum.

Pedes læte flavi.

Subtus nigra; ore, coxis atque apicibus metasterni et abdominis flavis.

Habitat Americam septentrionalem, in Louisiana exemplo unico capto.

Differt a *T. grandicolli* forma oblonga, setis erectis nullis, elytris longioribus, atque colore obscuro-nigro.

Trichopteryx fascicularis, Herbst. Pl. V. fig. 5.

Trichopteryx intermedia, Gill. *T. abrupta*, Haldeman?

T. nigra, sat lata, pilis brevibus pallidis vestita, tuberculis elevatis interstitiisque alutaceis ornata. Long. corp. $\frac{1}{2}$–$\frac{3}{4}$ lin.

Caput sat breve, latum, parvum; antennis flavis, ad apices fuscescentibus.

Pronotum postice dilatatum, lateribus parum rotundatis, tuberculis parvis, interstitiis profunde alutaceis, ornatum; margine posteriore sinuato, angulis valde productis, elytrorum humeros tenaciter amplexis.

Scutellum magnum, triangulare, asperatum.

Elytra subquadrata, in maribus parum attenuata, alutacea, confertim asperata, apicibus aliquantum rotundatis, anguste pallidis.

Abdomen parum exsertum.

Pedes læte flavi.

Subtus nigra, alutacea, coxis piceo-testaceis.

Habitat Americam septentrionalem.

Hanc speciem sub nomine *T. abrupta* a D. Haldeman descriptam esse opinor, sed e descriptione tam curta et imperfecta quomodo adjudicare haud sciam. Certum est, quod descriptio illius ad *T. fascicularem* omnino referre videtur.

Trichopteryx discolor, Haldeman. Pl. V. fig. 6.

T. nigra, haud nitida, elytris pallide testaceis, depressa, subparallela, tuberculis sat magnis, aliquantum remotis ornata, interstitiis profunde alutaceis, pilis quam brevissimis vestita; pronoto minime dilatato. Long. corp. $\frac{3}{8}$–$\frac{1}{2}$ lin.

Caput maguum, latum; antennis longioribus, pallidis, ad apices fuscescentibus.

Pronotum ad basin parum dilatatum, lateribus valde deflexis, angulis posticis productis; nigrum, angulis posticis dilutioribus.

Scutellum magnum, triangulare, nigrum.

Elytra depressa, oblonga, testacea, lateribus atque angulis apicalibus externis plus minusve nigrescentibus.

Abdomen nigro-piceum, sat exsertum.

Pedes pallide testacei.

Subtus picea, ore et coxis testaceis.

Habitat Brasilias.

Trichopteryx sericans, Heer. Pl. V. fig. 7.

T. nigra, haud nitida, oblonga, aliquantum depressa, pilis fulvis vestita, tuberculis elevatis, interstitiis profunde alutaceis, ornata. Long. corp. $\frac{3}{8}$–$\frac{1}{2}$ lin.

Caput modicum; oculis vix prominentibus; antennis piceis.

Pronotum postice latius, margine posteriore leviter sinuato, levissime reflexo, angulis aliquantum productis.

Scutellum magnum, triangulare, asperatum.

Elytra quadrata, sat depressa, capite atque pronoto parum longiora,

confertim asperata, obscure nigra, apicibus dilutioribus, fere rectis.
Abdomen parum exsertum, nigrum.
Pedes læte flavi.
Subtus nigro-picea.
Habitat Americam septentrionalem.

Exempla Europæa antennas fere nigras habent, sed ab illis insecta prope lacum Superiorem capta haud aliter differunt.

Trichopteryx Montandonii, Allibert. Pl. V. fig. 8.

Trichopteryx similis, Gillmeister.

T. nigra, nitida, convexa, oblonga, sparse et levissime tuberculata, interstitiis alutaceis, pilis griseis vestita. Long. corp. $\frac{3}{8}$ lin.
Caput magnum, latum; oculis sat magnis, haud prominentibus; palpis atque antennis flavis, his ad apices fuscescentibus.
Pronotum parum postice latius, valde convexum; margine posteriore sinuato, levissime marginato, angulis sat productis.
Scutellum magnum, triangulare, sat profunde asperatum.
Elytra oblonga, capite atque pronoto parum longiora, multo profundius ac distincte seriatim asperata, piceo-nigra, ad suturam dilutiora, apicibus summis albidis, parum rotundatis.
Abdomen sat exsertum.
Pedes flavi.
Subtus nigra, coxis flavis.
Habitat Brasilias, exemplo unico capto.

Trichopteryx ambigua, Matthews, Ent. Mag. 1865. Pl. V. fig. 9.

T. fusca, convexa, latior, tuberculis distinctis interstitiisque profunde alutaceis ornata, pilis longioribus pallidis vestita; pedibus atque antennis robustis. Long. corp. $\frac{3}{8}$ lin.
Caput magnum, breve, latum; oculis modicis, haud prominentibus; antennis nigro-piceis.
Pronotum haud postice dilatatum, lateribus aliquantum rotundatis; margine posteriore leviter sinuato, leviter marginato, angulis minime productis; in maribus ad basin aliquantum contractum.
Scutellum magnum, triangulare, confertim asperatum.
Elytra quadrata, haud postice attenuata, confertim asperata, aut potius tuberculata, interstitiis distincte alutaceis; apicibus minime rotundatis.
Abdomen sat exsertum.
Pedes quam robustissimi, læte flavi, femoribus obscuratis.
Subtus fusca, coxis flavis.
Habitat Americam septentrionalem, exemplis multis in provincia New York captis.

Hæc species cum multis aliis sub nomine *T. pumila* comprehendi videtur: quamquam D. Erichson ait, quod *T. pumila* tarsos anticos dilatatos habet, atque D. Gillmeister *T. simili* eam comparat, nihilominus exempla hujusce speciei cum *T. simili* aliisque nonnullis in una, *T. pumila*, sæpissime miscentur.

Trichopteryx aspera, Haldeman. Pl. V. fig. 10.

T. nigra, obscura, pilis brevibus griseis vestita, tuberculis sat elevatis dense obtecta, interstitiis fortissime alutaceis. Long. corp. $\frac{1}{4}$–$\frac{3}{8}$ lin.

Caput breve, latissimum, latitudini pronoti fere æquale; oculis magnis, prominulis; antennis nigro-piceis.

Pronotum transversum, postice parum dilatatum, lateribus sat rotundatis, confertim tuberculatum, tuberculis oblique seriatim dispositis; margine posteriore leviter sinuato, angulis vix productis.

Scutellum modicum, triangulare, fortissime asperatum.

Elytra longiora, postice parum dilatata, transverse seriatim confertissime asperata, apicibus extremis albidis, parum rotundatis.

Abdomen longius exsertum.

Pedes flavi.

Subtus nigro-picea; ore, coxis atque apice abdominis dilutioribus.

Habitat Americam septentrionalem, in provincia New York nonnullis captis.

Differt ab omnibus magnitudine minore ac forma singulari pronoti atque etiam sculptura rugosa corporis.

Hæc insecta ad *T. asperam*, Haldeman, referenda rugosum corpus indicat, sed descriptio ejus adeo imperfecta est, quod nescio, annon ad eam re vera pertineant.

Micrus filicornis, Fairmaire. Pl. V. fig. 11.

M. nigro-piceus, angustus, elongatus, tuberculis parvis confertim obtectus, pilis longioribus albidis vestitus. Long. corp. $\frac{3}{8}$–$\frac{1}{2}$ lin.

Caput magnum, pronoti latitudini fere æquale; antennis flavis, elongatis.

Pronotum antice dilatatum, pone medium contractum, ad basin iterum parum dilatatum, lateribus ac basi leviter marginatis; margine anteriore et posteriore fere rectis, angulis anticis obtusis, posticis acutis.

Scutellum parvum, triangulare, asperatum.

Elytra longiora, lateribus subparallelis, truncata, apicibus minime rotundatis, margine summo albido, transverso ordine leviter confertimque asperata, capite et pronoto parum dilutiora.

Abdomen elongatum, valde obtusum.

Pedes longiores, læte flavi.

Subtus piceo-niger; ore, coxis atque apice abdominis dilutioribus, femoribus obscuratis.

Habitat Americam septentrionalem, etiam in Brasiliis captus.

Rarissima in Europa, in America communis species videtur.

Nephanes læviusculus, n. sp. Pl. V. fig. 12.

N. fusco-castaneus, nitidus, in capite ac pronoto annulis minutis, distinctis, umbilicatis, seriatim ornatus, pilis albidis vestitus. Long. corp. $\frac{5}{16}$ lin.

Caput magnum, longitudini et latitudini pronoti fere æquale; oculis magnis, prominentibus; antennis piceis, ad basin flavis, articulo ultimo elongato-acuminato.

Pronotum transversum, lateribus minime rotundatis; margine posteriore recto, angulis obtusis.

Scutellum modicum, triangulare, leviter asperatum.

Elytra longitudini capitis atque pronoti fere æqualia, profundius asperata, ad apices dilatata, apicibus sat rectis, angulis externis obtusis.

Abdomen sat exsertum, castaneum.

Pedes flavi.

Subtus pallide castaneus.

Habitat Americam septentrionalem, in Louisiana exemplo unico capto.

Differt a *N. abbreviatello* magnitudine majore, sculptura eximia, pronoto minus rotundato, elytris multo longioribus, atque articulo ultimo antennarum elongato acuminato.

Ptilium Bollani, Mannerheim. Pl. V. fig. 13.

Ptenidium Canadense, Le Conte.

P. oblongum, nigrum, haud nitidum, alte confertimque verrucatum sive tuberculatum, pilis albidis vestitum. Long. corp. vix $\frac{5}{16}$ lin.

Caput magnum, fronte rotundata; ore sat producto; oculis magnis, prominentibus; antennis piceo-nigris.

Pronotum transversum, vix capite longius, parum postice latius, lateribus parum rotundatis; margine posteriore sinuato, angulis obtusis.

Scutellum sat magnum, triangulare, profunde verrucatum.

Elytra ovata, pronoto vix latiora, capite atque pronoto sesqui longiora, profunde verrucata, apicibus summis obtusis, aliquantum dilutioribus.

Abdomen haud exsertum.

Pedes fusco-testacei.

Subtus nigrum, ore testaceo.

Habitat Americam septentrionalem, prope lacum Superiorem captum.

Ptenidium macrocephalum, Nietner. Pl. V. fig. 14.

P. læte castaneum, valde convexum, nitidissimum, foveis quatuor ingentibus ad basin pronoti profundissime impressum. Long. corp. $\frac{3}{8}$ lin.

Caput magnum, latum, punctura sat parva prope oculos utrinque impressum; antennis flavis, clava fuscescente; oculis sat magnis.

Pronotum longitudini et latitudini capitis fere æquale, ante medium latissimum, lateribus rotundatis, fortiter marginatis, angulis posticis ferme rectis; foveis quatuor ad basin valde profundis, latissimis, rotundatis, inter se atque latera pari modo distantibus, atque alia profunda difformi utrinque ad angulum posticum, atque etiam punctis duobus minoribus ad medium marginis anterioris impressum; disco nitidissimo.

Scutellum modicum, triangulare, apice producto, acuto.

Elytra ovata, brevia, ante medium latissima, sat lata, apicibus angustioribus, acutis, alte marginata, leviter remoteque punctata, pilis brevibus sparse vestita, capite et pronoto dilutiora.

Pedes læte flavi, tibiis parum dilatatis.

Subtus piceum; ore, coxis atque segmentis ultimis abdominis flavis.

Habitat Americam septentrionalem, in provincia New York captum.

Hæc species pulcherrima, foveis ingentibus pronoti, atque lateribus marginatis facillime cognosci potest.

Ptenidium apicale, Erichson. Pl. V. fig. 15.

Ptenidium terminale, Haldeman?

P. nigrum, convexum, nitidissimum, sparse punctatum, pilis rarioribus indutum, elytrorum apicibus late rufo-piceis. Long. corp. $\frac{1}{2}$ lin.

Caput magnum, latitudini pronoti fere æquale; oculis sat parvis, prominulis; antennis læte flavis, ad apices paulum fuscescentibus.

Pronotum pone medium latissimum, lateribus rotundatis; margine posteriore recto, angulis obtusis, impressione indistincta transversa ad angulos posticos.

Scutellum modicum, triangulare.

Elytra capite atque pronoto fere duplo longiora, atque etiam profundius punctata, punctis in striis dispositis; medio dilatata, apicibus obtusis, rufo-piceis.

Pedes læte flavi.

Subtus nigrum, ore et coxis testaceis.

Habitat Americam septentrionalem, prope Baltimore captum.

Videtur mihi, quod *P. terminale*, Hald., ad hanc speciem referri debeat.

P.S.—Since this paper has been in the hands of the printer, entomology has lost one of its brightest ornaments by the death of my lamented friend Dr. Schaum. It may be long before the gap which his masterly intellect has left in the literature of our favourite science can be repaired; it must be long before entomologists can forget the energetic leader and kind friend to whose memory I now humbly offer this short testimony of my regard.

XVIII.—*Notice of a Japanese Pheasant.* By John Gould, Esq., F.R.S. &c.

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

Gentlemen,

Like other little-explored countries, the distant island of Japan now and then affords the ornithologist an opportunity of describing a new species pertaining to his favourite science; and that it will continue to do so for some time to come is, I think, more than probable. With this brief remark I beg to record in your 'Annals' a short notice of a bird which I think may hereafter be regarded as an additional species of the family Phasianidæ.

In affinity it is very closely related to the *P. Sœmmeringii* (*Graphophasianus Sœmmeringii* of Reichenbach and Bonaparte: see the latter's "Tableaux parallèliques de l'Ordre des Gallinacés," in the 'Comptes rendus de l'Académie des Sciences' for 1856), is of the same size and form, but is far more beautiful than any of the examples of that species I have seen. The differences, which are very striking, consist in the feathers of the back, rump, and upper tail-coverts being broadly margined with white, while the brilliant crimson which occupies the centre of the tip is far more fiery; in the flank feathers and greater wing-coverts being bordered with greyish white, in the ground-colour of the tail being cinnamon-brown, and the narrow bars, which are deep buff in *P. Sœmmeringii*, being greyish white and communicating a very marked appearance to the tail when spread. Some specimens are of the same size as *P. Sœmmeringii*, while others are rather smaller. That the peculiar features I have pointed out are not due to age, there can be no doubt; for I have examples of both birds which have long spurs—an evidence of their being mature.

If this bird should prove to be a new species, I would propose for it the name of *Phasianus* (*Graphophasianus*) *scintillans*; if it should not, a notice of its remarkable differential features is worthy of record in the 'Annals.'

I beg to remain,
Gentlemen,
Yours faithfully,
John Gould.

26 Charlotte St., Bedford Square, W.C.
Jan. 24, 1866.

BIBLIOGRAPHICAL NOTICE.

The Natural History of the Tineina. By H. T. Stainton. Vols. VIII. and IX. 8vo. London: Van Voorst, 1864–1865.

We have already repeatedly had occasion to notice, in terms of high praise, the appearance of the previous volumes of this excellent work; and we can hardly say more in favour of the two volumes which have appeared in the last two years, than that in every respect they maintain the reputation gained by their predecessors. As he approaches the end of the first stage of his journey (his first series of ten volumes), Mr. Stainton continues to devote to his task an unflagging zeal and industry which prove it to be to him a labour of love; and although, from the vastness of the design, we hardly dare hope that the author's energies will last long enough to enable him to complete the 'Natural History of the Tineina' on its present scale, every fresh volume that he issues will form one stone the more towards the construction of a monument which will preserve and adorn his memory for many years. And although we trust it may be long before his friends will need to be reminded by such a monument of his life and labours, we cannot but hope that the consideration thrown out above may at least serve as some inducement to him to persevere in the publication of the present work, each new volume of which (notwithstanding certain defects in its arrangement to which we have already more than once called attention) cannot but be received with pleasure by every entomologist. Independently of the exquisite beauty of the illustrations, it is no small gratification, in these days of slovenly work, to have to do with an author who honestly endeavours to tell us all about his subject, or at least to make his history of each object that comes under his treatment as complete as the existing state of knowledge will permit.

The first of the two volumes indicated at the head of this article contains the descriptions and natural history of fifteen species of *Gracilaria* and nine species of the allied genus *Ornix*, which with *Coriscium*, the distinctness of which from *Gracilaria* is doubted by Mr. Stainton, constitute the subfamily *Gracilariidæ*. Of the first-mentioned genus, *Gracilaria*, the author gives a list of forty-three known species, five of which inhabit North America, five have been brought from the neighbourhood of Calcutta, and three from Moreton Bay. The remaining thirty are European species; and of these, fifteen species are undoubtedly inhabitants of Britain. Of the latter, twelve are described and figured by Mr. Stainton in the volume before us. The larvæ of those whose transformations are known, twenty-two in number, feed upon plants belonging to a great variety of natural orders, among which, however, the Aceraceæ, Leguminosæ, and Amentiferæ are most conspicuous.

This is singularly in contrast with the state of matters in this respect in the genus *Ornix*, notwithstanding a close similarity both in the characters of the insects forming the two genera, and in the general habits of the larvæ. Here, out of twenty-two known species, the larvæ of no fewer than seventeen have been discovered; and the food-plants of these belong exclusively to the two natural orders Rosaceæ and Amentiferæ, the former nourishing ten species, and the latter furnishing food for seven or eight. Of the twenty-two species, four are North American, the remainder are European; and of these, nine (or, again, exactly one half) are known to occur in Britain. Eight of the British species are treated of in the present volume, which thus includes the natural history of nearly the whole of the native forms of the two genera.

In his ninth volume Mr. Stainton enters upon the hardest portion of his task, namely the description of the enormous genus *Gelechia*, the most numerous in species of all the Tineina. The number of *British* species described by the author in the 'Insecta Britannica' was no less than ninety-five, and several have since been added to our native list; the European and exotic species are also very numerous. Under these circumstances, and considering the difficulty attendant on the grouping of such a multitude of nearly related forms, we can hardly wonder that Mr. Stainton has postponed his general considerations on *Gelechia* to his next volume, which, like the one now before us, will contain twenty-four species of the genus.

MISCELLANEOUS.

On the Chevreulius callensis *of Lacaze-Duthiers.* By Joshua Alder.

In the 'Annales des Sciences Naturelles' for November last, M. Lacaze-Duthiers has given an interesting account of an Ascidian of a very peculiar structure, forming, in some respects, a connecting link between the Tunicata and the Lamellibranchiata. This animal the distinguished author conceives to be new and unique, and has therefore constituted for it a new genus under the name of *Chevreulius*. Of the great interest attached to this genus there can be no doubt; but M. Lacaze-Duthiers is mistaken in supposing that it is new to science, as it was described upwards of ten years ago (in July 1855), by Professor Stimpson, in the 'Proceedings of the Philadelphia Academy of Sciences,' under the name of *Schizascus*, and two species characterized, which he had met with in the Chinese seas. A specimen of one of these, *S. papillosus*, was kindly sent to me by that eminent naturalist. It bears a great resemblance to the figures given by M. Lacaze-Duthiers, differing principally in the papillose or echinated character of the valvular opening. A species apparently of the same genus was obtained in the Indian Ocean by Dr. Macdonald, who has also characterized it as a new genus, under the name of *Peroides*. This I only know through a paper of his in the 'Transactions of the Royal Society of Edinburgh' (vol. xxiii. p. 176), where it is stated to have "two apertures on the same plane, protected by a D-shaped opercular fold of the test common to both." It would thus appear that three generic appellations have been given to this curious genus, that of Professor Stimpson having the precedence. Naturalists are indebted, however, to M. Lacaze-Duthiers for the detailed account he has now given of its structure.

On the Extension of certain marine Fishes to the freshwater Rivers of India.

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

Gentlemen.—Dr. Günther, in reply to my note impugning his statement regarding the extension of certain genera of marine fishes to Nepal, states that he has received information that several species of *Therapon* are exclusively inhabitants of fresh water. Now, without denying this statement, I must say that it is quite opposed to my own experience. No doubt some species of *Therapon* frequent streams of fresh water *near the sea*, as well as tidal rivers and backwaters, as I many years ago pointed out, stating that I had caught one species of *Therapon*, with fly, in small streams on the Malabar coast; but I doubt if any species extends, in non-tidal rivers, more than a very few miles from the sea.

2. This, however it may be, does not affect my refutation of its extension to Nepal, which I emphatically deny, as well as that of the other marine genera of fishes mentioned by Günther as extending to Nepal. I have not his paper at hand, but, writing from memory, aided by a Catalogue of Hodgson's collections, I believe that, besides *Therapon* and *Scatophagus*, he makes a *Serranus*, two *Diagramma*, *Sillago*, and *Trachinotus* all extend to the rivers of Nepal, which, I need hardly again say, is perfectly erroneous. The only marine genera that I know which extend beyond the influence of the tides in India are *Coroina*, *Mugil*, and one or two Clupeoid fishes, including the celebrated Hilsa fish (*Alosa ilisha*), which, however, does not extend nearly so far as the mountain-streams of Nepal.

3. With regard to Dr. Günther's rejection of my generic name *Pristolepis*, because he was unable to recognize it, I can only state that a much less experienced ichthyologist, Dr. Day, in a copy of his 'Fishes of Cochin,' quite recently received by me, though forwarded last July, gives a footnote to *Catopra malabarica* (in manuscript), in which he states that in his large work with illustrations he shall give it as his opinion that *Pristolepis* must be preferred to *Catopra*.

4. The assumption by any one individual, however learned, to reject a genus or species because he states that he himself finds it impossible to recognize it, is certainly not authorized in the rules regarding nomenclature laid down in the Proceedings of the British Association.

I am, Gentlemen,
Yours obediently,
T. C. Jerdon,
Surgeon-Major.

Camp, Muzuffurnuggur,
December 6, 1865.

On the Amphipoda of the Adriatic. By Camil Heller.

Whilst the Amphipoda of the northern seas, especially those of the Scandinavian and English coasts, have been treated of in works of detail, this cannot be said of those of the Southern European seas. The only work which treats the Amphipoda of the Mediterranean with some completeness is that of A. Costa. But scarcely anything has been hitherto known of the Amphipoda of the Adriatic. Professor Grube was the first to make us acquainted with some forms occurring at Quarnero. Professor Heller has now directed his particular attention to this group of animals, and obtained an abundance of materials during his repeated visits to the Adriatic; and these have subsequently been increased by specimens sent him from various places. In this way he has been enabled to obtain a tolerably complete view of the Amphipodan fauna of the east coast of the Adriatic. In all, 100 species have been observed by Grube and himself—namely, 89 true Amphipoda, and 11 Læmodipoda; whilst, according to Costa, only 62 species are known from the Mediterranean, and, according to Bruzelius, only 77 from the northern seas. This number, however, forms an unfavourable contrast to the British Amphipod-fauna, of which Spence Bate cites more than 200 species.

The species observed by the author and characterized in his memoir are as follows:—

A. AMPHIPODA GENUINA.

I. Orchestidæ.

Orchestia mediterranea.
—— Deshayesii.
—— litorea.
—— Montagui.
Nicea plumosa, *n. sp.*
—— fasciculata, *n. sp.*
—— Buichichi, *n. sp.*
—— nudicornis, *n. sp.*
—— Nilssoni.
Nicea macronyx, *n. sp.*
—— camptonyx, *n. sp.*
—— crassipes, *n. sp.*
—— rudis, *n. sp.*
—— Schmidtii, *n. sp.*

II. Gammaridæ.

Probolium megacheles, *n. sp.*
—— marinum.
Lysianassa spinicornis.
—— loricata.
—— longicornis.
—— pilicornis, *n. sp.*
—— Costae.
Ichnopus affinis, *n. sp.*
—— calceolatus, *n. sp.*
Anonyx Schmardæ, *n. sp.*
—— filicornis, *n. sp.*
—— gulosus.
—— minutus.
—— nanus.
Anonyx Nardonis, *n. sp.*
—— tumidus.
Callisoma Hopei.
Ampelisca Gaimardi.
Isæa Montagui.
Iphimedia obesa.
—— Eblanæ.
—— carinata, *n. sp.*
Decamine spinosa.
—— spiniventris.
Atylus Costæ, *n. sp.*
Eusirus bidens, *n. sp.*
Leucothoë denticulata.
Protomedia hirsutimana.
Gammarella brevicaudata.
Melita palmata.
—— gladiosa.
—— Coroninii, *n. sp.*
Mæra grossimana.
—— scissimana.
—— integrimana, *n. sp.*
—— erythrophthalma.
—— Donatoi, *n. sp.*
—— brevicaudata.
—— orchestiipes.
Gammarus marinus.
—— locusta.
—— tenuimanus.

III. Corophidæ.

Amphithoë penicillata.	Podocerus longicornis, *n. sp.*	Cyrtophium glabrum, *n. sp.*
—— bicuspis, *n. sp.*	Microdeutopus gryllotalpa.	Cratippus pusillus.
—— Brusinæ.	—— Titii, *n. sp.*	—— crassipes, *n. sp.*
Podocerus pulchellus.	Cerapus abditus.	Corophium longicorne.
—— monodon, *n. sp.*		—— acherusicum.
—— Ocius.		Chelura terebrans.
—— largimanus, *n. sp.*		

B. LÆMODIPODA.

Caprella phasma.	Caprella armata, *n. sp.*	Caprella leptonyx, *n. sp.*
—— acutifrons.	—— monacantha, *n. sp.*	—— aspera, *n. sp.*
—— obtusa, *n. sp.*		

Sitzungsber. der Kais. Akad. der Wiss. in Wien, November 4, 1865.

On a new mode of Parasitism observed in an undescribed Animal. By M. Lacaze-Duthiers.

The author detected on the Antipatharian Coral described by him under the name of *Gerardia* some small, flat, reniform bodies, which were immersed in the soft tissues of the polypary. On opening some of these, he saw escaping from them a swarm of small Crustacean embryos. The enclosing capsule proved to be the parent animal.

M. Lacaze-Duthiers compares this parasite to a small lobster, at the utmost 1–2 centimetres (millim.?*) in length, having the thoracic portion disproportionately extended and forming a large flattened sac opening only by a pore situated near the middle of its free border.

The true body of the animal is suspended by its back within this greatly developed carapace, which attains a diameter of 3 or 4 centim. (millim.?). The body is strongly curved, and the head is very small. The abdomen consists of articulated segments, and bears six regular and symmetrical pairs of feet; it contains only a large yellowish digestive tube, of which the orifices are nearly obliterated. This curious Crustacean forms a new genus, to which the author gives the name of *Laura*; the species he denominates *L. Gerardiæ*. As it lives within the tissues of the *Gerardia*, M. Lacaze-Duthiers believes that its nourishment is obtained by direct absorption from the latter, rather than by digestion.

The walls of the utricular carapace are nearly cartilaginous in texture, are pierced by an immense number of pores, from which excessively delicate tubes radiate into the surrounding sarcosoma; and through these the fluids of the polypary pass directly into the venous lacunæ of the parasite. The circulatory apparatus is very rudimentary, and there are no special organs of respiration. The nervous system is also very little developed.

The reproduction of the animal is equally curious with its mode of parasitism. It is hermaphrodite. The female glands occur with the liver in the substance of the integuments of the utricle, and open

* The measurements given by the author seem to be erroneous; they would make the body of the animal from $\frac{2}{5}$ to $\frac{4}{5}$ inch in length, and the diameter of the carapace $1\frac{1}{5}$ to $1\frac{3}{5}$ inch.

in a singular position. The legs, which resemble those of the lower Crustacea in their general characters, present at the base behind a sort of process, at the apex of which are the genital orifices.

Those of the first pair are much slenderer than the rest, and it is in them that the oviducts terminate.

The male glands are lodged within the legs, and open upon the processes by as many apertures as there are spermatogenous capsules. Thus the ten posterior legs are male, and the two anterior female. Hence fecundation must take place within the pouch in which the body is suspended, and the utricle serves at once for absorption by its outer surface and for reproduction by its inner surface, as a true incubation takes place in its cavity. The author has observed all the details of the embryogeny of this singular parasite.

He also remarks upon the great development of the liver, and its position in the midst of the venous network of the carapace, which directly receives the nutritive fluid from without. Bile is secreted in great quantities, although scarcely any digestion can be said to take place; hence he infers that the liver must be regarded as a purifier or modifier of the fluids intended for nutrition, and that its function in digestion in the higher animals is probably to be regarded as a secondary one.—*Comptes Rendus*, Nov. 13th, 1865, p. 838.

On the Development of the Axolotl (Siredon mexicanus *vel* Humboldtii). By A. Duméril.

On the 17th April last, M. Duméril communicated to the Academy of Sciences some observations on the development of young Axolotls from ova deposited in the Menagerie at the Muséum d'Histoire Naturelle; and from that date to the month of September the development of these animals continued without presenting any phenomena calling for special notice. The animals having then attained a length of 0·21 metre, nearly equal to that of their parents (0·25 m.), one of them, which had not been particularly observed for a fortnight, suddenly attracted attention by presenting an aspect quite different from that of the other specimens of the same age. It no longer possessed branchial tufts, or only retained traces of them; the membranous crests of the back and tail had disappeared; the form of the head was slightly modified; and there appeared on the body and limbs numerous yellowish-white spots, which contrasted strikingly with the general blackish colour. On the 28th September a second individual had undergone the same change, and on the 7th October a third presented it in a less advanced form.

On the 10th October M. Duméril was enabled to observe this metamorphosis from its commencement. On this day some yellowish-white points made their appearance on the limbs of a specimen, and the portion of the crest nearest to the head was effaced. Between this day and the 25th October the crest disappeared throughout its whole extent, the branchial lamellæ and subsequently the appendages supporting them gradually diminished in length, until on the 6th November there were only three little projections, scarcely apparent above the skin, on the sides of the neck. The head had decreased

0·005 m. in breadth at the level of the anterior branchiæ. The crests had entirely disappeared.

These external metamorphoses are accompanied by internal modifications comparable with those observed in the Urodelous Batrachia when passing from the larval to the adult state. The anatomical examination of the hyo-branchial apparatus in the second metamorphosed Axolotl (28th September) proved that the three inner branchial arches had disappeared, the external arch only remaining; and this, deprived of its membranous denticulations and united by an articulation with the thyroid cornu, formed the posterior joint of the latter. Outside this piece the anterior branch of the hyoid is to be seen on each side. The basi-hyal was much developed, and in it, as in the other portions of the hyoid, ossification had commenced.

These unexpected facts would almost lead one to suppose, with Cuvier, that the Axolotls, hitherto regarded as perennibranchiate Batrachia, may be the larvæ of species destined hereafter to take a place in the group of those which undergo a metamorphosis and lose their branchiæ. If this be the case, the individuals with long external branchial tufts which have lived for nearly two years in Paris, and from which these young animals were procured, would only be larvæ, notwithstanding their power of reproduction *. But if this supposition be accepted, how are we to explain the rapid metamorphosis of these animals of eight months old, when the individuals brought to France from Mexico in 1863 have undergone no change except an increase in size?—*Comptes Rendus*, November 6, 1865, pp. 775–778.

On the Multiplicity and Termination of the Nerves in the Mollusca. By M. Lacaze-Duthiers.

Few animals are so richly provided with nerves as the Mollusca; hence, when they are studied anatomically, it is difficult to understand the name of *Apathique* which Lamarck gave to the general group in which he placed them.

I take *Thetys leporina* as an anatomical and histological type. This species presents in its tissues an abundance of nerves surpassing anything that could be imagined from what exists in the higher animals. In a general investigation of its organization I shall indicate in detail the very peculiar arrangement presented by its central nervous system. The only object of the present memoir is to make known the distribution of the nerves in the buccal veil, and their mode of termination in the barbules which fringe the margins of that organ.

It is well known that, around the mouth, the lips of which are produced into a trunk, the *Thetys* has a large funnel-shaped mem-

* M. de' Filippi has found spermatozoids and mature ova in individuals of *Triton alpestris*, which, from the persistence of the external branchial tufts and the imperfection of their palatine dental system, appeared to be still in the larval or tadpole state (Archivio per la Zoologia, tom. ii. pp. 206–211).

branous expansion, bordered by a fringe composed of innumerable tentacular barbules. This veil receives large nerves, which, after issuing from the subœsophageal ganglia or from the cerebrum, divide and subdivide so as to distribute themselves throughout its whole extent. The branches of these nerves at first anastomose in arches, then, having arrived beneath the tentacular filaments of the marginal fringe, they form lozenge-shaped networks or plexuses of inconceivable richness. Delle Chiaje saw these and figured them in part, but very coarsely.

In the angles of union of the anastomoses we most commonly find a ganglionic swelling destined to reinforce the nerves, which would otherwise soon exhaust themselves by their infinite divisions. Upon the meshes of the network, perpendicularly to the surface, nerves arise which penetrate directly into the tentacular barbules. A very remarkable fact is observed in the distribution of these nerves. In proportion as they advance into the tentacle, their subdivisions increase in number, until, in approaching the extremities, the transparency of the tissues is obscured by the quantity of their ramifications; and at the very apex of the tentacle the nervous trunks and their anastomoses become so voluminous and so considerable that observation by transmitted light, without preparation, is very difficult, and the end of the tentacle itself appears blackish.

Greatly multiplied collateral anastomotic branches detach themselves from the central trunk which occupies the axis of the tentacle, unite with each other, forming arches, and often become so slender that it is difficult, if not impossible, to distinguish them in the midst of the fine striæ produced by the cellular fibrillæ.

It would be supposed that the nearer a nerve approached its termination, the more delicate would its branches become. Here quite the contrary is the case, the anastomotic loops are more numerous and thicker towards the extremity, and in this part of the filaments we find hardly any delicate fibres. All the secondary nerves are nearly as thick as the trunk of the principal nerve at its origin. It is true that from place to place, and at nearly all the angles of anastomoses, there are dilatations, or ganglia of reinforcement, in the structure of which nervous cells and ganglionic corpuscles are recognized.

The termination is extremely simple. From the surface of those terminal networks of which the meshes are formed by the large ramifications just mentioned, there rise, towards the extremity, some processes in the form of rounded clubs, which come quite close to the outer surface, and are only separated from it by a thin layer of the fibrous framework of the barbule and an external epithelial layer.

When we examine the nerves of the tentacles, we find that they are formed of a pellicular envelope, and that their contents are a mixture of molecular corpuscles, fine granulations, sometimes small cells, and a gelatinous fluid, forming by their union the medullar portion.

The central masses present very remarkable peculiarities which I cannot indicate here. The nervous cells and elements are enclosed in pyriform sacs, appended on all sides to a comparatively small central part, from which the trunks of the nerves originate. The cerebrum and the other ganglia, like those of the great sympathetic nerve, present the appearance of small racemes; and if we wish to ascertain the origin of the nerves, it is in the midst of these masses of granules that we must seek it, notwithstanding the difficulty which this presents.—*Comptes Rendus*, Nov. 20, 1865, p. 906.

On a new Kind of Illumination for Opaque Objects under High Powers. By Messrs. SMITH, BECK, and BECK.

This method of illumination has been recently introduced by Mr. Smith, of Kenyon College, U. S. * ; the best effect may, however, be obtained by the following exceedingly simple plan :—

Fig. 1.

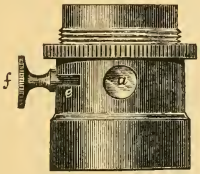


Fig. 2.

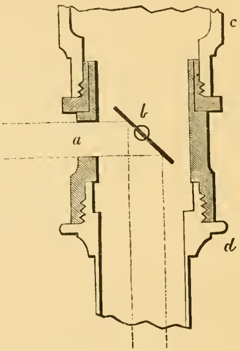


Fig. 3.

A piece of thin glass (*b*), attached to a small brass milled head (fig. 3), fits into the side of an adapter (fig. 1); and when in position, as in figs. 1 and 2, the light coming through a small circular aperture (*a*) may be reflected down and through the object-glass by the thin glass, which makes no obstruction to the rays of light passing upwards again from the object-glass to the eye-piece, nor even affects the definition to any perceptible degree.

The adapter (fig. 1) is used, as shown in section (fig. 2), between the nose-piece (*c*) and the object-glass (*d*); it has a rotating fitting at the milled ring; and this movement, in combination with that of the small milled head to which the thin glass is attached, is sufficient for the nicest adjustment of the illumination. By means of a slot (*e*, fig. 1) in the side of the adapter, the thin glass may be readily removed for the purpose of being wiped, as its perfect freedom from dust or smear is most essential.

* Silliman's Journal, September 1865.

When using this piece of apparatus, the light should be opposite to the small aperture (*a*), and in a position at right angles to the body of the microscope. When the lamp is used alone, an image of its flame will be seen upon the object; but the whole field of view may be illuminated, or unilateral light may be obtained, by placing a small condenser in different positions before the lamp.

Under this method of illumination, which is available with the highest powers, the appearances presented by objects are very remarkable, and they vary exceedingly according to the character and condition of the specimen. It is in all cases best to have the object uncovered. The subject is of great importance and interest, and requires thorough investigation; but this, from the moderate cost of the piece of apparatus (10*s*. 6*d*.), is within the reach of every microscopist.

Observations on some Lepidosirens (Protopterus annectens, *Owen*) *which have lived in the Menagerie of Reptiles in Paris, and formed their Cocoon there.* By A. Duméril.

M. A. Duméril has observed the formation of the cocoon by two specimens of Lepidosiren living in the Menagerie at the Jardin des Plantes. About the 20th February last, these two animals showed indications of a desire to shelter themselves in the soft soil at the bottom of the aquarium; and as previous specimens had died, owing to the necessary change of conditions not being realized for them, the water was nearly all drawn off from the aquarium, so as to leave the mud at its bottom as nearly as possible in the same condition as the rice-fields inhabited by the Lepidosiren at the approach of the dry season. In three weeks the ground gradually hardened, forming a mass with fissures in several parts; no trace of the animals was to be detected.

The fissures in the mass of dried mud enabled portions of it to be removed; and the two Lepidosirens were found, about eleven weeks after their disappearance, enveloped in regular cocoons. The block of dried mud, which is preserved in the museum, exhibits a cavity moulded upon the cocoon, with the walls perfectly smooth and lined with a strongly adherent portion of the cocoon.

This cocoon is produced by a mucous secretion. Its brown colour might lead to the supposition that it is formed of dried leaves; but when examined by Professor Decaisne, it presented no trace of vegetable structure; and when burnt, it diffused the characteristic odour of animal substances.

The Lepidosirens, when desirous of burying themselves, emit an abundant mucosity from the surface of the body. This coats and agglutinates the portions of the soil which they traverse, so that the walls of the subterranean canal made by each animal and remaining open after desiccation are smooth and appear polished; then when the animal stops, this exudation acquires the consistency of a membranous envelope. The Lepidosirens when examined by M. Duméril were still alive, as was proved by their slight movements when touched; they have since died.—*Comptes Rendus*, January 8, 1866, p. 97.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 99. MARCH 1866.

XIX.—*On the Asexual Reproduction of Cecidomyide Larvæ.* By Dr. R. Leuckart*.

[Plate I.]

About a year and a half ago we received, through a communication to the Academy of St. Petersburg, the surprising intelligence that Nicolas Wagner, Professor of Zoology at Kasan, had observed an asexual reproduction in the larvæ of a fly belonging to the genus *Cecidomyia*†. This reproduction was said to commence in autumn, to continue through the winter and spring, giving origin during the whole of this period to a series of successive generations of larvæ, until finally, in June, the last of them were developed into perfect and sexually mature animals. The flies then, as usual, after copulation, lay eggs, and thus recommence the developmental cycle just described.

A few months afterwards the 'Zeitschrift für wissenschaftliche Zoologie' (Band xiii. p. 512) furnished us with a detailed memoir, illustrated with numerous beautiful figures, on the same subject, which had been sent by Wagner two years previously to the editors for publication, but had been kept back by them because the observations described in it appeared to be "almost incredible." But this incredible has completely verified itself; and it even appears probable, from the confirmatory observations of Meinert‡ in Copenhagen, and Pagenstecher§ in Heidelberg, that the mode of reproduction discovered by Wagner is still more widely dif-

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1865, p. 286.

† K. E. von Baer, "Bericht über eine neue von Prof. Wagner in Kasan an Dipteren beobachteten abweichende Propagationsform," Bull. Acad. St. Petersb. 1863, pt. vi. p. 239. (As early as 1861, however, Wagner had incorporated a short notice of his observations in the 'Journal of the University of Kasan,' which is published in the Russian language; but, as far as I am aware, this has remained unknown out of the country.)

‡ Zeitschr. für wiss. Zool. Bd. xiv. p. 392. § *Ibid.* p. 400.

fused among the *Cecidomyiæ*, and possibly occurs very generally in that group of flies.

What I purpose communicating in the following pages is only suited to support this opinion, as it chiefly relates to a new case of the reproduction in question.

The larvæ on which I made my observations were found by me during the first days of the present year, in considerable numbers, under the bark of a half-dead apple-tree attacked by fungi. They most closely resembled the form observed by Pagenstecher in the beet-root refuse, with which they agreed especially in the number (two) of stigmata, and in the presence of points on the ventral surface; but, from the somewhat larger size and the much more slender form of the body of my larva, as also from some other smaller differences, I believe I must regard it for the present as the representative of a distinct species.

Unfortunately I have not yet succeeded in studying the entire developmental history of my larva. Almost all my larvæ had very recently escaped from the dead envelopes of their parents (3 millims.), which lay sometimes singly, sometimes grouped together under the bark, or were still enclosed in them although otherwise perfectly developed. The largest individuals that I found living measured about 2 millims., nearly twice the length possessed by the animals on escaping from the skin of their dead parents. The body-cavity of these larger individuals usually contained, besides a number of small germs, from three to five larger, elongate oval masses up to 0·38 millim. in length; but, on closer examination, these masses all proved to be dead and altered. Their contents were broken up into a granular substance, which gradually became darker towards the centre, and generally enclosed one or several oil-drops, sometimes of very considerable dimensions.

The following communication, therefore, relates less to the embryonic development of the Cecidomyide larvæ, the investigation of which I postpone to a more favourable season, than to the question of the origin and nature of the germs, which move about freely in the body-cavity and become new larvæ.

I cannot, however, publish my investigations on this subject without mentioning the assistance which I was so fortunate as to receive in them from M. Mecznikoff of Charkow. The following pages probably contain but few facts which this talented young zoologist had not likewise observed, and which he was not about to publish.

According to Wagner's representation, the germs (*Embryonaltheile*, Wagn.) are produced from the fatty body of the larva, the contents of this, with a simultaneous change in its appearance, becoming massed together in portions, and broken up into the form of round balls after the separation of its enveloping membrane. Sometimes several of these balls are seen united in a common group. They have at first a granular texture, but pretty quickly develope a number of cells, and finally, whilst the external form becomes gradually extended and the size constantly increases, are filled with a granular vitelline mass, which undergoes a segmentation, and then produces the embryo in its interior. The latter, surrounded by a stratum of peripheral vitelline substance, remains in its envelope until it has arrived at its full development.

Meinert also adopts the notion of the production of the germs from the fatty body, and remarks, in its justification, that the latter, as the residue of the original formative material, might just as well be employed for the generation of a new brood as for the further development of the insect.

As, however, Meinert, to all appearance, has not specially examined into this question (his investigations were particularly directed to the later stages of the development of the larva), we cannot lay any great stress on his acquiescence, especially as Pagenstecher in the course of his description repeatedly states expressly that the young germs (" *Eier*," Pag.) possessed no true resemblance to the balls of the fatty body, and were never connected therewith. Pagenstecher therefore believes in the existence of a proper germ-stock, although he sought in vain for any such structure, and found himself confined to mere suppositions with regard to the origin of the germs. He especially notices the possibility that these may have separated from the subcuticular cellular layer (the "hypoderma" of Weismann), and calls attention to the great development presented by these cells in the last segments of the body of our larvæ. The rectum also, below the opening of the Malpighian vessels, is surrounded by a group of cells which may perhaps likewise function as the place of origin of the germs. Certainly, he adds, " the whole matter requires a further controlling examination."

As has been said, I have, in conjunction with Mecznikoff, turned my particular attention to this point, and I rejoice to be able to furnish the proof that the Cecidomyide larvæ really, as Pagenstecher supposed, possess a germ-stock.

When the larvæ just escaped from the skin of their parent's body are examined under the microscope with a moderate pressure, we see, in the posterior half of the tenth (or, including the head, the eleventh) segment, two clear roundish balls, which are situated at the back, between the cords of the fatty body, here rather widely separated, and possess a diameter of 0·034–0·04 millim. (Pl. I. fig. 1). These are the more easily discovered, because they lie almost immediately beneath the outer integument, and, during the contractions of the muscular apparatus, are moved up and down in the cavity of the body with the neighbouring organs. In general these balls are pretty symmetrically arranged, and placed at the same level; but sometimes one or the other of them is more approximated to the median line, or placed a little forward.

When the body of the larva is torn up, we soon ascertain that these balls do not float freely in the body-cavity like the germs which succeed them, but are affixed to two Malpighian vessels, by means of a pair of longer or shorter, thin ligamentous cords. In general the point of attachment is not far from the insertions of the vessels, and indeed usually rather higher on one side than on the other. Sometimes a thin filament is seen passing backward from it.

Under a higher power (fig. 2) we may distinguish in the balls a delicate structureless enveloping membrane, and a number of clear vesicular cells of 0·01–0·017 millim. in diameter, which lie in a finely granular pale protoplasm, and according to their size enclose one or more (three to five) likewise vesicular nuclei (0·006 millim.).

When the investigation is extended to a greater number of larvæ, those being especially selected which have already quitted their original dwelling-place, it is soon discovered that these structures do not all possess the same constitution. Not only do they gradually increase and change their form to an oval, but, further, at a certain size (length 0·067, breadth 0·042 millim.) they are repeatedly and irregularly constricted and acquire a form (fig. 3) by which one is involuntarily reminded of the appearance of a lobate embryonic kidney. The lobes which are separated by the constrictions prove on closer examination to be the peripheral segments of balls, which are flattened on their contiguous surfaces, but otherwise have a globular form and a diameter of 0·02–0·025 millim.

In their interior these contain according to their diameter a larger or smaller number of vesicular nuclei (of 0·007 millim.). In the largest balls as many as from sixteen to twenty of these nuclei may be counted; and here we may also further ascertain that each of them bears a clear superficial layer more or less distinctly defined, and has thus become the central point of an individual cell (fig. 3).

On comparison with the previous stages of formation, it appears beyond a doubt that these balls represent a further development of the vesicular cells formerly described. By displacement of the intercellular substance originally present, these cells have gradually increased and become mother cells by formation of brood cells in their interior. The original cell-membrane persists, in the form of a structureless bounding membrane, which has only acquired a somewhat tougher consistence, and is still covered by the common *tunica propria.*

I need hardly state expressly that the organs here described are nothing but the germ-stocks of our larvæ. The certain conviction of the correctness of this assertion is indeed attained only by their subsequent behaviour when we see that the individual balls gradually become more sharply and independently separated from each other, and finally (fig. 4) break loose in order to pass through their embryonal development in the body-cavity.

In general, however, the mass of the germ-stocks does not break up at once into its constituent balls, but gradually; so that its remains are sometimes found in individuals in which the free germs have already grown to a considerable size and show indications of the embryonic structure. In this way the fact noticed by previous observers, that the germs of our larvæ are by no means always met with at the same stage of development, may also be explained.

The balls when ready for separation are about 0·028–0·03 millim. in diameter. They have (Pl. I. fig. 4) a perfectly globular form, and exhibit, beneath the structureless clear and transparent enveloping membrane, two different kinds of cells. Some of these are small (0·0063 millim.) and sharply defined, and are united to form an epithelium which clothes the inner surface of the above-mentioned membrane; whilst the others, which fill the interior space of the ball, are of much larger size, and so imperfectly discriminated from each other that they almost present the appearance of a coherent mass of protoplasm in which numerous vesicular nuclei (0·007 millim.) are imbedded. The contexture of these central cells reminds us of the behaviour of the primitive germ-stock, only that here the protoplasm is less massive and is destitute of the small, strongly refractive oil-globules which are deposited in larger or smaller quantities round the individual nuclei.

The genetic relations of these mature germ-balls to the previous stages of development are easily understood. The cells which we met with in the latter, although then without any differences, have become, by gradual differentiation, partly converted into epithelial cells and partly into structures which, by their histological nature, sufficiently show that they have still to pass through a further development.

After separation, however, the germ-balls for a time retain the structure just described*. They grow to a diameter of 0·04 or

* For comparison we may here cite Pagenstecher's description of the youngest germs observed by him. "They consist," says our author, "of a peripheral layer of small clear globules, in which neither membranes nor nuclei are distinct, and of an interior space enclosed by these, in the homo-

0·045 millim. without giving any signs of further development (fig. 5), unless we regard as such the enlargement of the central nuclei (to 0·01 and 0·014 millim.) and the more distinct appearance of a clear vesicular nucleolus.

But when the germ-ball has attained the size just mentioned, we observe that one of the eight or ten clear nuclei contained in it surrounds itself with a strong accumulation of coarsely granular protoplasmic mass, and inflates the peripheral envelope of the ball like a hump (fig. 6). At first only of inconsiderable size, this hump gradually becomes larger with the increasing growth of the granular mass, so that the ball loses its globular form and gradually acquires a pyriform and oval shape (figs. 7 & 8). The mass of granules situated in the interior of the smaller pole, and filling this entirely, becomes more and more sharply discriminated from the other contents of the ball, and gradually grows into an independent body, the previous relations of which one could hardly indicate without a knowledge of its development.

The increase of this body takes place so rapidly that in a germ-ball of 0·077 millim. in length (0·042 millim. in breadth) it already measures 0·03 millim., and therefore has almost attained the size of the whole of the rest of the contents (fig. 8), although a little while before (in balls of 0·06 millim. in length and 0·038 millim. in breadth, fig. 7) it had scarcely more than half this diameter (0·018 millim.). And this increase of size is the more remarkable, because it depends solely on the growth of the granular peripheral mass, the vesicular nucleus still measuring not more than 0·014 millim. The latter has, however, so far undergone a change, that the nucleolus contained in it has become smaller (down to 0·004 millim.) and acquired a sharper outline.

Although, from the dark and opaque texture of the granular mass, the processes here described readily attract the attention of the observer, they have been as good as completely overlooked by previous investigators*—a fact which can only be explained on the supposition that they were more interested in the subsequent fate of the germ-balls than in their earlier states.

Notwithstanding their neglect on the part of former observers, these processes are now of great significance, inasmuch as they throw an unexpected light upon the nature of the germ-balls, and the relations of the present mode of increase to the ordinary reproduction of insects.

---

geneous mass of which some strongly defined and rather angular oil-granules and vesicular vacuoles appear."

* The only indication of them is a figure of Wagner's (*l. c.* tab. 36. fig. 25), which is explained as representing "two anomalously united germs (*Embryonaltheile*)," of which one is filled with a turbid fluid, whilst cells are already formed in the clear contents of the other.

Every one who is acquainted with the developmental history of insects, or who consults the existing observations on that subject by Stein*, myself†, Lubbock‡, Claus§, and others, will agree with me when I assert that the germ-balls of our larvæ with their contents precisely reproduce the conditions of one of the so-called germ-chambers from the ovarian tubes of a female insect. This is perhaps most striking on comparison with *Melophagus*‖, the germ-chambers of which are united to each other only by a thin cord, and consequently represent structures almost as independent as the germ-balls of our *Cecidomyiæ.*

In both cases we have a structureless proper membrane, containing in its interior, besides an epithelial layer, two different kinds of cell-formations. One of these cell-forms is present only singly, and situated at the originally narrower pole of the germ-chamber. It is the future egg, which consists of a granular ball, constantly increasing in size, and a vesicular nucleus, the so-called germinal vesicle; whilst the other cells, which, with their likewise vesicular nuclei and often incompletely discriminated protoplasm, fill all the rest of the interior space of the chamber and play a part in the separation of the yelk, are usually described as formative cells of the vitellus¶.

The agreement of the germ-balls with egg-chambers is so complete, that it applies not only to the later stages, but also to the development, as is sufficiently proved by the accurate investigations of Claus, which I can fully confirm. The egg, the formative cells of the vitellus, and the epithelial cells, indeed everything is developed in the ovarian chambers exactly in the same way as is described above for the germ-balls, by differentiation from an originally quite homogenous cell-mass. Even as regards time these processes present precisely the same conditions in both structures.

The germ-balls of the Cecidomyide larvæ are therefore neither "embryonal particles" (*Embryonaltheile*, Wagner) nor "ova" (Pagenstecher), but *germ-chambers which produce a reproductive*

* Vergl. Anat. und Physiol. der Insekten, 1847, p. 46.

† Art. "Zeugung," in Wagner's Handwörterbuch, Bd. iv. 1852, p. 802; Zur Fortpflanzung und Entwickelung der Pupiparen, 1859; Zur Kenntniss des Generationswechsels und der Parthenogenesis bei den Insekten, 1858, p. 48.

‡ "On the Ova and Pseudova of Insects," Linn. Trans. 1859.

§ "Beobachtungen über die Bildung des Insekteneies," Zeitschr. für wiss. Zool. Bd. xiv. p. 42.

‖ Leuckart, Fortpflanzung der Pupiparen, taf. 1. figs. 6 & 7.

¶ Weismann (Entwickelung der Dipteren, p. 208) is decidedly in error when he denies, in *Musca*, the distinction between the egg and the formative cells of the vitellus, and represents the entire contents of the germ-chamber, with its many nuclei, as passing directly into the egg.

body in their interior in accordance with the type of egg-formation.

It is certainly the best proof of the correctness of this view, that by the investigation of the later stages of development we attain directly to the conviction that the embryo is produced from that part of the germ-chamber which we have just referred to as the reproductive body on account of its morphological relations. And this conviction must force itself upon every one who has even once had an opportunity of observing the processes of embryonic development in these animals.

According to my observations, these processes commence in germ-chambers of about 0·12 millim. in length and 0·05 millim. in breadth, by the surface of the granular ball becoming surrounded by a germinal membrane, exactly in the same way as in the fecundated ovum (figs. 9 & 10)*.

The granular mass, or yelk, as we may therefore call it with perfect justice, has by this time filled up about two-thirds of the germ-chamber, and inflated this in such a manner that the former pointed pole which contains the yelk-mass has now become the thickest. The opposite or anterior end is filled with the formative cells of the vitellus, which, as before, persist in their entire quantity, but have lost their former protoplasm almost entirely, and are consequently reduced essentially to the clear nuclei (between 0·01 and 0·019 millim. in diameter), all of which now show a large but not very distinct nucleolus (fig. 9).

From analogy with the formation of the ovum, we might perhaps have expected that the embryonic development would only begin when the vitelline mass had overgrown the entire germ-chamber and the formative cells of the vitellus had disappeared, with the exception of a small residue (Stein's *corpus luteum*). But our germs comport themselves so far differently, that, even before the conclusion of their individual development, they commence the discrimination of the embryo, exactly as is the case with the so-called germ-grains of the *Aphides*. There is also another agreement between these two asexual reproductive bodies—the so-called chorion never being formed in either of them, so that the vitellus remains without that envelope which has so remarkable and peculiar a development in the true eggs of Insects.

* See Weismann, *l.c.* taf. xii. fig. 2. (The analogy here indicated is also probably referred to in the assertion made by the reporter to the St. Petersburgh Academy, K. E. von Baer, in opposition to Wagner's supposition that the germs of the *Cecidomyiæ* originate from the fatty body,—namely, "I should rather give the name of yelk-masses to the masses from which the daughter larvæ are developed. They closely resemble the yelk-masses of other Diptera, especially those of *Chironomus* as described by Dr. Weismann.")

Whether the appearance of a germinal membrane in our Cecidomyide larvæ is preceded by the separation of a structureless peripheral layer, as has been proved by Weismann to be the case in the eggs of *Chironomus* and other Diptera, must be left undecided by me, from a deficiency of material for observation. Nor can I say how the germinal membrane is formed; but there cannot be the least doubt that it exists, and, as in true eggs, induces the series of embryonic developmental processes.

The cells of which this germinal membrane is composed lie close together in a stratum, and have, as in *Chironomus*, an extremely strong refractive power, so that it is difficult to detect a nucleus in their interior. At the posterior pole the cells are largest (0·007 millim.), perhaps twice as large as at the opposite anterior end of the yelk—a difference which of course affects the thickness of the germinal membrane, more especially as from appearances it would seem that the posterior cells are arranged in a double layer (fig. 9).

In somewhat larger germ-chambers (0·14 millim. in length, and 0·056 millim. in breadth) this difference is no longer perceived upon the yelk, which now measures 0·11 millim. Both before and behind, the cells now have exactly the same elongated form (fig. 10), and are of equal size; but even here the germinal membrane on the hinder part of the yelk is apparently composed of two superimposed layers of cells*.

The formative cells of the vitellus are reduced to three or four vesicular structures at the anterior pole of the yelk, although the form of the germ-chamber presents so far a certain amount of change, that the transverse section of the anterior segment is but little less than that of the hinder one. In this condition I found the epithelial lining of the germ-chamber constantly converted into a granular layer. Whether this character is normal, I cannot say; but perhaps the circumstance that the later developmental stages of my larvæ all died off and became transformed into a homogeneous granular mass might be connected with it. This supposition appears to me to be the more probable, as I some time since observed in the posterior half of the ovarium of a sterile queen bee, where the epithelium of the egg-chambers had undergone a perfectly similar change, that the ova were decomposed, and finally broke up into little fragments, instead of being further developed.

In particular cases, however, the destruction of the contents seemed only to have commenced at a later period, as was shown not only by the greater size of the germ, but also by the circum-

* Tab. 36. fig. 31 of Wagner's memoir must, I think, be referred to a chamber with a germinal membrane; only it appears as if the formative cells of the vitellus had already completely disappeared.

stance that it exhibited a clear band along one of its sides, which I am the more inclined to regard as a residue of the primitive band, because it sometimes had a repeatedly undulated course, as if a division into so-called primitive segments had already taken place. These were stages which might correspond with fig. 33 of Wagner's memoir.

Wagner's statement that the embryo is developed, not in the periphery, but in the interior of the yelk, is undoubtedly an error, probably induced only by the incomplete analysis of the parts situated in the interior of the germ-chamber. What Wagner calls the peripheral yelk is probably nothing but the epithelium of the germ-chamber, or the granular layer proceeding therefrom, of which mention has already been made, in the periphery of the germinal membrane. The "segmentation" figured by Wagner (fig. 82) also evidently pertains to this epithelial layer, and might possibly serve as evidence that, as above surmised, its cells in the normal state persist much longer than I observed them in my specimens.

Imperfect as are my observations upon the fate of the Cecidomyide germs, they enable us at least to assert that the processes of embryo-formation agree in all essential points with the ordinary phenomena of development in a fecundated egg, exactly as has been proved (by Huxley) to be the case in the *Aphides*.

According to the preceding investigations, the asexual propagation of the *Cecidomyiæ* unmistakeably approaches the phenomena long known to take place in the *Aphides* (since the time of De Geer and Réaumur). The only difference consists in the germ-chambers of the Cecidomyide larvæ separating from the germ-stock, and moving about freely in the cavity of the body, whilst in the *Aphides* they remain permanently attached, and constitute an apparatus which, in its form and arrangement, reproduces the conditions of the female organs.

That the germ-stock of the Cecidomyide larvæ likewise presents us with an analogue of the sexual glands seems to be the less doubtful, because we find it precisely on the spot where we should expect the first traces of these structures, and see it in a form which is at first very generally proper to the sexual glands in Insects. The appendicular filament running backward is evidently to be regarded as a rudimentary efferent duct.

Hence the asexual reproduction of the Cecidomyide larvæ not only shows a close agreement with the similar reproduction of the *Aphides*, but even approaches much more closely to sexual reproduction than previously appeared to be the case. The germ-stock of the viviparous larvæ is to a certain extent a second form of sexual apparatus; and its reproductive bodies so completely correspond with eggs, as regards their general morphological relations, that we might, with a certain amount of justice, regard them as a second form of eggs, as, indeed, Claus has recently done in the case of the *Aphides*. In all probability, the larvæ of the sexually mature *Cecidomyiæ*, at the first appearance of the genitalia, present so little difference from the earlier states of the viviparous larvæ, that it might be supposed that the subsequent fate of those organs, and at the same time that of the animal to which they belong, may be determined, as in the *Aphides*, by certain external conditions—in other words, that it may depend upon certain external conditions whether the larva shall be developed into a sexual animal or a viviparous individual.

With every inclination to recognize the morphological relations to eggs presented by the reproductive bodies in the detached germ-chambers of the *Cecidomyiæ*, I cannot quite determine to describe them as eggs and thus characterize the reproduction of the Cecidomyide larvæ as a parthenogenesis. Just as the larval forms of an animal cannot be placed on the same level as the fully developed creatures, and regarded as such, so we must not transfer the denomination "eggs" to structures which have only their first stages of development in common with eggs. The existence of an egg in all cases presupposes sexual maturity; but our larvæ are (much more strikingly than the viviparous *Aphides*) marked out as immature animals by their developmental form, and, from the condition of their genitalia (their conversion into germ-stocks), are to be described as sexually indifferent, or rather as asexual.

An egg, according to the ordinary conception of its conditions, must, at least in its structure, present the possibility of fecundation; where this possibility is absolutely wanting, we have certainly not to do with an egg, but rather with an asexual reproductive body.

Hitherto we have been accustomed to characterize structures of this kind, produced freely in the body of the parent, as germ-grains or spores, in opposition to eggs; if this name be regarded as inapplicable in the present case (as in that of the *Aphides*), from its being too general and morphologically unmeaning (*farblos*), the name *pseudovum* might perhaps be recommended for adoption—a name which has been employed by Huxley, although certainly in a different and scarcely justifiable manner (for the true eggs which are capable of spontaneous development).

After the preceding statements, I need scarcely state expressly that in the reproductive history of the *Cecidomyiæ* I see a case of *alternation of generations*, approaching in the closest manner to the alternation of generations in the *Aphides*, but distinguished from the usual forms of this mode of reproduction with larviform nurses by the circumstance that the sexual individuals do not from the first possess their ultimate form, but only acquire this by a supplementary metamorphosis. The alternation of generations in the *Distoma*, however, presents us with an approximation to these conditions, inasmuch as in this case also the newly born sexual animal (*Cercaria*) represents a creature which only becomes matured into the definitive form after undergoing certain transformations.

Addition.

Since the preceding was written (in the middle of January 1865) the viviparous Cecidomyide larvæ have been uninterruptedly observed by us. The larvæ conveyed into a warm room thrive admirably, grow, and produce germs, the development of which proceeds in a normal manner, whilst in the open air, as above described, they are sooner or later destroyed by fatty degeneration. In our climate, therefore, the propagation of the larvæ must be usually interrupted by the winter, to recommence as soon as the warm weather sets in.

The abundant material for observation (even of the later stages of development) now before us has gradually given us a tolerably complete insight into the embryonic development of the pseudovum, as will appear from the forthcoming memoir by M. Mecznikoff, to whom I have handed over the material for further investigation. Of this I will only anticipate one point—namely, that the large balls which lie upon the embryonal yelk (with a blastoderm) described by me above as the remains of the formative cells of the vitellus, have proved to be so-called polar cells, which belong to the hinder end of the germ-chamber, and, according to the interesting discovery of M. Mecznikoff, which I can fully confirm, finally pass into the germ-stock of the young larva. The formative cells of the vitellus have already disappeared in the stages with a developed blastoderm (which alone were previously observed by me), but are still present when the formation of the latter commences. This error might have been avoided, if the first processes of embryonic development had come earlier under my observation. However, this has no influence on the conception of the conditions in general; in this respect I could only now repeat, word for word, what I wrote at the time.

For the characterization of the larva, I may also state that it has only two stigmata in the earlier phases of its existence, but afterwards acquires a greater number (five pairs). In this later condition, moreover, the granulation of the ventral plates is somewhat different, and the first segment of the body is coalescent with the second, so that the accordance of the off-shoot with its parent (at least in the Giessen larvæ) by no means appears to be so complete as was affirmed by previous observers and also quite recently by Von Siebold *, who has received a number of the larvæ for examination from Meinert.

The species to which the larva belongs can only be determined hereafter, when we have the sexual animal before us. For the present we can only say that it is different from Wagner's species (with which, according to Siebold's statements, Meinert's species is identical).

XX.—*Notice of* Torynocrinus *and other new and little-known Fossils from the Upper Greensand of Hunstanton, commonly called the Hunstanton Red Rock.* By Harry Seeley, Esq., F.G.S.

The curious new crinoid genus here described was one of the first found of the Red-Rock fossils. One species, chiefly known from the separated joints of the column, is the Apiocrinite of old writers on the Hunstanton section; while the other, rarer and more obscure, with a column fused into a rod, has passed unnoticed. This latter, which is the type species, commonly occurs as short fragments of a slender cylindrical stem of uniform thickness, and broken at both ends. But in the Woodwardian Museum there may be seen three examples of the head, several of the base, one of a dichotomous stem, and some showing the column to consist of thick joints. On these data the genus is founded.

The *calyx*, like the column, is soldered into one mass, and is inseparable from the stem, on the side of which it is placed, exactly like the bowl of a ladle, at right angles to the usual position, instead of being at the summit of the column. It is relatively small, hemispherical exteriorly, smooth, and, as in *Millericrinus*, appears to be made by two circles of five plates each (with the addition, I think, of five interradials). The cup is relatively large, with well-marked radiating vascular impressions. In each of the five compartments of the narrow brachial margin there are, on the inner part of the plate, two articular facets for arms. In one example, three of these compartments are confluent and regular, but the other two are irregular and separated by calcareous interspaces. In *Eugeniacrinus* the calyx is sometimes set obliquely on the column, but in no other crinoid except the Palæozoic *Cheirocrinus* has it the singular spoon-like position shown in the specimens described.

* Zeitschr. für wiss. Zool. Bd. xv. p. 115.

The *column*, which is about half the diameter of the calyx, slightly enlarges for four or more times the length of the cup, and, then contracting a little, terminates in a hollow cone. There is also one remarkable specimen, unfortunately imperfect, which appears to show a branching division in the column.

The *base* varies; but in all specimens it expands near the bottom as it descends, either conically or into a thin plate like the base of a *Gorgonia*. The upper columnar end, at a variable length, seems to terminate in a conical cavity like that of the headpiece, with which the cylindrical stem corresponds in diameter. In this cavity I notice a circlet of twenty-five granules. The ordinary plates of the column are twice as wide as high, but near the articular end get deeper. There is nothing to indicate how the two parts were connected, or how the dichotomous part of the column came on.

On the whole it seems most nearly related to *Millericrinus*. The species may be marked *Torynocrinus canon*. It is the *Koninckocrinus Agassizi*, mihi, of my list in the 'Annals' for Oct. 1864.

Another species from Hunstanton, which is doubtfully placed in the same genus, should be named ?*Torynocrinus variolarius*. It is the *Apiocrinus* of authors, the *Bourguetocrinus ellipticus* (Mill.) of Mr. Rose [Ann. Phil. 1836], *Bourguetocrinus rugosus* (D'Orb.) of Mr. Wiltshire [Geologist, 1859], and the *K. rugosus* of my list [Ann. Nat. Hist. 1864].

Of this I only know the base and parts of the column. The base is an expanded plate contracting conically to the size of the thick cylindrical cheese-like pieces forming the column. These vary in thickness, but are rarely more than half as high as wide. The articular surfaces are ornamented with concentric rows of pustules, generally very close together; the outer surface is smooth.

Ammonites ochetonotus (Seeley).

A compressed shell with subparallel sides, a back widely channelled, and moderate umbilicus. It is often a foot in diameter. The umbilicus is as high as the mouth is wide, moderately deep, varying with the variety, flat at the periphery and oblique, making an obtuse angle with the side. It commonly shows at its outer limit a few large tubercles, in which in the young state the close, rounded, flexuous ribs which then ornamented it were knotted.

The ratio in which the height of the side increases, taken at each half whorl, is $1\frac{1}{2} : 2 : 3$; and the whorls are coiled nearly parallel to the back. In large specimens the sides are smooth, gently inflated, slightly converging, and round rapidly on nearing the back.

The back is hollow—not ploughed, to use a carpenter's term, as in *A. falcatus*, but with a central concave channel, shallow and wide, occupying a third of the width. In some varieties it is margined with distant slightly elevated tubercles.

Specimens in which the mouth is wide have the ribs more strongly marked, and continued to a larger diameter. About five appear to collect in each tubercle, and one or two between, all dying off insensibly towards both back and umbilicus. In these thicker forms the sides converge more rapidly near the back. It is essentially an inflated form of *Ammonites lautus* in which the ribs and tubercles are obliterated.

In the more inflated varieties the umbilicus becomes very large, and the sides round into it. In these the base of the side is margined by eight or nine rather sharp large tubercles. In a young state there were on the sides many close straight ribs, but they disappear with a diameter of 2 inches.

The septa are complicated. The upper lateral lobe is much notched and digitated, and divided by a five-fingered branch into two parts, of which the outer one is the longer. The lateral saddle, in the middle of the side, is large, has one major branch on each side much digitated, and behind it two or three minor branches, which probably vary with age: it terminates in a large central branch, with three or four fingers on each side and one in the middle, all well notched. There are two inferior lateral lobes and an inferior saddle.

Diameter 6 in.; greatest height of mouth $2\frac{3}{4}$ in., height of side $2\frac{1}{2}$ in., height of umbilicus $2\frac{3}{4}$ in., height of whorl opposite mouth $2\frac{3}{4}$ in. The back has no real limit, but may be stated as an inch wide.

I am not acquainted with any Cretaceous Ammonite having a channeled back and smooth sides. Hence this is readily distinguished from all described species. *A. solenonotus*, mihi, of my list in the 'Annals,' Oct. 1864, was the name then used for the inflated, ribbed, tubercled variety of this species.

Ammonites sphærotus (Seeley).

A compressed shell with flat converging sides, a round back, and small umbilicus; devoid of ornament. Height 4 inches, height of mouth $2\frac{1}{8}$ inches, greatest height of umbilicus $\frac{5}{8}$ inch; width of base of mouth $1\frac{1}{16}$ inch, width of back $\frac{3}{8}$ inch.

The small umbilicus is bordered by a flat and but slightly inclined periphery, which makes a sharp angle with the side. The inner halves of the sides are nearly parallel, and converge slightly, but the outer halves converge more rapidly. The width of the base of the mouth, where the shell is half a whorl smaller, is $\frac{11}{16}$ inch, and the back is relatively wider than at the larger diameter. There are on the sides of a whorl about eight or nine narrow flexuous ribs but little elevated and only appearing on the outer or converging parts of the sides. The back is perfectly rounded into the sides, so that it cannot be said to have a limit.

The septa are complicated, apparently with many saddles and lobes.

I suppose this shell to be that hitherto included in Hunstanton lists as *A. complanatus* (Mant.), with which it has no near affinity, rather recalling the *A. bicurvatus* of Michelin ; but its nearest relations appear to be with *A. Austini* (Sharpe), pl. 12, Palæont. Cret. Moll., from which it is distinguished by its small umbilicus, compressed form, and smooth shell, which at the utmost separate it as a variety. The *A. alternatus* of S. Woodward had a round back.

Ammonites proboscideus (Sow.).

The species is given by Morris as from the Gault of Cambridge. I have neither found nor heard of it there. One specimen has been obtained from the Gault in the Ely pit.

Nautilus simplex (Sow.).

I only know this fossil by the figure of a cast in the 'Min. Conch.;' and with that this very beautiful Hunstanton fossil agrees in the straight distant septa and the size of the umbilicus. It corresponds well, too, with Ooster's figure. Externally it is much like *N. Bouchardianus*, for which recent figures of it might well pass. The two species are probably varieties of each other.

Plicatula minuta (Seeley).

A small shell attached by the umbo, with an oblique axis ; one valve flat and the other convex.

Length $\frac{1}{4}$ inch ; width $\frac{3}{16}$ inch.

Form ovate, lower valve moderately inflated. It is ornamented with numerous fine ribs, which radiate from the umbo, are sometimes dichotomous, and vary greatly in the degree of their elevation and continuity, occasionally appearing as pseudo-spines laid flat on the shell. The attached part is generally small, and I have never seen it equal to a third of the length of the shell; in the upper valve it produces a corresponding elevation, which is generally worn off, giving specimens the look of *Anomiæ*. The upper valve is flat or a little concave, sometimes *very* finely marked with radiating striæ, otherwise imbricated.

It might be supposed that this is the young of *Plicatula inflata*; but the fact that specimens in the Cambridge Greensand, where it is not rare, all occur of the same size and quite resembling this of Hunstanton, seems to point conclusively to these being adult shells.

Mantell's *Plicatula spinosa*, which is the young of *P. inflata*, is a very different shell. Woodward's *Plicatula sigillina* is attached by the entire lower valve, and is of a different form.

Spondylus gibbosus (D'Orb.).

This may be described as an attached form of *Lima obesa*. In the early state the shell was attached, but afterwards became free. It is symmetrical, about two-thirds as wide as long. The upper valve is remarkable for a degree of inflation unusual in the genus, its height being equal to about half the length. From the apex it expands in a wedge-form for three-fifths of its length, and then contracts semicircularly. The ribs are small, close, without spines, and seemingly one elevated and one depressed alternately; but as the surface of the shell is not well preserved, this is not certain. Length 1 inch. It may be regarded as a variety of *S. gibbosus* (D'Orb.). The same shell occurs in the Cambridge Greensand.

Ostrea vesicularis (Lam.).

A small shell, quite flat, attached to a *Perna*.

Ostrea curvirostris (Nills.).

This shell differs a little from Upper-Chalk forms in being broader and less round posteriorly, but it is matched exactly with specimens from the Lowest Chalk of Burwell.

Exogyra conica (D'Orb.).

This is the shell figured in 'T. Crétacés,' pl. 478. figs. 5–8. I fail to see the advantage of associating it with Sowerby's shell. It is the fossil mentioned as *E. conica* in my list of Greensand Bivalves, and is not uncommon in the Cambridge Greensand.

Exogyra Rauliniana (D'Orb.), var. *arcula*.

This may be described as an *Exogyra* with the mode of growth of *Ostrea hippopodium*. The shell is a broad ellipse, with the spire slightly coiled in, and the free valve increasing in growth at its base, the lines being curves, which extend from the apex round by the base for nearly half the circumference. The attached valve increases by a nearly equal amount of growth all round, and projects above the upper valve. Attached by the whole of the base. It wants both the ridging and folding of *E. laciniata*, and in the regular growth of the side resembles *E. Rauliniana*. Similar shells occur in the Cambridge Greensand, and differ from *E. Rauliniana* sufficiently to make a distinct name a convenience.

Hinnites trilinearis (Seeley), var.

An irregular shell, about 6 inches long and nearly as wide, which has the convex valve very moderately inflated, the other valve flat or concave; so that the shell has a compressed aspect. In the young state it nearly resembled Cambridge examples of *H. trilinearis* in the aspect of the convex valve; but the ribs begin to disappear before the shell is half grown, so that the greater part of it is nearly smooth, being marked with the eccentric lines of growth and faint prolongations of the ribs. The concave valve resembles the flat valve of *H. trilinearis* in having the ribs with which it is ornamented much more dense than on the large valve; they are rather more dense than in Cambridge specimens, and, instead of getting wider apart with age, get rather closer; they extend to the margin of the shell.

Hinnites Salteri (Seeley).

Another large species of this genus is known by a convex valve of growth more regular than usual, measuring 4 inches in each diameter. It is about as much inflated as the large valve of *Pecten maximus*, and ornamented by a large number of (about twenty-five) primary ribs, which radiate from the umbo, are little raised, and sharp. Commonly between each two ribs there is another in the middle of the intercostal space, much less elevated; and on each side of this are frequently seen one or two tertiary ribs. The whole intercostal space is densely marked with fine radiating striæ. *H. trilinearis* is the species to which it comes nearest.

Perna sulcata (Sow.).

Two distinct varieties occur—one the common typical form, the other that partly sulcated shell occurring in the *Grès Vert*, which in its young state is quite smooth. I suspect that the shell described from the Cambridge Greensand as *Arca sulcata* may be a dwarf race of this species.

Perna lissa (Seeley).

Fragmentary valves, indicating a very peculiar species about four inches long. Both valves are moderately convex, about as much so as in *P. Crispii*; the right valve seemingly most inflated. The anterior side of the shell is truncated. Its axis is oblique, like that of an *Avicula*. It is gradually more compressed posteriorly, and quite smooth, or only marked with a few regular imbrications of growth like those in the Chalk shell *Perna striata*. Its affinities are with *P. tenuis* on the one hand, and with *P. transversa* on the other.

Perna transversa (Seeley).

Had this shell occurred in the Oolites there would have been a strong temptation to refer it to *Myacites*. It is transversely oblong, with the two pairs of sides subparallel. The umbo on the anterior margin is recurved. The anterior side is short and inflected; the hinge-line is at right angles with it. The posterior side is moderately compressed. The thin shell, which is not quite regular in its growth, is only ornamented with regular imbricated lines, which, at distances of about four of these, have a tendency to thicken into ridges. It is 2 inches long, and $1\frac{3}{4}$ inch deep.

Avicula cuneata (Seeley).

A small species, with an anterior ear. Anterior side straight; hinge-line short; posterior side depressed, lunate; seemingly traces of a small posterior ear; base round. Smooth, being only marked by faint lines of growth. Length $\frac{1}{2}$ inch; width rather more than $\frac{1}{4}$ inch. From the middle the shell narrows to the apex.

Terebratula biplicata (Brocchi, Sow.).

There probably does not exist in the kingdom such materials for the study of this species as may be found in the boxes of Messrs. Westmoreland and Hammond, the keepers of the lighthouse at Hunstanton (March 1863). My largest specimen is 2 inches long and $1\frac{3}{4}$ inch wide.

Kingena lima (Def.).

The largest specimen is $1\frac{1}{8}$ inch long, $\frac{3}{4}$ inch wide, and $\frac{5}{8}$ inch thick. It shows the pustules well; they are distant and arranged in lines of growth. The fossil is not rare, and is perhaps more variable than in any other locality.

Cardiaster suborbicularis (Def.).

Of this fossil, besides the typical form, two very marked varieties occur.

β. In this the length is $1\frac{5}{8}$ inch, and width the same. The outline of the side is more orbicular. The apex is nearer the middle of the shell, and consequently the anterior sulcus is a little longer. The shell is more depressed, and a transverse section is a large curve; so that the sides are more inflated, and there is no apical prominence. It much resembles *C. granulosus*.

γ. The other variety reminds me of *Epiaster gibbus*. The apex is just behind the anterior third of the shell; and from it the upper surface slopes down in every direction, conically. In transverse section the sides make more than a right angle and in longitudinal section an angle of 130°. It is as wide as long, widest at the anterior third. Posterior side short. Height $1\frac{6}{16}$ inch; length $1\frac{13}{16}$ inch, and as wide. Another example gives $1\frac{11}{16}$ long, and as wide; height $1\frac{1}{16}$ inch. In this latter the apex is more anterior. Having examined about sixty specimens, I believe these three varieties may be traced into each other; but it is necessary to have the means of distinguishing any part of the series.

Salenia (*Hyposalenia*) *Wiltshirii* (Seeley).

Round, moderately depressed; disk small and convex; anus protuberant, oval; mouth deeply sunk.

The *disk* is smooth, punctate, graven with short lines, and notched round the circumference.

An *ocular* plate is nearly semicircular, marked on its outer margin by two small notches (one on each side of the ambulacral granules), and separated from the genital plates by deep narrow notches, which are in a line with the interambulacral tubercles and terminate in a large puncture. At the inner apex of the plate, in a line with the ambulacra, is a large puncture, which divides the semicircular margin of the plate into quadrants, each of which is crossed in the middle at right-angles by a short narrow *slit*. The inner halves of these quadrants are again divided by a mesial puncture, which is just as distant from the slit as the puncture on its other side terminating the sutural notch. The transverse slits mentioned are so arranged that they radiate opposite to each other in fives round the genital openings, which are in the centre of the genital plates.

There are six *tubercles* in each of the two interambulacral rows, of which three large ones are on the side and three small ones on the base. The plates of each row are confluent, not being separated by granules; but the rows are separated from each other by a sinuous double row of very large granules, between which appears to be another double row much more minute. There are also a few large granules on the ambulacral border of the plates. The bosses of the tubercles are not greatly larger than these large granules; they are placed on elevated conical bases, the tops of which are crenulate. Ambulacra very narrow and straight, consisting of two rows of twenty dense granules, rather smaller than those between the ambulacra.

Width 1 inch; height $\frac{5}{8}$ inch, height to the margin of disk $\frac{11}{16}$ inch; width of disk nearly $\frac{3}{4}$ inch.

I have named this beautiful species in honour of the excellent Secretary of the Palæontographical Society, who, in 1859, was the first to make known the fossil wealth of the Red Rock.

Bernericea contracta (Seeley).

This species nearly resembles *B. Clementina* (D'Orb.), of which it is a good variety. It is attached, orbicular, and has the cells arranged like an expanded fan; they are very distinct and narrow, being about twice as long in proportion to their width as in *B. Clementina,* and contract from the point where they first appear to the aperture, which is very small. This tapering character of the cells suffices to distinguish it from all other forms.

Proboscina dilatata (D'Orb.), var.

This fossil is about intermediate between D'Orbigny's figures of *Idmonea dilatata* and *I. virgula,* being nearer to the former. It appears to differ a little, too, in having the mouths more contracted.

Cellulipora sulcata (Seeley).

The form of the colony in this species is similar to that in *C. spongiosa,* with which it is most nearly related. It is similarly composed of undulating bosses and depressions. Each subcolony is placed on a boss, from which the cells, which are depressed, not very distinct, rather wide, and contracted at the mouth, radiate. The intermediate spaces, which are thus in most cases depressed, and never elevated, are smooth, being formed of abortive cells. *Diastopora Sowerbia* (Lonsd.) belongs to this genus, and is nearly related and may even be this species; but, from the important characters being overlooked in the description and figure, I cannot determine the point.

Reptomulticava.

A form nearly related to *R. collis* and *R. mamilla,* but irregular in growth, twice as high as wide, and twice the size of those species, more resembling D'Orbigny's *Ceriopora digitata.* The cells are more dense than in *collis,* and generally separated by walls so thin as to be hexagonal except at the contracted top, where they are distant, round, and protuberant. It is a common fossil, and may be marked *R. favus.*

Chenendopora expansa (Benett), var.

This fossil differs much from Miss Benett's figure, being an elongated cone the cup of which extends nearly to the base; but I have Warminster specimens intermediate between the type and this fossil, which, I suppose, bears to it much the same relation as those lobed varieties of *Hallirhoa* which are united under the specific name *costata* (Lamx.) do to each other.

Scyphia tessellata (Seeley).

In form and general characters this species resembles *S. cri-*

brosa (Phil.) and *S. Zeppei* (Reuss). It is tall, subcylindrical, tapering slightly basewards, more or less irregular, occasionally contracting, sometimes expanding. Ornamented by cell-like apertures, which are nearly square, being higher than wide, arranged in longitudinal lines, and also necessarily forming circles. As it increases in size these longitudinal columns give off at intervals lateral branches, so that the cell does not increase in size very rapidly. At a diameter of $\frac{3}{4}$ inch one example has twenty-eight columns of pores.

Grinding a specimen down, it is seen to be a hollow tube, the walls keeping about an even thickness from base upwards, at a diameter of $\frac{3}{4}$ inch being nearly $\frac{1}{4}$ inch thick. The pores on the outside pass through the walls and open on the inside. Intertubular tissue extremely fine and reticulated. A specimen from Hunstanton bed no. 2 is 4 inches long and nearly an inch and a quarter wide. It is not rare in the Cambridge Greensand.

Edaphodus Huxleyi of my list (Annals, Oct. 1864) is only *E. Sedgwicki* (Ag.). The other new fossils from Hunstanton are eminently Cambridge species, and will appear in the 'Catalogue of Cretaceous Invertebrata in the Woodwardian Museum.'

With these descriptions ends the series of papers in which I have attempted to illustrate the literature, the rock, and the fossils of the Red Limestone of Hunstanton. The considerations on which I have chiefly relied in determining its place among rocks are the following:—To the north of Cambridgeshire, between the Chalk and the Kimmeridge Clay, there are but two formations instead of three. Hunstanton Red Rock and Speeton Clay in Yorkshire, and Hunstanton Red Rock and Carstone in Norfolk, correspond to Greensand, Gault, and Shanklin Sands in Cambridgeshire and the south. The rocks are divided differently, and are clearly the result of two very different series of causes acting in distinct geographical areas. And as the changes of level in which the geological periods terminated were on so grand a scale as to change the rock-making material and to cause the immigration, emigration, and partial extinction of life in what was then the sea of much of Europe, it is almost certain that even this little area of the Wolds must have participated to some extent in such vast heaving undulations. And therefore the Hunstanton Rock, graduating into both of the deposits on which it rests, and into that one (the Chalk) which is over it, is far more likely to have been parted from the beds below by one of those great changes of level which made the Greensand and the Gault than by any independent oscillation, which would have been exactly confined to its own little area. Therefore it follows that the Carstone formation will be the equivalent of the Speeton Clay*, and either that this latter bed in its newest part represents the Shanklin Sands, while the Red Rock represents the Gault and Upper Greensand, or that the Red Rock is Upper Greensand, and that the upper part of the Speeton Clay is Gault. There is no other alternative. Now, as the Clay deposit was (as is admitted on all hands) continued through the Shanklin-Sands period at Speeton, very much more would it be continued through the Gault period, which was but a return to the geographical conditions of the Kimmeridge Clay. So the Speeton Clay must, in its upper part, be Shanklin Sands and Gault; and the Red Rock can only be Upper Greensand, as its fossils indicated.

I had hoped to give some indications of the subsequent history of these fossil species after they disappeared before the encroaching Chalk; but as soon as may be those remarks will appear, in a lecture given before the Yorkshire Philosophical Society in December 1864, "On the Origin of the Superposition and Sequence of British Strata, and the Laws which have determined the Distribution of Life in Space, through Time, up to actual Nature."

XXI.—*Notulæ Lichenologicæ.* No. III.

By the Rev. W. A. Leighton, B.A., F.L.S.

By the generous liberality of Prof. Santo Garovaglio of Pavia, Italy, I have been favoured with a copy of his 'Tentamen Dispositionis Methodicæ Lichenum in Longobardia nascentium,' 4to, Mediol., 1865. Of this elaborate work only a portion has been as yet published, containing the unilocular and bilocular spored *Verrucariæ*. It is the result of a very comprehensive examination of specimens in a living state and in their native localities, and also of all the published collections since the time of Acharius, as well as of extensive collections in his own herbarium and those of many continental lichenologists. The work is illustrated with five large plates of microscopical details most carefully prepared by his learned coadjutor, Dr. Joseph Gibelli, and is to be accompanied with actual specimens so far as practicable.

The Professor limits his genus *Verrucaria* to those angiocarpous Lichens which have a simple homogeneous nucleus, with a carbonaceous black epithecium and a crustaceous thallus, thus excluding all those whose thallus is foliaceous or squamose, which have been comprised in the genus by the celebrated Dr. W. Nylander and others.

He regards the spore and the number of its cells as furnishing the

* Geological Magazine, No. 12, p. 262, &c.

most valuable characters for constituting *sections* of the genus. The presence or absence of paraphyses, the situation of the male organs (*spermogonia* and *spermatocalia*), the figure of the ascus, with the arrangement of the spores in its interior, and sometimes also the variations of the thallus, position of the apothecia, and size of the spores are made available for the characters of the secondary divisions, termed *cohortes;* whilst the multiplied modes in which the exterior and interior organs combine themselves form the basis of his definition of the *species.* The chemical reaction of iodine, form of the pycnides, and the sterigmata and spermatia are rejected as furnishing no available characters.

The author rejects all the interminable subtle and minute divisions into innumerable genera of the Massalongian school, and holds a middle course between that and the collective or aggregate school.

The genus, thus limited, comprises no less than thirty-five genera of the Massalongians: viz. *Acrocordia,* Mass., *Amphoridium,* Mass., *Arthopyrenia,* Mass., *Blastodesmia,* Mass., *Bunodea,* Mass., *Campylacia,* Mass., *Geisleria,* Nitschke, *Gongylia,* Körb., *Leptorhaphis,* Körb., *Lithoicea,* Mass., *Lithosphæria,* Beck, Körb., *Microthelia,* Körb., *Paraphysorma,* Mass., *Polyblastia,* Mass., *Porphyriospora,* Mass., *Pyrenula,* auct. plur., *Sagedia,* auct. plur. p. p., *Segestrella,* Fries, Körb., *Sphæromphale,* Reich., Körb., *Sporodictyon,* Mass., *Staurothele,* Norm., *Stigmatomma,* Körb., *Sychnogonia,* Körb., *Thelidium,* Mass., *Thelotrema,* Hepp. (non Ach.), *Tichothecium,* Flot., *Thrombium,* Wallr., *Verrucaria,* auct. plur., *Weitenwebera,* Körb., &c., and more than 200 of their species, and is thus characterized:—

Verrucaria.

Apothecium verrucæforme, primo clausum, deinceps poro pertusum, duplici instructum excipulo proprio; interius nucleum solitarium obvolvens, ceraceo-membranaceum, molle, primitus hyalinum, vel pallide coloratum, desuperne pedetentim nigrescens; exterius durum, fragile, mox aterrimum, fere corneo-carbonaceum, rarissime rufidulum, majorem minoremve apothecii superioris partem tegens. Sporæ variæ. Sterigmata simplicia.

Each species is described at length, its synonymy amply developed, and valuable *adnotationes* as to prominent characters and allied plants appended.

Space only permits us here to give the arrangement of the species, with references to such figures and *Exsiccati* as are generally in the possession of or accessible to British lichenologists.

Sectio I.

Verrucariæ uniloculares. (Euverrucariæ.)

Omnes saxicolæ et hermaphroditæ (i. e. spermatocalia una cum sporis in eodem nucleo); paraphyses nullæ vel obsoletæ; asci substantia mucilaginoso-floccosa, interdum in fila subtiliora producti, obvallati, 8-spori; sporæ normales incoloratæ, uniloculares, rarissime una alterave biplurilocularis, per ætatem passim fuscescentes. Thallus varius. Hypothallus distinctus modo, modo obliteratus.

Cohors I.

Thallo mucoso-gelatinoso, continuo; apotheciis parvulis, emersis, nudis; epithecio dimidiato vel subintegro; sporis magnitudine admodum variis.

1. *V. aberrans,* Garov. = *V. chlorotica,* Leight. Exs. 34; Anzi, Lich. rar. Long. 245 (non Schær. Exs. 253, neque Heppe, 93, 94, 435).

Very distinct from *V. æthiobola, V. hydrela,* and *V. submersa,* on account of the spores being variable in size.

2. *V. æthiobola,* Ach.! L. Univ. 292.

Graphica Acharii descriptio *V. æthiobolæ* adeo bene nostræ respondet, ut nullomodo dubitare queam de recta speciei appellatione. (Non *V. Leightonii,* Heppe, 95, neque *V. margacea,* Anzi, Lich. rar. Long. 287.)

Cohors II.

Thallo tartareo-areolato, crassiusculo; apotheciis parvis, omnino demersis, velamine thallodico destitutis, superficieque thallo adæquata; epithecio integro vel dimidiato, tunicæ concolori arcte hærente; sporis magnitudine variis.

3. *V. plumbea,* Ach. = Schær. Exs. 102? Leight. Ang. Lich. t. 19. f. 5; Heppe, 223; Schær. Exs. 643.

4. *V. glaucina,* Ach. = *V. lecidioides,* Heppe, 682, 683; Anzi, Lich. rar. Long. 366. *V. sphærospora,* ibid. 240.

5. *V. fuscella,* Ach. = Heppe, 426, 427; Leight. Ang. Lich. t. 7. f. 2 (haud bona). *V. glaucina,* Heppe, 90.

6. *V. Anziana,* Garov. = *V. margacea,* Wahl. (teste Anzio); Anzi, Lich. rar. Long. 287. *V. prætermissa,* Anzi, ibid. 243. (Non *V. Leightonii,* Heppe, 95.)

Cohors III.

Thallo ab initio gelatinoso-membranaceo, dein tartareo-areolato; apotheciis velamine obductis thallodico continuo, vix unquam in furfurem soluto, ad lentem subdiaphano; epithecio integro, rarius dimidiato; sporis magnitudine variis.

7. *V. hydrela,* Ach. = Moug. & Nest. 952; Schær. Exs. 521; Anzi, Lich. rar. Ven. 153. *V. lævata,* Leight. Ang. Lich. t. 19. f. 1.

Subspecies:—*V. submersa,* Schær. (non *V. submersa,* Borr. teste Leightonio Ang. Lich. p. 62). *V. papillosa,* Rabenh. Exs. 572. *V. chlorotica,* Hepp. 94. *V. hydrela,* Zwackh. 29 A. *V. submersa,* Hepp. 93. *V. eleeina,* Schær. Exs. 590. *V. acrotelloides,* Mass. 23. *V. mucosa,* Lieb. Ard. 317. *Pyrenula Funckii,* Funck, Crypt. 658. *Lithoicea eleomelæna,* Rab. 333; Anzi, Lich. rar. Ven. 153.

Cohors IV.

Thallo jam primitus tartareo-areolato, subsquamosulo, crassiusculo; apotheciis junioribus velamine thallodico, mox detrito, tandem in furfurem soluto evanidove, magis minusve obductis; epithecio integro vel dimidiato, interdum juxta basin a tunica sejuncto; sporis magnitudine variis.

8. *V. nigrescens,* Pers. = Leight. Ang. Lich. t. 27. f. 1; Hepp. 433 & 434; Moug. & Nestl. 1065; Schær. Exs. 439 & 284; Massal. Exs. 172 & 21; Leight. Ang. Lich. t. 23. f. 2? Anzi, Lich. rar. Ven. 158.

A most variable species—passing, on the one hand, into *V. submersa,* and, on the other, into *V. macrostoma.*

V. maura, Wahl., has an affinity with *V. nigrescens,* but is distinguished by the epithecium being thick and coalescent at the base.

V. Leightonii, Hepp, n. 95, though a remarkable plant, yet seems scarcely distinct from a var. of *V. nigrescens.*

Subspecies 1. *V. collematodes,* Garov. Thallo tartareo, orbiculari-determinato vel subeffuso, rimoso-areolato, subsquamaceo, areolis crassiusculis, in sicco planis, discretis, sordide castaneo-fuscis, madore in massam contiguam, verrucoso-rugulosam, fere gelatinosam turgescentibus, coloris olivaceo-viridis; apotheciis infrequentibus, vix perspicuis; epithecio tunicæ concolori arcte hærente, et subtus nucleum producto; sporis 0·0171 usque 0·0185 millim. longis, 0·0071–0·0085 latis.

On the stones of breakwaters.

Subspecies 2. *V. macrostoma,* Duf. = Leight. Ang. Lich. t. 21. f. 4; Mass. Exs. 194 A, B, 21 & 195; Anzi, Lich. rar. Venet. 159 & 160; Leight. Lich. Brit. Exs. 229; Ang. Lich. t. 21. f. 2?

9. *V. tristis,* Kremp. = Mass. Alc. Lich. t. 4. f. 12–16; Anzi, Lich. rar. Long. 241.

Cohors V.

Thallo farinoso, tenui, erimuloso, passim obliterato; apotheciis mox nudis et sessilibus; epithecio subintegro vel dimidiato; sporis mediæ magnitudinis vel parvulis.

10. *V. Dufourei*, DC. = Moug. & Nestl. 953; Hepp. 436; Anzi, Lich. rar. Ven. 152. *V. concinna*, Borr. apud Leight. Ang. Lich. t. 22. f. 3? (excl. *V. Dufourei*, Leight. Ang. Lich. t. 22. f. 4).

11. *V. decussata*, Garov. = Anzi, Lich. rar. Ven. 151, 148, 155; Leight. Ang. Lich. t. 24. f. 3? Mass. Exs. 212; Hepp. 429.

Cohors VI.

Thallo tartareo-farinoso (interdum rimoso vel verrucoso), passim evanido; apotheciorum hemisphærio altero innato, altero per ætatem soluto et elabente; epithecio vario, plerumque dimidiato; nucleo parvo, sphærico; sporis mediam magnitudinem æquantibus, aut superantibus.

12. *V. epipolæa*, Ach. = Schær. Exs. 441; Anzi, Lich. rar. Long. 247; Leight. Ang. Lich. t. 25. f. 4? Hepp. 221.

13. *V. cinereo-rufa*, Schær.! Spicil. 338. In habit near to *V. epipolæa*, but distinguished readily by the size and disposition of the spores.

Cohors VII.

Thallo tartareo-amylaceo, effuso vel determinato, in verrucas sive pustulas elevato, passim subæquali et farinoso; apotheciis ipsius thalli verrucis omnino inclusis vel magis minusve extantibus; epithecio vario; nucleo amplissimo, in forma ampullæ, amphoræ vel sphæræ; sporis maximis 0·0256–0·0327 millim. long., 0·0156–0·0199 millim. latis.

14. *V. papularis*, Fr.! = Mass. Exs. 250? Leight. Ang. Lich. t. 19. f. 3? Leight. Lich. Brit. Exs. 140!

15. *V. Hochstetteri*, Fr.! = Hepp. 432; Anzi, Lich. rar. Long. 409; Schær. Exs. 292; Mass. Exs. 251.

Cohors VIII.

Thallo tartareo, maculari, cum matrice plerumque confuso; apotheciis saxi scrobibus plane immersis, solo apice extante, tandem elabentibus; epithecio brevi, vario; nucleo mediocri, in forma sphæræ, amphoræ vel ampullæ; sporis grandiusculis.

16. *V. purpurascens*, Hoffm. Pl. Lich. t. 15. f. 1 = Schær. Exs. 440; Anzi, Lich. rar. Long. 246; Mass. Exs. 207; Heppe, 431.

17. *V. calciseda*, DC. = Hepp. 428, 691; Hoffm. Pl. Lich.

t. 12. f. 2–4; Leight. Lich. Brit. Exs. 30! Schær. Exs. 104, 103; Moug. & Nestl. 951; Anzi, Lich. rar. Long. 365? Mass. Exs. 9; Anzi, Lich. rar. Venet. 146, 135, 150?, 147.

Sectio II.

Verrucariæ biloculares.

Saxicolæ vel corticolæ; hermaphroditæ, monoicæ vel dioicæ; epithecium plerumque dimidiatum, raro integrum; paraphyses nullæ, obsoletæ vel distinctæ, simplices vel ramosæ, immo trabeculatæ; asci clavati, ventricosi vel cylindrici; sporæ intra ascos alterna vice ad lineam oblique superpositæ, vel duplici triplave serie absque certo ordine distributæ, fere semper biloculares, rarissime una alterave uni- triloculares, loculis amplis vel angustatis. Thallus varius. Hypothallus distinctus modo, modo obliteratus.

Cohors I.

Paraphysibus nullis; ascis elongato-ventricosis obovatisve, fugacibus, octosporis; sporis in duplicem seriem, turbato ordine, dispositis, plerumque biloculcaribus, interdum in eadem specie uni- bi- trilocularibus, loculis anguste conicis. (Species omnes saxicolæ, hermaphroditæ.)

18. *V. Pertusatii,* Garov. Thallo effuso, primum mucoso-gelatinoso, dein subtartareo, erimuloso, tenui, fusco-nigro; apotheciis minutis, omnino superficialibus, sphæricis, atris; epithecio valido, ultra dimidiam nuclei partem producto, infra a tunica soluto, flexoque deorsum; paraphysibus obsoletis; sporis bilocularibus, 0·0285–0·0356 millim. longis, 0·0142–0·0185 millim. latis.

On subalpine moist granitic or micaceous rocks.

19. *V. olivacea,* Fr. = Schær. Exs. 642; Hepp. 226; Anzi, Lich. rar. Long. 408.

20. *V. Ungeri,* Flot. = Leight. Ang. Lich. t. 22. f. 4; Hepp. 441; Anzi, Lich. rar. Long. 238; E. Bot. Suppl. 2791.

[Prof. Garovaglio claims to be the discoverer of this species, which he communicated to Flotow, Schærer, &c., in 1846–48. It is but just to remark that the plate of *V. Dufourii* (E. Bot. Suppl. 2791) is dated Aug. 1, 1834; and in the letterpress Mr. Borrer states that the plant was discovered at Chedder in 1833.]

21. *V. heterospora,* Garov. Thallo maculari-determinato, tartareo-farinoso, continuo, minute rugoso-verrucoso; apotheciis parvulis, globoso-conoideis, ad apicem umbilicato-depressis, tandem pertusis; ascis citissime evanidis; sporis uni- bi- tri-

locularibus, maximis 0·0360–0·0444 millim. long., 0·0085–0·0099 latis.

Ad saxa calcarea.

Hepp. 699, 692, & 440 approach this species.

22. *V. scrobicularis,* Garov. = Leight. Ang. Lich. t. 25. f. 2; Anzi, Lich. rar. Ven. 134; Hepp. 698.

Cohors II.

Paraphysibus ramosis, persistentibus; ascis cylindricis, elongatis, octosporis; sporis alterna vice ad lineam oblique superpositis, bilocularibus, loculis late conicis. (Species saxicolæ vel corticolæ, monoicæ.)

Saxicolæ.

23. *V. conoidea,* Fr. = Leight. Ang. Lich. t. 26. f. 2; Lich. Brit. Exs. 31; Mass. Exs. 319, 280; Anzi, Lich. rar. Long. 339; Hepp. 697.

Corticolæ.

24. *V. gemmata,* Ach. = Moug. & Nestl. 1064; Leight. Ang. Lich. t. 18. f. 4 & 5; Exs. 136; Hepp. 104; Anzi, Lich. rar. Ven. 132.

25. *V. biformis,* Borr. = E. Bot. Suppl. t. 2617. f. 1; Leight. Ang. Lich. t. 16. f. 2; Exs. 100.

Cohors III.

Paraphysibus filiformibus vel articulatis; ascis elongato-clavatis, ventricosis; sporis in duplicem seriem intra ascos distributis, bilocularibus, loculis conico-elongatis, duplo ad minus longioribus quam in ima basi latis. (Species omnes corticolæ, monoicæ vel dioicæ?)

26. *V. confusa,* Garov. = *Lembidium polycarpum,* Flörk, Rabenh. Exs. 483. Thallo effuso, rimuloso-verruculoso, vel farinoso-leproso, lurido, opaco, fusco-cinereo, passim evanido; apotheciis sat grandibus, primum crustæ immersis, dein illam magis minusve supereminentibus, opacis, exterius intusque atris; epithecio integro, crasso, cum tunica confuso; ascis elongato-clavatis; sporis 0·0313–0·0342 millim. long., 0·0128–0·0142 lat., bilocularibus, loculis conico-elongatis.

27. *V. micula,* Flot. = Hepp. 103; Leight. Ang. Lich. t. 18. f. 2; Anzi, Lich. rar. Ven. 124.

Sporæ ipsæ mox fuliginosæ ab omnibus varietatibus *V. epidermidis* perbelle distinguunt.

28. *V. epidermidis*, Fr. et auct.
  A. Var. *Fraxini*, Garov. = Mass. Exs. 298 & 299.
    Subvar. *diminuta*, Garov. = Hepp. 453, 454; Leight. Exs. 288; Anzi, Lich. rar. Ven. 127.
    Subvar. *atomaria*, Garov. = Hepp. 456; Leight. Exs. 344.
  B. Var. *analepta*, Garov.
    Subvar. *spectabilis*, Garov.
    Subvar. *Lapponina*, Garov. = Anzi, Lich. rar. Long. 347.
    Subvar. *vulgaris*, Garov. = Schær. Exs. 287; Moug. & Nestl. 364; Mass. Exs. 185, 186; Hepp. 451 & 452; Leight. Exs. 29?
    Subvar. *diminuta*, Garov. = Mass. Exs. 258.
    Subvar. *betulæ*, Garov. = Schær. Exs. 107, 108; Moug. & Nestl. 363 & 364 *e*; Heppe, 450.
  C. Var. *cinereo-pruinosa*, Garov. = Hepp. 105, 106, 107; Leight. Exs. 197; Mass. Exs. 203; Anzi, Lich. rar. Ven. 129.
    Subvar. *stigmatella*, Garov. = Mass. Exs. 197, 198; Hepp. 455, 456.
  D. Var. *Lauri*, Garov. = Leight. Ang. Lich. t. 17. f. 5?

Appendix.

The following have not been found as yet in Lombardy, but deserve mention:—

Pyrenula muscorum, var. *faginea*, Rab. 623 (non Hepp. 708). (Corticola, sporis bilocularibus.)

Arthropyrenia saxicola, Mass. Exs. 348. (Saxicola, sporis bilocularibus).

Verrucaria margacea, Leight. Brit. Lich. Exs. 319. (Saxicola, sporis bilocularibus).

Thelidium Nylanderi, Rab. 594 (non Hepp. 440). (Saxicola, sporis bilocularibus.)

Reaction of Iodine in Lichens.

Owing to the misreading of the formula given in 'Not. Lich.' No. I. (p. 59 of this volume) by the chemist to whom it was entrusted for preparation of the solution, a very important and serious error has been committed respecting the quantity of water to be used. The proper quantities are therefore here given:—

Iodine, gr. j.
Iodide of potash, gr. iij.
Distilled water, $\frac{1}{2}$ oz.

XXII.—*Contributions to an Insect Fauna of the Amazons Valley.* Coleoptera : Longicornes. By H. W. Bates, Esq.

[Continued from p. 42.]

Subtribe Desmiphoritæ.

Group *Exocentrinæ.*

Genus Exocentrus, Mulsant.

Mulsant, Coléopt. de France, Longicornes, p. 152.

Exocentrus is a well-known genus of wide distribution, and comprising a number of small Lamiaires, of ovate or oblong form of body with thorax armed on each side with a distinct acute spine. The antennæ are not much longer than the body in the most slender species, and are generally setose; the basal joint is of moderate length, forming an elongate club thickened almost from the base. The claw-joints of the tarsi are elongated but slender, and the claws are widely divergent. The genus may be known from all the genera of Acanthocinitæ by the sockets of the anterior thighs being open or angulated on their outer edges.

1. *Exocentrus striatus*, n. sp.

E. oblongus, convexus, fusco-ferrugineus, griseo sparsim pubescens; antennis corpore paulo longioribus, pubescentibus; oculis magnis, supra fere contiguis; thorace pone medium spina valida longa armato; elytris striato-punctatis; pedibus testaceo-ferrugineis, femorum clavis fuscis. Long. $3\frac{1}{4}$ lin.

Head rather narrow; sides occupied by the voluminous eyes, which also almost meet on the vertex; muzzle below the eyes short but rectangular; rusty brown, clothed with hoary pile. Antennæ filiform, a little longer than the body, clothed with laid pubescence, rusty brown, bases of joints reddish; basal joint of nearly equal thickness throughout, gradually narrowed near the base. Thorax subquadrate, very little narrowed behind, each side, behind the middle, armed with a long, stout, slightly curved spine; surface thickly punctured and sparsely clothed with recumbent shining hoary pile. Elytra oblong, convex, a little narrowed towards the apex, the latter rounded; surface punctured in rows, except about the suture near the base, where they are very closely punctured; the scant hoary pile lies in lines along the interstices; colour rusty brown. Body beneath rusty brown, thinly clothed with shining hoary pile. Legs moderately elongate, pale reddish; thighs strongly clavate, clubbed part blackish.

Santarem, on slender dry twigs.

2. *Exocentrus nitidulus*, n. sp.

E. oblongus, convexus, fusco-ferrugineus, nitidulus, pube sparsa brevissima cinerea vestitus; antennis corpore dimidio longioribus, thorace utrinque spina recta armato, supra postice linea transversa impresso; elytris punctatis, punctis apud discum sublineatim ordinatis. Long. 2–2¾ lin.

Head convex in front; central line deeply impressed; muzzle narrowed below the eyes; the latter moderately large, distant on the vertex; rusty brown, clothed with ashy pubescence. Antennæ half as long again as the body, nearly naked, ferruginous. Thorax subquadrate, constricted behind the spines, the latter stout, very acute, and straight; surface closely punctured, dark rusty, scantily clothed with ashy pubescence. Elytra oblong-ovate, convex, very thinly clothed with short, shining, cinereous hairs, thickly punctured, the punctures on the disk partly arranged in rows; colour rusty, in some examples with a brassy tinge. Body beneath dark rusty, scantily clothed with ashy hairs. Legs dark rusty, thighs abruptly clavate.

Santarem, on slender dry twigs.

Genus Blabicentrus, nov. gen.

Body oblong-ovate, convex, clothed with longish stiff hairs. Head small; muzzle narrowed below the eyes; the latter large and nearly approximating on the vertex. Antennæ filiform or setaceous, a little longer than the body, clothed with stiff hairs; basal joint narrowed towards the base. Thorax tumid on each side in the middle, but quite destitute of spine. Elytra oblong-ovate, convex, rounded or briefly and obliquely truncated at the apex. Legs moderately elongated; thighs abruptly clavate; tarsi rather narrow and shorter than the tibiæ even in the hind legs; claw-joint elongated, claws divergent.

1. *Blabicentrus hirsutulus*, n. sp.

B. oblongo-ovatus, convexus, undique setosus, brunneus, nitidulus; elytris maculis elongatis griseis lineatim ordinatis, apice rotundatis. Long. 3 lin.

Head dingy brown, clothed with coarse light-brown pubescence and with longish stiff hairs; central line faintly impressed; eyes simple. Antennæ very little longer than the body (? ♀), rusty red, scantily clothed with longish stiff hairs. Thorax equal in width to the head, much narrower than the elytra, convex above, very slightly tumid on the side in the place of the missing lateral spine, faintly constricted posteriorly; rusty brown, shining, sparsely pubescent, and clothed with a few longish stiff hairs. Elytra elongate-ovate, rounded at the tip; surface punctured in rows and bristly with dark-coloured hairs, brown, pubescence greyish except near the base, and forming several rows of short linear spots separated by dark-brown specks. Body beneath and legs dark brown, the latter clothed with long, stiff hairs.

Banks of the Tapajos, on dead twigs.

2. *Blabicentrus angustatus*, n. sp.

B. angustatus, ellipticus, minus convexus, fusco-ferrugineus; thorace medio utrinque distincte tumido, deinde angustato; antennis elytrisque setosis, his apice oblique breviter subobtuse truncatis. Long. $2\frac{1}{4}$ lin.

Head rusty brown, impunctate, scantily clothed with greyish pubescence; eyes moderate, distant on the vertex. Antennæ setaceous, half as long again as the body (? ♂), scantily clothed with fine bristles, rusty brown. Thorax broader than the head in the middle, thence sinuate-angustate to the base; surface very slightly convex, smooth, rusty brown, shining, scantily clothed with very fine pubescence. Elytra scarcely broader than the middle part of the thorax, narrowed towards the apex, which is briefly and obliquely truncated; surface very slightly convex, marked with a few scattered punctures, and clothed throughout with longish and rather fine erect hairs, rusty brown, with fine greyish pubescence arranged in lines. Body beneath and legs rusty brown, the latter partially clothed with fine hairs.

Santarem, on dead twigs.

Genus Eriopsilus, nov. gen.

Body elongate-oblong or sublinear, clothed throughout with long woolly hairs. Face short and rather broad; muzzle a little dilated below the eyes; eyes small, widely distant on the vertex; crown broad and not depressed between the antenniferous tubercles, the latter scarcely prominent. Antennæ scarcely so long as the body, filiform; basal joint short and thick, attenuated at the base; third and fourth joints together as long as all the succeeding joints, which are each very short. Thorax subquadrate, each side armed in the middle with a short conical tubercle. Elytra elongate-oblong, rounded at the apex. Legs short; thighs clavate; tarsi short and broad, basal joint triangular; claw-joint elongated, slender, claws widely divergent and simple.

Eriopsilus nigrinus, n. sp.

E. elongato-oblongus, fuliginosus, nitidus, capillis longis ubique vestitus, supra grosse punctatus. Long. 3 lin.

Head broad, forehead closely and finely punctured and with an impressed central line, vertex coarsely punctured, black shining. Antennæ a little shorter than the body, thickly clothed throughout with long and fine woolly hairs of a blackish colour;

second and third joints elongated and equalling in length the succeeding joints taken together Thorax sooty black, shining, coarsely punctured, and clothed with long blackish hairs. Elytra elongate-oblong, rounded at the tip, coarsely punctured, the punctures becoming shallower towards the apex, sooty black, shining, clothed with long blackish hairs. Body beneath punctured, black, clothed with dark-greyish hairs. Legs black, thickly clothed with dark hairs.

S. Paulo, Upper Amazons.

Genus Omosarotes, Pascoe.

Pascoe, Journal of Entomology, vol. i. p. 131.

The remarkable insect which constitutes this genus is much more elongated in form even than the preceding (*Eriopsilus*); yet its essential characters show that its true place is amongst the series of genera composing the Exocentrine group—a position already accorded to it by Mr. Pascoe (Trans. Ent. Soc. 3rd ser. vol. iii. p. 55). In the form of the head it does not differ much from *Eriopsilus* or even *Exocentrus*, the face being moderately broad and the muzzle slightly dilated and quadrate below the eyes; but the antenniferous tubercles are more conspicuously developed and the vertex depressed between them. The antennæ are nearly as long as the body; the basal joint forms a smooth, elongate-pyriform club, the third and fourth joints are much elongated, and the succeeding joints abbreviated, the fifth being only half the length of the fourth; but what is remarkable in them is their clothing, the long fine hairs which exist scantily on the joints being changed into very long and rather stiff bristles at the apices of the joints; the third joint is thickened towards the apex, beneath. The thorax is oblong, very convex and almost gibbous in the middle, and constricted before and behind; in the middle of each side is a very distinct and sharp tubercle. The elytra are scarcely longer than the head and thorax taken together, and are remarkable for a very long pencil of hairs surmounting the prominent centro-basal ridges, besides an acute carina extending from the prominent shoulders halfway down the sides of each elytron. The legs are rather elongated, the thighs clavate, and the tarsi very short. The insect in general form and colour resembles certain species of *Mallocera* or *Ibidion* in the Cerambycide section of Longicornes.

Omosarotes singularis, Pascoe.

Omosarotes singularis, Pasc. Journal of Entomol. vol. i. p. 131, pl. 8. f. 5.

O. elongatus, niger, antennis pedibusque nigro hirsutis; capite et thorace subtiliter strigosis, hoc antice griseo-sericeo; elytris pube tenuissima griseo-sericea vestitis, lateribus fasciaque pone medium nigerrimis, pedibus piceo-rufis. Long. $4\frac{1}{2}$ lin.

I met with two examples of this insect, namely on a slender branch of a tree in the forest at S. Paulo, Upper Amazons.

Genus Scopadus, Pascoe.

Pascoe, Trans. Ent. Soc. n. s. vol. iv. p. 100.

This genus resembles *Omosarotes* in its elongate shape and Cerambycideous aspect; but its antennæ are much elongated, filiform to their apex, and nearly naked. The groove of the anterior tibiæ, which is the invariable character of the Lamiaires, is scarcely perceptible, so that, were it not for the vertical face, square muzzle, and pointed palpi, it might be doubted whether the genus would not have its true place amongst the Cerambycidæ; the groove, however, on careful examination, is seen to be present. The legs are elongated; the thighs very abruptly clubbed, the tibiæ slender and linear, and the tarsi short, with the basal joint triangular. The anterior and middle coxæ are globular, the sterna very narrow, and the anterior sockets angulated on their outer side. As in *Omosarotes*, the elytra have raised centro-basal ridges surmounted by a pencil of hairs; on the outer side of each ridge lies an oblique linear depression, extending from the inner side of the prominent shoulder to the middle of the suture.

Scopadus ciliatus, Pascoe.

Scopadus ciliatus, Pasc. Trans. Ent. Soc. n. s. iv. p. 100, pl. 22. f. 5.

Sc. elongato-oblongus, rufescens, capite et pronoto nigris opacis, elytris dimidio apicali purpureo-nigro velutino; thorace supra convexo tuberoso lateribus utrinque tuberculo acuto armatis. Long. 5 lin.

On stem of dead tree, Ega; three examples.

Genus Esmia, Pascoe.

Pascoe, Trans. Ent. Soc. n. s. vol. i. p. 44.

Like the three preceding genera, the present has an elongate form of body. The antennæ are a little longer than the body, and have the basal joint and the third and basal half of the fourth joints thickened and densely clothed with hairs; the fifth joint has also a dense patch of hairs on its upper surface; the third and fourth joints are greatly elongated; the rest of the antennæ, body, and legs are clothed less densely with shorter hairs. The front of the head is vertical, and the muzzle quadrate. The thorax is short, subquadrate, and armed on each side with a tubercle. The legs are moderately short, the tarsi short and rather broad, the claws divergent.

Esmia turbata, Pascoe.

Esmia turbata, Pascoe, Trans. Ent. Soc. n. s. vol. i. p. 44.

E. sublinearis, saturate castanea, subnitida, breviter hirsuta, punctata, linea laterali totius corporis, altera per thoracem et suturam elytrorum extensa lineolisque discoidalibus elytrorum flavis. Long. 3½ lin.

Ega, on slender branches; rare.

Group *Tapeininæ* *.

Genus Tapeina, Serville.

Serville, Encycl. Méthod. x. p. 545.

Body oblong, extremely depressed, clothed with erect hairs. Head broad and short, the lower part not being prolonged below the eyes, and the front edge of the crown in the female either forming a transverse ridge a little above the labrum or sloping to the epistome, and in the male elongated laterally into projections of various forms according to the species. Antennæ longer than the body, stout, setaceous. Thorax transverse oval. Elytra rounded at the tip. Legs moderately short; thighs clavate; tarsi short and broad; claws divergent.

The species forming this curious genus are found underneath close-fitting bark of trees, after they have been felled or uprooted in the forest. They share this peculiar habitat with the flattened Cucujidæ, Nitidulidæ, Histeridæ, and others, all of which form together a somewhat extensive insect-fauna suited to these confined habitations.

1. *Tapeina dispar*, Serville.

Tapeina dispar, Serv. Encycl. Méthod. x. p. 546.
—— *bicolor*, id. (♀).
—— *dispar*, Thomson, Archives Entomolog. i. p. 42, pl. 7. fig. 4 *a*, *b*.

T. castaneo-rufa, capite thoraceque supra nigris nitidissimis, antennis nigris; armatura frontali maris elongata transversa, plana, apice utrinque obtuso truncato, margine superiore medio dentato. Long. 3½–4 lin. ♂ ♀.

Generally distributed in the forests of the Amazons.

2. *Tapeina erectifrons*, Thomson.

Tapeina erectifrons, Thoms. Archives Entomol. i. p. 43, pl. 7. f. 2 *a*.

T. nigra, nitida; armatura frontali maris elongata transversa, angus-

* This group was placed provisionally under the Saperditæ, in the synopsis previously given of the Lamiaires. A more accurate examination has convinced me that it has closer affinities with the members of the Desmiphoritæ. The Tapeinæ, in fact, appear to be abnormally flattened forms of Exocentrinæ.

tata, concava, apice utrinque rotundato, margine superiore subrecto, margine inferiore utrinque angulato-dilatato. Long. 4–4½ lin. ♂ ♀.

Generally distributed throughout the forests of the Amazons.

Group *Compsosominæ.*

Genus Compsosoma, Serville.

Serville, Ann. Soc. Ent. 1835, p. 55.

This well-known and handsome genus of Lamiaires, by its compact, thick, oval forms, reminds one of the Anisocerinæ and Hypsiomæ. The group has been placed in the neighbourhood of the Hypselominæ by Mr. Pascoe, and M. Thomson sees a resemblance between the genus *Ærenea* (belonging to the Compsosominæ) and *Gymnocerus*. *Compsosoma* and its associated genera, however, differ from the Anisocerinæ by the tarsal claws, which are scarcely divergent, and from the Hypselominæ by the shortness of the claw-joint. The hairy clothing of body and antennæ, and the form of the head, gradually rounded off or sloping from the occiput to the epistome, are also characters which distinguish the Compsosominæ from the Anisocerinæ and the Onciderităe, to which *Hypsioma* and *Hypselomus* belong. Although the lower part of the head, or muzzle, of some species resembles, in its square form, that of the Anisocerine group, yet this is evidently an inconstant character in the Compsosominæ; for other species (e. g. *Compsosoma Mniszechii*) have almost precisely the same form of muzzle as the Desmiphoritæ, to which group I consider, notwithstanding the difference in the general form of the body, the Compsosominæ belong. This form of head is utterly foreign to the Anisocerinæ and the Oncideritæ.

1. *Compsosoma Mniszechii,* Thomson.

Compsosoma Mniszechii, Thoms. Archiv. Entom. i. p. 74, pl. 9. f. 4.

C. oblongo-ovatum, crassum, convexum, hirsutum, grosse punctatum, elytris nigro-tuberculatis; thorace fuliginoso, vitta lata cinereo-fulva; elytris humeris rotundatis, plaga humerali fuliginosa (fulvo tincta), deinde utrinque vitta lata obliqua cinereo-fulva, parte postica fuliginosa, medio fulvo-sericea, suturaque cinerea; pectore utrinque plaga cretacea; antennis filiformibus, hirsutis. Long. 7 lin.

I found a few examples only of this fine species, on the slender stem of a young tree, in the forest at Ega, Upper Amazons. The lower part of the face is extremely short, scarcely extending below the eyes; the latter are large and convex.

2. *Compsosoma terrenum,* Pascoe.

Ærenea terrena, Pascoe, Trans. Ent. Soc. n. s. vol. i. p. 25.

C. parvum, ovatum, obscure fulvum, undique breviter setosum; capite parvo, infra oculos brevissimo, contracto; antennis grossis, filiformibus, corpore paulo brevioribus, fuscis; elytris humeris subfalcatis, maculis duabus nigris utrinque basalibus; abdomine plagis duabus basalibus nigris. Long. $3\frac{1}{4}$ lin.

S. Paulo, Upper Amazons.

Genus Tessarecphora, Thomson.

Thoms. Archiv. Entom. i. p. 77.

The chief differences which M. Thomson assigns as distinguishing this genus from *Compsosoma* are the swollen and densely hirsute third and fourth joints of the antennæ, and the elevated shoulders and centro-basal ridges of the elytra. To them may be added the convexity of the front part of the head, and the extension of the lower part considerably below the narrow, oblong and scarcely convex eyes. The *Compsosomæ*, so far as at present observed, are found in their perfect state only on woody stems or trunks of trees; *Tessarecphora arachnoïdes* I found only on the foliage of Mimosa trees.

Tessarecphora arachnoïdes, Thomson.

Tessarecphora arachnoïdes, Thoms. Arch. Entom. i. p. 77, pl. 9. f. 10 *a*, *b*.

T. ovata, nigra, nitida; capite coriaceo, opaco; antennis articulis 6^o–7^m albis et albo hirsutis, 8^o–11^m fere nudis; thorace et elytris lineolis reticulatis cinereis, his carinis centrobasalibus conico-elevatis et longe penicillatis, humeris falcatis et valde oblique elevatis. Long. 4 lin.

I found this exquisite little insect only in the forest of Obydos, in the month of March, on the foliage of Mimosa trees.

Genus Ærenea, Thomson.

Thomson, Archives Entom. i. p. 298.

This genus is closely allied to *Compsosoma*, but differs in several points, admitting of clear definition. The antennæ are destitute of the dense fringe which exists in *Compsosoma*, and are furnished with scattered hairs. The face is broad and plane, and the muzzle quadrate and prolonged below the eyes. The mesosternum has a conical horizontal projection in front; and the prosternum is longitudinally convex or keeled, and sometimes vertical on the posterior face. The general form of body and the structure of the legs and tarsi are very similar to the same features in *Compsosoma*.

1. *Ærenea albilarvata*, n. sp.

Æ. breviter ovata, fulvo-brunnea, fronte fascia lata cinerea albo marginata, thorace lateribus castaneo-fuscis, elytris prope apicem fascia lata curvata grisea; antennæ parce breviter setosæ articulo basali clavato, articulis tertio et quarto longitudine æqualibus; elytris pedibusque breviter setosis. Long. 4½ lin.

Head broad, upper part of the forehead with a curved impressed line on each side besides the central longitudinal line, face plane and broad; colour tawny; the face crossed by a broad belt of milky-white tomentum, margined with lines of denser white, and extending up the face of each antenniferous tubercle. Antennæ a little longer than the body, sparingly clothed with short bristles, tawny brown; basal joint forming an oblong pyriform club; third and fourth joints about equal in length. Thorax quadrate, convex and tubercular above, and marked with a few punctures, tawny; sides dark chestnut-brown. Elytra short, ovate, shoulders obtusely rounded but slightly falcate; surface punctured and beset with short bristles; tawny, basal margin edged with dark brown; a broad curved grey fascia on each at a short distance from the apex. Body beneath and legs reddish, clothed with greyish-tawny pile.

Forests of the Tapajos.

2. *Ærenea cognata*, Pascoe.

Ærenea cognata, Pascoe, Trans. Ent. Soc. n. s. vol. i. p. 25.

Æ. ovata, breviter griseo setosa, purpureo-brunnea, fronte plana, griseo tomentosa; antennis rufescentibus, fere nudis; thorace supra tuberoso et cum occipite fulvo; scutello fulvo; elytris brevibus, convexis, punctatis, humeris falcatis, purpureo-brunneis, marginibus lateralibus fulvis, fasciaque obliqua grisea; pedibus testaceo-rufis, cinereo variegatis; abdomine piceo-nigro, nitido. Long. 6 lin.

Ega; Upper Amazons.

Group *Desmiphorinæ.*

Genus Desmiphora, Serville.

Serville, Ann. Soc. Ent. Fr. iv. 62.

Desmiphora is distinguished from the neighbouring genera by the numerous tufts of hair arising from the thorax and elytra, and the long hairy clothing of its body and limbs. The body is elongate-oblong or linear, with the apex of the elytra obtusely rounded. The head is small and retracted, with sloping crown, very short face and muzzle, and large eyes. The antennæ are stout, about as long as the body, tapering to a point, with short thick basal joint narrowed at the base, elongated second and third joints, and progressively abbreviated remaining joints. The thorax has an acute prominent tubercle on each side in the middle. The legs are stout, thighs not elavate; tarsi with short triangular joints, and fine divergent claws.

The *Desmiphoræ* are found clinging to slender decaying branches of trees, and are numerous in species in Tropical America. Some of them resemble, in their colours and tufted forms, decayed fragments of wood covered with minute cryptogamic plants.

1. *Desmiphora fasciculata*, Oliv.

Lamia fasciculata, Olivier, Ins. p. 67, t. 17. f. 131; Fab. Ent. Syst. i. 2. 284. 268; Syst. El. ii. 299.

D. oblongo-elongata, fusco-nigra, capite, thorace articulisque basalibus antennarum fulvo hirsutis et penicillatis, articulo tertio apice infra dilatato; elytris utrinque pone medium fulvo plagiatis, basin et apicem versus nigro penicillatis, undique breviter setosis, et griseo hirsutis; pedibus nigris, fulvo variegatis; tibiis extus dense setosis; corpore subtus nigro nitido; abdomine utrinque fulvo plagiato. Long. 8–9 lin. ♂ ♀.

Ega; Upper Amazons.

2. *Desmiphora cirrosa*, Erichs.

Desmiphora cirrosa, Erichs. Consp. Ins. Col. Peruan. p. 147.

D. oblongo-elongata, brunnea, capite fusco, vertice fusco bipenicillato; antennis fulvo-brunneis, hirsutis; thorace supra plaga magna, postica brunnea, parte antica et lateribus sordide albis albo penicillatis; elytris utrinque prope basin fusco penicillatis, postice et abdomine albo strigatis et penicillatis. Long. 6 lin. ♂ ♀.

Generally distributed throughout the forests of the Amazons; also found in South Brazil near Rio Janeiro.

3. *Desmiphora senicula*, n. sp.

D. cylindrica, brunnea, griseo hirsuta, vertice bipenicillato; antennis obscuris; thorace disco cristis duabus elongatis parallelis fulvo-brunneis; elytris antice simplicibus, postice sordide albo strigatis et fasciculatis; abdomine cinereo-fulvo lanuginoso; pedibus rufescentibus, cinereo dense hirsutis. Long. 4 lin.

Head dark-brown, coarsely pubescent, vertex with two short erect pencils of dark-brown hair. Antennæ blackish brown, densely pubescent, and clothed besides with long, coarse, brown hairs. Thorax brown; disk with two parallel lines of tawny-brown hairs. Elytra moderately punctured, dingy brown, pubescent, and clothed with long hairs; base with one or two short tubercles on each side, but without tufts of long hairs; apical part ashy and marked with whitish streaks and tufts of whitish hairs. Body beneath and especially the abdomen densely clothed with woolly tawny pile; legs reddish and clothed with woolly pubescence.

Forests of the Tapajos.

4. *Desmiphora elegantula*, White.

Desmiphora elegantula, White, Cat. Longic. Brit. Mus. ii. p. 401.

D. cylindrica, ferrugineo-castanea, longe hirsuta, nitida; thorace et elytris grossissime punctatis, illo disco cristis duabus parallelis et lateribus fulvis, his utrinque prope basin unipenicillatis, apice albo strigatis et penicillatis; corpore subtus tenuiter cinereo pubescente. Long. $2\frac{3}{4}$–3 lin.

Forests of the Tapajos.

5. *Desmiphora multicristata*, n. sp.

D. elongato-oblonga, fulvo-testacea, undique longe hirsuta; antennis gracilibus; thorace convexo, crebre punctato, tripenicillato; elytris grosse punctatis, utrinque prope basin cristis tribus densis elongatis parallelis, prope apicem penicillis tribus, testaceo-fulvis; corpore subtus subnudo; pectore abdomineque lateribus nigricantibus. Long. $4\frac{3}{4}$ lin.

Head coarsely punctured, brown, clothed with pale-tawny pubescence, the forehead and vertex having numerous long and erect pale hairs. Antennæ rather longer than the body, slender, the joints being much longer and thinner than in the other species; third joint rather strongly curved; fourth less curved; all the joints pale testaceous tawny, shining, and clothed throughout with long pale hairs. Thorax convex, surface even, coarsely punctured, tawny-pubescent, and clothed with erect hairs; disk on each side and front margin each with a thin pencil of hairs. Elytra oblong, coarsely punctured, especially towards the base, tawny testaceous, shining; each elytron towards the base with three rather long parallel crests of dense hairs all of equal height, and towards the apex with three thin pencils of similar hairs arranged in a row across the elytron. Body beneath and legs pale, tawny testaceous, shining, clothed with long pale hairs; sides of breast and basal segments of abdomen black*.

Forests of Obydos, Lower Amazons.

[To be continued.]

* The following new species, sent from South Brazil by Mr. Squires, belong also to this genus:—

Desmiphora ornata. Elongato-oblonga, fulvo-ochracea, nigro lineata et variegata. Caput grosse punctatum, fulvo hirsutum, vertice nigro bipenicillato. Antennæ corpore breviores, robustæ, hirsutæ, dimidio basali rufo, apicali nigricante. Thorax fulvo-ochraceus, lateribus utrinque nigro trilineatis, disco postice brunneo; juxta marginem anticum penicillis tribus porrectis quarum una antica fusca, alteræ duæ posticæ fulvo-ochraceæ. Elytra grosse punctata, fulvo-ochracea, pone medium annulo communi nigro, fasciaque subapicali alba; singulis cristis setosis parum elevatis, una prope basin, altera longe ante apicem. Corpus subtus fulvo villosum, pectore nigro.

XXIII.—*Conchological Gleanings.* By Dr. E. von Martens.

[Continued from p. 88.]

II. *On some Species of* Assiminea.

This genus, so well characterized among all operculated Gasteropoda by the position of the eyes near the tip of the tentacles, was proposed as early as 1819 (Leach's manuscript), and has never since been seriously opposed; but up to the present time some species of it have not been recognized as such, but have been described under the generic name of *Realia, Hydrocena, Omphalotropis, Paludina, Melania,* or *Paludinella.* *Realia* seems to be, and *Omphalotropis* is, if we take *Cyclostema rubens,* Quoy and Gaimard, as its representative, a true land-shell with two long slender tentacles bearing the eyes on the outside near the base. There is no objection to placing these two genera in the family of Cyclostemidæ, and supposing, therefore, the radula (still unknown, as far as I am aware) to belong to the type of the *Tænioglossa.* The genus *Hydrocena* was founded on a submarine shell from Dalmatia, *H. cattaroënsis,* uniting the umbilical callus and general shape of *Helicina* with the opercular apophysis of *Neritina,* and agreeing with both in the conformation of the radula (Rhipidoglossa), (see Küster in the 'Continuation of Chemnitz,' genus *Paludina,* pl. 13. figs. 28, 33; and Troschel 'Gebiss der Schnecken,' vol. i. pl. 6. fig. 1). The name *Hydrocena* can henceforth be applied only to shells showing the said characters, or, as long as their radula and operculum are not known, supposed to do so. *Paludina* and *Melania* are, as everyone knows, freshwater shells belonging to the Ctenobranchia tænioglossa. The genus *Paludinella* was founded by Pfeiffer in 1841 (Wiegmann's Archiv für Naturgeschichte), for the so-called *Truncatella litorea* of Philippi, a littoral shell from the Mediterranean, whose natural position is not yet clear; the name has been transferred by many authors wrongly to the small freshwater *Paludina* with spiral operculum, for which exists the older name *Hydrobia,* Hart-

---

Pedes fulvo-testacei. Long. $4\frac{1}{4}$ in. *Hab.* in Rio Janeiro, a Dom. Squires lecta.

Desmiphora venosa. Elongata. Caput fuscum, fulvo hirtum, punctatum. Antennæ robustæ, pilosæ, fulvo-brunneæ, articulis supra nigris. Thorax niger, nitidus, crebre foveolatus, lateribus fulvo plagiatis, dorso fusco bipenicillato. Elytris juxta basin et latera crebre foveolata, fusca, medio plana vix punctata, cinereo-brunnea, apice fusco maculata; singulis penicillis grossis fuscis, decumbentibus, una prope basin, altera apicem versus, lateribus et parte postica lineis flexuosis elevatis cinereo tomentosis. Corpus subtus et pedes testacea, cinereo villosa. Long. $3\frac{1}{2}$ lin. *Hab.* in Rio Janeiro, a Dom. Squires lecta.

mann. Whether *Assiminea* is rightly supposed to be an air-breathing (pulmonate) mollusk I am not prepared to decide; the Tænioglossan conformation of its radula is affirmed by Troschel, *l. c.* pl. 7. figs. 13 & 14.

All the species of *Assiminea* which I have observed alive dwelt in *brackish water*, on the *muddy banks* of rivers, channels, or inlets very near to the sea, never in fresh water, never on the open sea-shore, neither on rocks and stones, nor on plants, but simply on the muddy flat itself, near high-water mark, during the ebb, surrounded by the air; but I cannot affirm that in every case they were covered at flood-time by the water. I have found them in such situations in China, Siam, and Singapore; and the same I suppose, after consulting various English authors, to be the case with the British species *A. Grayana*.

The species I have observed are the following:—

1. *Assiminea carinata*, Lea, Proc. Acad. N. Sc. Philadelphia, 1856, p. 111.

Omphalotropis maculata, m., Proc. Zool. Soc. 1860, p. 11.

Siam, on the muddy banks of the channels of the Menam river, below Bangkok.

Resembles in size and outline the Bengal *A. Francisci*, but is distinguished by a sharp keel round the umbilicus and by some rows of dark spots and a dark basal band. I was myself mistaken, before starting with the Prussian Expedition for Eastern Asia, in describing a specimen of this shell, collected by the late M. Mouhot and examined in the British Museum, as an *Omphalotropis*. During my stay in Siam I found it alive, and recognized the true characters of the mollusk; this I stated, in the 'Malakozoologische Blätter,' edited by Dr. Pfeiffer, vol. x. (1863) p. 120; nevertheless the editor himself, in his 'Second Supplement to the Monograph of *Pneumonopoma*,' 1865, p. 176, enumerates it among the *Cyclostomacea*, and near it the *Hydrocena fasciolata*, Crosse & Fischer, and *H. fulvida*, Pfr. (Journ. Conch. vi. & x.), which are evidently later names for the same species.

2. *Assiminea pinguis*, m.

A. testa globosò-ovata, vix rimata, oleoso nitente, linea impressa infra suturam notata, fusco-aurantiaca, unicolore; spira conica, acutiuscula; anfr. 5, paulum convexi, ultimus infra rotundatus, carina nulla; apertura spiram æquans, fere verticalis, supra acute angulata; peristoma rectum, margine externo tenui, columellari incrassato.
Long. 6, diam. 4, apert. alt. 3, lat. 2 millim.

Makao, in a muddy inlet.

Head of the animal grey; foot below yellow, with bluish edge.

3. *Assiminea miniata*, m.

A. testa ovato-globosa, vix rimata, subtilissime striata, lineis impressis binis infra suturam sculpta, intense rubra, unicolore; spira convexa, obtusa, sæpe erosa; anfr. circa 5, vix convexiusculi, ultimus infra ventricosus, carina nulla; apertura spiram superans, fere verticalis, supra angulata; peristoma rectum, margine externo tenui, columellari incrassato.

Long. 9, diam. $4\frac{1}{2}$, apert. long. 4, lat. 3 millim.

Singapore, on the muddy bank of the streamlet, close to its mouth, near the new church, east of the town.

Head and foot of the animal pale red.

These species agree with each other, as well as with *A. Grayana* and *A. Francisci*, in a peculiar smooth appearance of the shell, neither brilliant, nor rough, but as if they were formed of some fatty or greasy substance; the whorls are generally flat, the umbilicus more or less narrow, but existing, the outer lip sharp, the inner lip thickened, but neither of them bent outwards; the colour varies from a pale yellow to a deep red, but is never the dark dull brown of so many species of *Paludina* and some *Realiæ*. A distinct system of sculpture is sometimes entirely wanting; in some species a keel round the umbilicus, in others impressed spiral lines below the suture are to be found.

These species being ascertained, by observation of the living animal, to belong to the genus *Assiminea* must lead, of course, to the supposition that some others, very nearly resembling them, but known only from the dead shell and described as *Hydrocena, Omphalotropis, Paludina*, &c., may also in reality belong to the genus *Assiminea*. I examined, for the purpose of deciding this question, a year ago, the shells, in the late Mr. Cuming's collection, called *Hydrocena* by Dr. Pfeiffer, and have since consulted some published descriptions; and, judging from the above characters of the shell as well as in some cases from the localities indicated by the authors, it is my opinion that the following species belong to the genus *Assiminea*:—

a. European Species.

Assiminea Grayana, Leach. Well known to British conchologists.

Assiminea Charreyi (*Melania Charreyi*, Morelet, Mollusques de Portugal, 1845, p. 98, pl. 7. fig. 5). As this work is not to be obtained everywhere, I quote the diagnosis and habitat from it:—

"Testa solida, perforata, fusiformis, ventriculosa, glabra, luteovirens, linea albida pone suturam, apice acuta, violacea; apertura parva, ovato-angulata, sublanceolata. Long. 11 millim."

Lives, with the *Auriculæ* and some *Paludinæ* (*Hydrobia* probably), in the lagoons of Villa Reale, which the ebb leaves almost dry during a great part of the day.

I received, many years ago, from Nantes a small shell resembling in size and general form the well-known *Hydrobia ulvæ*, but with flatter whorls, of pale-yellow colour, and the peculiar smooth greasy appearance of the *Assimineæ*. I think it to be the species described by Morelet.

b. Species from the West Indies.

Assiminea helicoides (*Paludinella helicoides*, Gundlach, in 'Repertorio Fisico-natural de la Isla de Cuba,' entrega 3ª, Habana, Junio 1865, p. 70). Umbilicated, whitish, somewhat glossy, with four rounded whorls. Length 1, diameter 1½ millim. Inhabits the land immediately near the sea, in company with some Auriculacea; is not submerged, but occurs under leaves, on moist beaches, littoral of Cardenas, Cuba.

I have not seen this shell; but the locality given seems to indicate an *Assiminea*, and the description contains nothing repugnant to this supposition. It would be the most depressed species I know of.

c. Species from the shores of the Indian Ocean.

1. *Without keel.*

Assiminea Francisci, Gray, Wood (*Paludina conica*, Troschel, Wiegmann's Archiv für Naturgesch. 1837; Philippi, Icones, i. 1. 15; Küster, 'Paludina,' 6. 15–17). Estuary of the Ganges. A variety with a white spiral band, collected with the type by Lamare Picquot, seems to agree with the specimen I saw some years ago in the Museum of the East India Company, named *Assiminea fasciata*, Cantor.

Assiminea cornea (*Hydrocena cornea*, Pfr. Pneum. Suppl. p. 156). Bashi Islands. Cuming's collection.

A. brevicula (*Hydrocena brevicula*, Pfr. p. 156). Singapore.

A. pinguis, m. } See above.
A. miniata, m. }

2. *A keel round the umbilicus.*

A. carinata, Lea. See above. Siam, Cochinchina.

A. radiata (*Hydrocena radiata*, Pfr. Pneum. Suppl. p. 163). Borneo. Cuming's collection.

A. glabrata (*Hydrocena glabrata*, Pfr. ibid. p. 164). Borneo. Cuming's collection.

A. lirata (*Hydrocena lirata*, Morelet, Journ. Conch. xi. p. 371). Cochinchina.

d. Species from the Pacific Islands.

1. *Without keel.*

A. albescens (*Hydrocena albescens*, Pfr. Pneum. Suppl. p. 157). Opara. Cuming's collection.

A. solidula (*Hydrocena solidula*, Pfr. *l. c.*). Lord Hood's Island. Cuming's collection.

A. ventricosa (*Cyclostoma ventricosa*, Hombron & Jacquinot, Voy. au Pôle Sud, pl. 12. f. 34–36. *Realia ventricosa*, Pf.). Otahiti. Allied to *A. Charreyi.*

2. *A keel round the umbilicus.*

A. rosea (*Cyclostoma rosea*, Gould, Exped. Shells, p. 39. *Omphalotropis rosea*, Pfr. Pneum. p. 308). Fiji Islands. Cuming's collection.

A. bulimoides (*Cyclostoma bulimoides*, Hombron & Jacquinot, Voy. au Pôle Sud, pl. 12. f. 37–39. *Hydrocena bulimoides*, Pfr. Pneum. Suppl. p. 162). Caroline Islands. Cuming's collection.

A. dubia, Pfr. Zeitschrift f. Malakozoologie, 1847, p. 112. (*Omphalotropis dubia*, Pfr. Pneum. p. 310). Opara. Cuming's collection.

A. huaheinensis (*Hydrocena huaheinensis*, Pfr. Pneum. p. 163). Huaheine.

A. maritima (*Hydrocena maritima*, Montrouzier, Journ. Conch. xi. pl. 5. fig. 4). New Caledonia.

Also *Realia producta, abbreviata*, and *fragilis* (Pease), from the Sandwich Islands (Cuming's collection), I suppose to belong to *Assiminea.*

e. Species from the North Pacific beyond the Tropics.

Laguncula pulchella, Benson (Ann. & Mag. Nat. Hist. 1842, ix. p. 488), found at Chusan by Dr. Cantor, may perhaps be an *Assiminea.* I suspect this to be the case from the words, "peristomate interrupto, labio subreflexo, umbilico profunde tortuoso," and "apertura intus fascia lata pallide castanea ornata." This coloration calls to mind the Siamese *Assiminea maculata.* The sculpture, however, and the deep suture are not favourable to this supposition. The locality given is, "said to inhabit canals." The same words are repeated for *Bullæa caurina, Arca galactodes, Mytilus niger, Dreissena purpurascens* (evidently a *Septifer* near *bilocularis*, L.), *Venus sinensis, Sanguinolaria iridescens*, and *Novaculina constricta*,—all marine or brackish-water shells; whereas, for the true freshwater shells *Planorbis, Limnæus, Paludina*, the locality is given with much more assurance and detail. From this we may perhaps be led to suspect that *Laguncula pulchella* inhabits the same localities as *Novaculina, Venus sinensis*, &c.; and as the two last-named are common in the brackish water of the estuary of the Yangtsekiang, and I have also found a *Bulla* in company with *Assiminea* in a muddy inlet at Macao, this consideration seems to give some reason for suspecting *Laguncula pulchella* to be an *Assiminea*.

Paludina pulchella, Hutton, from British India, seems to be distinct from this Chinese shell; but it resembles, in common with some nearly allied species from the same country, some *Assimineæ*, by the keel in the base of the shell; the operculum, however, as well as the outer appearance of the shell, are those of *Bithynia*; and it seems to inhabit, like this latter genus, really fresh water.

Finally, it ought to be observed that, in order to ascertain the length of the tentacles and the position of the eyes in a living mollusk of amphibious habits, it will be as well to observe it both in the air and when surrounded by water. An example will show how mistakes may occur. In the 'Voyage of H.M.S. Samarang' (a work which has contributed so largely to our knowledge of living mollusks), pl. 13. fig. 3 *a*, *Cerithium obtusum*, a relatively large mollusk, is figured with short tentacles and the eyes at their tips, just as in *Assiminea*, and the description at page 44 says exactly the same. Such is, indeed, the appearance of the living animal when seen out of the water; but if observed in water, the long slender portion of the tentacle is instantly seen to be prolonged far beyond the eye, as in all other *Cerithia*; the apex must have laid close to the base when the animal was out of the water, as I have repeatedly seen in Singapore.

III. *The Sandwichian Species of* Limnæus.

So far as I am aware, only four species of *Limnæus* are recorded in different malacological works as living on the Sandwich Islands, — *L. oahuensis* and *affinis*, Souleyet, *L. sandvicensis*, Phil., and *L. volutatus*, Gould. Three species are contained in the Berlin Museum, a comparison of which with the existing descriptions and figures has led me to the following results:—

1. *Limnæus oahuensis*, Souleyet, Voyage de la Bonite, Zool. (1841) vol. ii. pl. 29. figs. 38–41. *L. sandvicensis*, Philippi, Wiegmann's Archiv für Naturgeschichte, 1842, figured in Küster's new edition of Chemnitz, Limnæacea, pl. 4. figs. 25, 26, does not offer any specific difference. Oblong-ovate, with rather convex whorls; columellar plait moderate.

2. *Limnæus affinis*, Souleyet, *loc. cit.* figs. 42, 44. Sinistral, ovate-globose; the whorls convex, the upper ones worn off.

3. *Limnæus volutatus*, Gould, Expedition, Shells, p. 41

(1847). Oblong, with flattened whorls and conspicuous columellar plait.

I have no specimen before me to which Gould's description is entirely applicable; but the following one, differing almost solely by its sinistrorsity, I consider a variety of it.

3 *b*. *Limnæus volutatus*, b. *sinistrorsus*.

L. testa sinistra, conico-oblonga, striatula, luteo-fusca, vix nitidula, apice truncata; anfractus superstites 3, plani, sutura superficiali, ultimus antrorsum valde deflexus, basi rotundatus; apertura sat obliqua, piriformis, superne acutangula; peristoma rectum, tenue, lamina parietali distincta, crassiuscula; plica columellaris valida.
Long. 8, diam. maj. 5, min. 4, apert. long. 5, lat. 3 millim.

Sandwich Islands. Received many years ago from the Heidelberg Museum, under the name of "*Physa*, sp."

4. *Limnæus Newcombi* (*Erinna*), H. & A. Adams, Gen. Moll. vol. ii. pl. 138. fig. 9.

The preceding resembles so much the Sandwich freshwater shell regarded as a new genus by the above authors, that I cannot help placing the one next to the other, although I have no specimen of *Erinna* before me to examine. The only difference I can make out is that in *L. Newcombi* the whorls are more involute, the last one forming almost the whole outside of the shell—a difference well known to exist not only between distinct species of European *Limnæi* but also between the varieties of our most common species, *L. stagnalis*, as well as between those of *L. auricularius*; in both the degree of exsertion of the spire is very variable. The curved elevated external ridge of the columella mentioned by the authors, I consider, from an inspection of the figure, to be the columellar fold common to almost all species of *Limnæus*, but more strongly developed in *L. volutatus*. *Erinna Newcombi* is dextral.

All the above species are of small size and dark-brown colour, resembling in both respects the European *L. truncatulus*, Müll. (*minutus*, Drap.), and the dwarf forms, allied to *L. palustris*, called *L. fuscus*. Their chief differences are combined and repeated in a curious crossing manner, as is shown by the following table:—

Whorls.	Less involute.	More involute.
Convex.	Dextr. *L. oahuensis*, Soul. Sin.? *Physa reticulata*, Gould	Dextr. Sin. *L. affinis*, Soul.
Flat.	Dextr. *L. volutatus*, Gould. Sin. *L. volutatus*, b., mihi.	Dextr. *E. Newcombi*, Ad. Sin.

Limnæus oahuensis exhibits no striking difference from the general appearance of the European species. *L. volutatus* and *L. Newcombi* cannot be compared with any of them. Nevertheless an affinity between the four species cannot well be denied. This is another example of the case (frequent in malacology) in which a single species seems to offer very strong characters for its separation as a genus, while the consideration of all the species living in the same country shows its close connexion with others in which all the characters of the new genus disappear. Striking examples of the same among land-snails are the well-known Brazilian *Bulimus navicula* and the Peruvian *Bostryx solutus*.

The sinistral forms have been placed repeatedly in the genus *Physa*. How can it be decided whether they are *Physæ* or *Limnæi*? Our European *Physæ* are distinguished from the European *Limnæi*, at first sight, by their sinistrorsity and by the glossy surface of their shell; more essential differences are the long setaceous tentacles and the prolongation of the mantle outside of the shell. This latter character does not hold good for *P. hypnorum* (*Aplexa*), which according to its other characters is a good *Physa*, and shows by its glossy shell that this lustre is not in every case connected with a prolonged mantle. This gloss of the shell is absent in the Sandwich species, and also in *Physa contorta* from Southern Europe (*Diastropha*) and in some species from North America. Souleyet has figured the living animal of his *L. affinis*. No prolongation of the mantle is to be seen, and the tentacles are not long and slender, as in the European *Physæ*, but like those of *Limnæus*. A. Gould refused to rely upon this figure, calling it "rather indifferent," but took for guide only the direction of the whorls; so he described (*loc. cit.* p. 43) a *Physa reticulata* from the Sandwich Islands, the relations of which with *Limnæus* struck him and which may perhaps be (I know it only from his description) a sinistral form allied to *Limnæus oahuensis*. The above-described *Limnæus volutatus sinistrorsus* is a strong argument, I think, against the practice of calling all the sinistral forms *Physa*. It is true that sinistral specimens have been found, but very rarely, among the European species of *Limnæus* (such have been described in the case of *L. stagnalis, pereger, ovatus, auricularius* var. *tumidus*, and *æronicus* by Geoffroy, Held, Hartmann, Forbes and Hanley), and that from no other country in the world is a normally sinistral *Limnæus* known to us, since Lamarck's *Limnæus columnaris* is a land-snail (*Columna flammea*). But, on the other hand, it is well known that in Transgangetic India and the large islands of the Indian archipelago a peculiar group of *Bulimus* (*Amphidromus*) is found, distinguished by the about equal number of dextral and sinistral specimens in most of the species. The Sandwich Islands themselves are the country of the *Achatinellæ*, in many of which the same peculiarity obtains; and it seems at least not absurd to assume that the same may occur in the genus *Limnæus*. Let us hope that the zeal of the Sandwichian malacologists, which within the last few years has enriched science with so many new species, will take up and furnish an early answer to this question.

IV. *On the species of* Amphipeplea.

Amphipeplea is distinguished from *Limnæus* by the external expansion of the mantle in the living animal; and this expansion can be traced by the existence of a more whitish and less glossy deposition on the outside of the shell. Various authors have introduced into the genus species based only on the involuted whorls and thinness of the shell, without regard to the above characters.

1. *European Species*.—The only one of all the Palæarctic species which certainly belongs to *Amphipeplea* is, so far as I know, *A. glutinosa*, Müll. sp., the type of the genus. Ehrenberg (Symbolæ Physicæ, 1828) distinguished from it, as a subspecies, his *A. glutinosa syriaca* from Beirut, chiefly because he could not believe that the same species should inhabit Sweden and Syria. I have examined the typical specimen in the Berlin Museum, and cannot detect any constant differences between it and specimens from Sweden and northern Germany.

The deposit on the outside of the shell occupies in *A. glutinosa* only a circumscribed part of the last whorl near to the columella, and is nothing else than a slight enlargement of the parietal lamina, which can be distinguished in all specimens of *Limnæus* rather from its difference in colour and gloss than as a formally distinct superposition. The spire is entirely free from any external deposit. Nevertheless it is well ascertained by different authors (and I have had opportunity of noticing it myself) that the external lobes of the mantle can be produced far beyond the limits marked on the shell, these indicating only, I suppose, a mean average or stationary degree of expansion.

The geographical distribution of *Amphipeplea glutinosa* extends from the Polar Circle, in the Baltic provinces of Russia, to Sweden, Denmark, and the northern half of Germany (where it is rather local and rare), Holland, England, the northern and western parts of France. Its southern limits are not yet ascertained; in southern Germany it has not yet been found, so far as I know; and only two stations for it are recorded in the whole Mediterranean province—Rome (by Cantraine) and Beirut.

Beck (Index Molluscorum, 1837, p. 115) introduced the *Limnæus ampullaceus*, Rossm., into the genus *Amphipeplea*. This species, inhabiting the Lake De Joux, in western Switzerland, has indeed the general outlines of shell similar to those of *Amphipeplea*; but, judging from a specimen in the Albersian collection presented by Carpenter himself, who sent the specimens to Rossmässler, the author of the name, I can state that neither is the outer surface of the shell so glossy as in *Amphipeplea,* but rather dull, nor is the parietal lamina in any way extended beyond the limit common to the true *Limnæi.* In both respects it closely resembles the common *L. auricularius* and *L. ovatus,* and may safely be considered one of the numerous varieties comprehended under these two names.

Some British authors, and among them Adams (Gen. Moll. ii. p. 256), admit into the genus *Amphipeplea* a shell from an Alpine lake near Killarney, *Limnæus* (or *A.*) *involutus,* Harvey. I have at present no opportunity of examining the shell; but the figure of the living animal given in Gray's figures (Moll. An. pl. 301. fig. 3) is that of a *Limnæus,* not that of an *Amphipeplea.* Jeffreys (British Conchology, i. p. 104), however, states the following:—"Dr. Perceval Wright informs me that the greater part of the shell in this species (*Limnæa involuta*) is covered by the mantle, as in *L. glutinosa.* The form and substance of the shell are also similar in both of these species." But the same author, in the same book, on the preceding pages, terms the shell of *L. glutinosa* (true *Amphipeplea*) "excessively thin, highly polished, transparent," that of the questionable *L. involuta* only "rather glossy, semitransparent," just as he terms that of *L. auricularia* "thin, glossy, semitransparent;" so that, judging from his words, the substance of the shell of *L. involuta* is nearer to that of *L. auricularia* than *L. glutinosa,*—*i. e.* that of a true *Limnæus,* not of an *Amphipeplea.* Most specimens of *Limnæus auricularius, ovatus,* and *pereger* exhibit on the outside of their shell some thin incrustation of muddy or vegetable matter, which never occurs in *Amphipeplea.* I think that a careful examination of the shell alone would enable us to arrive at a more satisfactory conclusion as to the accordance either with *Limnæus* or with *Amphipeplea.* Judging from the published descriptions and figures of the shell, I think that Forbes and Hanley are right in suspecting it to be some variation of a more ordinary *Limnæus*; indeed it seems to have the same relations to the smaller varieties of *Limnæus ovatus* (*L. vulgaris,* Pfr.) as *L. Monnardi* and *L. tumidus,* Held (= *amplus,* Hartm.), to *auricularius, L. roseolabiatus* to *L. pereger, L. lacustris* to *L. stagnalis*—that is, to be a more involuted lacustrine variety of it. The term "*involutus*" itself I imagine to have been applied to it on account of the involution of the whorls, and by no means to indicate an envelopment of the shell by any soft part.

2. *Australian Species.*—Dr. Pfeiffer (Malakozoologische Blätter, 1854; Proc. Zool. Soc. 1856; Novitates Conchologicæ, pp. 2, 5, 6, & 19, 14, 15) has described two Australian species under the names *Amphipeplea Strangei* and *A. Melbournensis.* The latter resembles in every respect so closely the *Limnæus Lessoni,* Deshayes (Guérin, Magasin de Conchyliologie, 1830, pl. 16), that I cannot satisfy myself as to its specific distinctness. *L. Lessoni* has been observed alive, described and figured by Lesson, 'Voy. de la Coquille, Zool.' pl. 15. f. 1 and 'Centurie Zoologique,' pl. 44 (Gray, Fig. Moll. An. 307. 2): the foot is figured rather large and elongated; but nothing like an expansion of the mantle over a part of the outside of the shell is indicated. Even in the figure of the shell given by Pfeiffer for his new *Amphipeplea* the limits of the parietal lamina are to be distinctly traced, and prove to be those of a *Limnæus.* Therefore the claims of *A. Melbournensis* to a place in the genus *Amphipeplea* appear to be unfounded. The same is the case with *A. Strangei,* which has still more the appearance of a *Limnæus,* the spire being more produced. The analogy of the shell with *Amphipeplea Cumingi* is the only reason alleged by Pfeiffer for its systematic position; but this resemblance of the shells is much more distant than that between the so-called *A. Strangei* and *Limnæus Lessoni,* or also *L. ampullaceus.* It must be left to Australian naturalists to ascertain whether any real *Amphipeplea* is found in Australia; at present we have no proof of it.

3. The *Philippine species,* on the contrary, is not only a true *Amphipeplea,* but exhibits the distinguishing characters of that genus more developed than in the European type itself. The late Mr. Cuming, to whom science is indebted for valuable observations on the habits of living mollusks, besides an unparallelled increase of new species, has described it as a "freshwater *Bulla.*" Pfeiffer (Novitat. p. 6; Souleyet, Voyage de la Bonite, Zoologie, pl. 29. f. 33; Gray, Fig. Moll. An. 304. 7) figured the living animal, exhibiting an extraordinary development of the mantle and a very long foot. The development of the mantle-lobes is confirmed by the examination of the shell; the parietal lamina is continued in a shelly deposition with unequal waved limits, occupying nearly half the circumference of the last whorl and enveloping the apex itself. Beyond it, in the latter half of the last whorl, there are to be seen, in many of the specimens, scattered spots, of the same whitish appearance, probably thin shelly deposits made by temporary contact of the mantle.

Three authors have named and described a Philippine *Amphipeplea,* without taking notice one of the other:—

Beck, 'Index Molluscorum,' 1837, p. 115. *Amphipeplea Luzonica.*

Souleyet, 'Voyage de la Bonite, Zool.' 1841. *Limnæus Luçoniensis.*

Pfeiffer, 'Proc. Zool. Soc.' 1845. *Amphipeplea Cumingi*; figured afterwards (as *A. Cumingiana*) in the 'Novitates Conchologicæ,' pl. 2. figs. 3, 4, and in Küster's 'Continuation of Chemnitz, Limnæacea,' pl. 10. figs. 17 & 18.

I suppose these all to be the same species, and identical with one which the Berlin Museum has received from Mr. Jagor; but one of its principal characters, the deepened suture, is not well expressed in Pfeiffer's figure. Beck introduced the name without any description; therefore the species cannot be regarded as duly established by him, which, in fact, was done by Souleyet. Beck refers to the same species, with some doubt, the *Limnæus imperialis*, Lea: this (published in 1837, in the 'Transactions of the American Philosophical Society at Philadelphia,' vol. v. p. 81, pl. 19. fig. 73) would be the oldest specific name, if it should prove to be the same species; but the figure is either very bad or disproves this supposition. As to the habitat, Lea supposes, with some doubt, the shell to be South American; but as, especially in this paper, almost all the foreign localities given by this author (except North America) have since proved to be erroneous, no dependence can be placed on his statements.

XXIV.—*On Phthiriasis, and on the Structure of the Mouth in* Pediculus. By Professor J. C. Schjödte*.

That *Pediculi* are possessed of mandibles and able to bite is an opinion which seems not unlikely to be adopted by the naturalists and physicians of the present day. I expect, however, that naturalists, after renewed investigations and more careful consideration, will all sooner or later agree that this opinion is not only false in itself, but incompatible with the simplest, most elementary, and most certain principles of the morphology of Arthropods; and physicians will, I am sure, be not a little pleased to get the ancient monster "Phthiriasis" placed on "the retired list," in company with other griffins and dragons, the offspring of ignorance. The many old and new fabulous and confused accounts of cases of phthiriasis could not by themselves keep alive a belief in its actual existence; and that such a belief is still entertained is merely due to the notion that the mouth of *Pediculi* is adapted for biting, enabling them to eat their

* Translated from the Danish original in 'Naturhistorisk Tidsskrift,' ser. 3. vol. iii. p. 48. Copenhagen, 1864.

way into the skin, and thus produce so-called "lice-blains, open or closed." Once admit that the whole structure of these animals, in every part from beginning to end, is exclusively calculated for blood-sucking habits, then a peculiar disease caused by them, such as phthiriasis is described to be, will immediately show itself to be an impossible thing, unless we return to the ancient notion, which now-a-days is in so little esteem that nobody dares to avow it publicly,—viz. that vermin could be generated spontaneously by the formation of cutaneous secretions. If, therefore, the name is not to disappear altogether, nothing will remain to which it could be applied except such abnormal conditions of the skin as, in consequence of its peculiar structure and manner of growth, may perhaps develope themselves under continued ill-treatment by blood-sucking animals, at any rate when combined with other influences, such as may always be supposed to exist in individuals who allow their persons to serve as habitation and food for that kind of parasite. At the same time, the notion of such a disease will presumably linger a long while amongst the uninitiated; for imagination, which originally seems to have bred this notion as a kind of consolation and excuse for the continued existence of these animals, will also in future be inclined to stamp the degradation as an unfathomable affliction of providence, and to give that which is merely disgusting a touch of the sublime by unlimited exaggeration. And in this respect it will always be a circumstance of great moment that precisely the most famous and mighty men, poets, philosophers, and statesmen, kings and emperors, are reported to have died from this direful disease.

All those who have written on the subject have more or less misunderstood Swammerdam's treatise "Van de ontleeding van de Menscheluys" (Biblia Naturæ, i. 67); but none of them have read it carefully, much less mastered it fully. It is true, however, that a superficial abstract of his observations pervaded all works on natural history until the year 1839. According to this, the mouth of the louse consisted of an haustellum armed with hooks and capable of protrusion, from which a much smaller sucking-tube could be pushed out: "Os aculeo exserendo" (L. Syst. Nat.); "haustellum retractile, recurvum" (Fabr. Ent. Syst.); "os haustello antico tubuloso, brevissimo" (Latr. Gen. Ins. et Crust.). But when Burmeister (Genera Insector. icon. illustr. 1838) had published Nitzsch's posthumous drawings of the mouth of the louse (pl. 2. f. 3–6), the following remarkable statement was made by Erichson in 'Archiv f. Naturgesch.' 1839, ii. p. 377:—

"The drawing of the parts of the mouth agrees entirely with the description given by Nitzsch in the third volume of Germar's Magazine.

But his observations have been not less defective than those of Swammerdam. The hooks on the so-called haustellum do not exist at all, but there are instead a pair of strong four-jointed palpi ; the lice also possess very distinct mandibles, so that I cannot but entirely side with the unlearned, who maintain that the lice *bite*, in opposition to the opinion of the learned,—and that so much the more as the structure of their mouth renders it impossible for lice to sting. It follows of necessity from these indications, that it becomes altogether impossible to class Pediculini with Hemiptera as proposed by Nitzsch, a classification which Burmeister considered necessary on purely philosophical grounds."

In vain did Burmeister afterwards give a detailed account (Linnæa Entomol. ii. 1857, p. 569, pl. 1) of the structure of the mouth in *Pediculus urius*, agreeing with Nitzsch's statements, and confirming the hypothesis of this author in his well-known treatise in Germar's Magazine ("die Familien und Gattungen der Thierinsecten"), vol. iii. p. 304, viz. that the inner tube of suction consists of several setæ. It was of no avail, as indeed it never does avail in science, simply to put forth one view as true and reject the opposite as false, because the one thing necessary for a final decision is to test the harmony of the discoveries with the rational connexion of things : it is, so far, of small importance that Burmeister's account contains several mistakes and faults. Accordingly we read, in Simon's elaborate work on cutaneous diseases, published in the following year :—

"Concerning the structure of the mouth in lice, the earlier observers supposed that they possessed an haustellum armed with hooks, which, however, as early as 1839, was denied by Erichson, who, on the contrary, discovered distinct mandibles, and a pair of four-jointed palpi.

"As the view formerly held is still favoured by many, I have not thought it superfluous to enter more fully on this matter. I have therefore, together with Professor Erichson, examined *Pediculus capitis* in this respect [Professor Erichson's former investigations had been made on *P. vestimenti*]; and we found, by application of a strong magnifying-power, that the parts of the mouth were precisely as indicated by Erichson, and as drawn by me on tab. 7. figs. 4 & 5. In the head, under the haustellum (*a*), there are a pair of mandibles, of a brownish colour (*b*), and on the haustellum itself a pair of four-jointed palpi (*c*). We have not examined the mouth in *Phthirius*. As long as it was believed that lice were furnished merely with an haustellum, it was supposed that they perforated the skin with this. The existence of mandibles having now, however, been demonstrated, it must be assumed that they first bite through the skin with these, and then introduce the haustellum through the wounds thus produced. The palpi probably serve to discover the places favourable to suction."—*Die Hautkrankheiten durch anatomische Untersuchungen erläutert,* Berlin, 1848, p. 274, 275.

This view, which had already gained so much attention by the influential support of Erichson, has recently again been maintained in the strongest terms, in two treatises, by Dr. Leonard Landois in the 'Zeitschrift für wissenschaftliche Zoologie,' Feb. 1864. In the first paper, on the anatomy of *Phthirius inguinalis,* he expresses himself in the following manner:—

"The organs of the mouth are situated in the foremost part of the head, mostly underneath. They consist of an haustellum ("promuscis," Kirby), which altogether has a length of $\frac{1}{30}$ millim. On this I observed, first of all, a labrum longitudinally divided into two parts, which forms the upper part of the haustellum, and which proceeds from the middle part of the head. Near the root of the haustellum the two halves of the labrum diverge, having a width of $\frac{1}{45}$ millim. each, and ending in a continuation bent inwards. Viewed as a whole, the labrum presents the shape of a bottle, of which the greatest width, near the bottom, is $\frac{1}{11}$ millim., whilst the narrowest part (the neck of the bottle) only measures $\frac{1}{60}$ millim. in width. Each half of the labrum carries on its foremost extremity a pair of excessively slender small hooks, which are biarticulated and turned outwards, diverging from one another; these hooks consist of chestnut-brown, transparent and hard chitine. Underneath the labrum, not far from its point, two horizontally-working mandibles, true organs of biting, are placed in a transverse position; they consist of a close-grained transparent chitine of a yellowish tint, along the lower edge shining brown. They are $\frac{1}{15}$ millim. long and $\frac{1}{90}$ millim. broad. There are certainly no palpi to be found. My description and figure prove that the organs of the mouth in *Phthirius* correspond very nearly (except with regard to palpi) with the description of the same parts in *P. capitis* and *P. vestimenti* given by Erichson and G. Simon; and the last-mentioned author is no doubt quite right when he says, jokingly, that the common people know better that lice "bite" than the naturalists, who take them to be sucking parasites. This point deserves, in a high degree, the attention of systematic authors, who have hitherto persisted in separating lice "with sucking organs of the mouth" from their congeners "with a mouth organized for biting" (*Ricinus, Mallophaga*), an arrangement first proposed by De Geer and afterwards further developed by Nitzsch and Latreille." (*Vide* the periodical quoted, vol. xiv. no. 1, pp. 4 & 5, tab. v. fig. 2.)

In the second paper alluded to, containing historical and critical investigations concerning phthiriasis, the author expresses himself, if possible, in still stronger terms:—

"The occurrence of lice underneath the skin can only be explained by a number of them *eating their way through* the skin in one and the same place. This is to be understood literally; for the lice are not, as was formerly generally supposed, provided with sucking-organs, but with true biting-organs, in the shape of chitinous mandibles working horizontally, such as Erichson and Simon have shown to exist in ***P. capitis*** and ***P vestimenti***, and as I have found myself in ***Phthirius inguinalis***." (*Loc. cit.* p. 34.)

Amongst the results of his inquiries the author also mentions the following—evidently the most important of them all:—

"In the lighter cases, the lice produce merely a papulous exanthema; but in more serious cases, they eat their way in large numbers through the skin on a circumscribed area, whereby open lice-blains are formed, or, if the perforated skin remains over the place, closed lice-blains." (*L. c.* p. 41.)

The verbal tenor of this last passage shows clearly that it is principally founded on the recent communications of Dr. Gaulke on phthiriasis, communications to which Dr. Landois ascribes an extraordinary weight and importance, introducing them as he does in the following words:—

"We are indebted to Dr. Gaulke for recent observations concerning phthiriasis, which are in the highest degree important and interesting (Casper's Vierteljahrschrift, 1863, vol. xxiii. p. 315), and which he has made at Susterburg, near Gumbinnen, on the high road to Russia and Poland. In that neighbourhood, which is teeming (*überaus versehen*) with lice, he has observed many cases of true phthiriasis, of which I will here communicate two, which are of the greatest importance." (*L. c.* p. 32.)

Let us, then, examine these proofs, which Dr. Landois considers so very important.

The first of these cases was that of a lame, lunatic, old woman. She became to that degree infested with *Pediculus vestimenti*, of which her lameness and *a complete want of nursing* made her a defenceless victim, that she got a bad exanthema. (It is here assumed, without any further proof, that the exanthema was caused by the parasites.) This "exanthema" (Ausschlag) consisted of innumerable cavities in the skin, of the diameter of a pea and about a quarter of an inch deep, in which cavities there were thousands of *P. vestimenti*. The habitation of the woman, which was dirty and *dark*, teemed with the vermin, and she *did not leave it during the medical treatment*. The latter remained without sensible effect, and she died of "phthiriasis externa."

The other case was that of an utterly degraded vagabond, formerly an artisan. After a prolonged absence from home, he returned, full of vermin, in a low and thin condition (anämisch und kachektisch), with sallow face and thin parchment-like skin. On the skin, particularly on the inner side of the limbs, about one hundred places were observed, partly open, partly covered with a membrane, of a yellowish-red colour, a little protruding and "resembling abscesses," the largest of the size of a nut, the smallest not larger than a pea. The open cavities contained thousands of lice, *but not a drop of pus*; the membranes covering the closed places were observed by a pocket magnifier to be perforated by small holes, not larger than might have been made by a pin. These closed places resembled shot-bags to the touch; and when opened, the living contents spread in all directions; but not a drop of moisture was to be observed. According to Dr. Gaulke's opinion, the lice deposit their eggs underneath the epidermis, which he supposes them to perforate by means of the "ovipositor" (Afterstachel) at the extremity of their abdomen; the young, when hatched, remain under the skin; and thus he fancies the "Läusenabscess" to be formed. Dr. Gaulke rejects most external remedies against this disease as ineffectual; only benzin and the *internal* use of cod-liver oil "effect," according to him, "a radical cure." This patient, however, understood quite well how to clean his clothes on his wanderings from place to place—namely, by burying them for a time in an ants' nest.

We should, no doubt, hesitate in drawing conclusions as to the state of public sanitary police in Prussia from these accounts of Susterburg and Gumbinnen, which are said to be "mit Läusen überaus versehen;" but, at any rate, we cannot in other respects bestow particular praise on accounts which contain such gross blunders in natural history and pathology, and by their whole style betray their author's ignorance of what now-a-days is required of a scientific inquiry. No critical reader could find more in them than in the many earlier confused and contradictory accounts, over which those of Dr. Gaulke really have no other advantage than that of being dressed in modern medical language. Nor can it be doubted that the very bad cases which he describes, probably with a great deal of exaggeration, mostly reduce themselves to an abnormal pealing off of the epidermis, which in most cases had been utterly neglected. He gives not even the faintest shadow of a proof that the cavities of the skin, which he describes as exanthemata and abscesses, were formed by the parasites; and the hypothesis which he puts forward in this respect has no other foundation than a gross blunder in natural history, as he has no doubt mistaken the penis of the male for an ovipositor *. Dr. Landois himself, who cites these com-

* The remarkable size and free position of this organ have long before caused naturalists to fall into this and other errors. Some have thought that the males used it as a sting. This last idea is owing to Leeuwenhoek, who otherwise has communicated very valuable observations on the structure and development of lice. (Arcana Naturæ, Contin. p. 75, Epist. 98.)

munications of Dr. Gaulke, has found several particulars too open to criticism. He rejects most properly the idea of the ovipositor "sehr energisch," and consequently rejects at the same time Dr. Gaulke's whole theory of the formation of the abscesses; he marks the account of the *dry* abscesses with a note of exclamation; and where Dr. Gaulke speaks of the internal use of cod-liver oil, Dr. Landois suggests "that the external use might probably be more effectual." But without considering that the dry abscesses are equally worthy of a note of exclamation whether they are assumed to have been caused by a sting or dug by the insect by means of its mandibles, Dr. Landois nevertheless persists in pronouncing Dr. Gaulke's relation of cases of phthiriasis to be "of the greatest importance, because they place many dark points in the history of phthiriasis in their proper light." And thus the present examination of this matter is again brought back to its starting-point. For so much must here become evident, that, if Dr. Landois finds such highly important information and great discoveries in these communications of Dr. Gaulke's, this is solely because he has allowed himself to be blinded by the prospect that, in spite of their manifest confusion and untrustworthiness, these communications might serve to procure for the new theory of the structure of the mouth in the louse serious consideration and final victory.

Let us therefore return to Erichson and Simon's, and Dr. Landois's own account of the organs of the mouth in these animals, and we shall in that respect find their drawings very useful*.

Whilst Swammerdam, step by step, shows us the way by which he has come to his final conclusion, our three authors leave us in entire ignorance how they have carried on their investigations. However, it is not difficult to find out their method, which a few experiments will prove to have been the simplest that could possibly have been adopted for the examination of such objects. It is only necessary to cut off the fore part of the head, place it under the microscope covered with a thin glass, and press it hard, and, if the magnifying-power used is considerable, the figure given by these authors on their plates will immediately present itself. A long dark object is discernible lying longitudinally inside the head, and provided at its anterior extremity with some smaller appendages, which appear to vary in a curious way as to number and position. Sometimes they resemble diminutive hooks, as in Dr. Landois's figure; but if the experiment is oftener repeated, they will sometimes arrange themselves into two rows, as if we had a pair of slender articulated appendages before us,

* A copy of Erichson and Simon's figure is inserted in p. 227.

that is, Erichson and Simon's so-called "palpi;" but, not to mention that the two rows will never appear quite alike, there are two points here to observe:—first, that these "palpi," when they appear, always show themselves further back than the hooks; and secondly, that we never succeed in seeing hooks and "palpi" at the same time and in the same preparation: on the contrary, when the hooks appear, the "palpi" are gone, and *vice versâ*. There is now no room for wonder that Erichson and Simon found no hooks, but only "palpi," whilst Landois saw "palpi" but no hooks; at the same time the uncertainty remains as to what these small organs really are. As for the so-called mandibles, they always remain the same, just as represented by our three authors.

Let us for a moment content ourselves with this figure, and seek the guidance of our authors in explaining it. But here we at once meet with a certain degree of vacillation. In his first statement Erichson does not seem quite inclined to acknowledge the haustellum, which he alludes to as the "so-called" haustellum. But he must have overcome his doubts in this respect when he had repeated his investigation together with Dr. Simon; for then he spoke quite unreservedly of an haustellum provided with palpi. Landois, too, describes the elongated dark object as an haustellum, but at the same time considers it equivalent to a bifid labrum. It is true that his expression is that he "first" (zuerst) found a labrum on the haustellum; but, as he does not mention any further or second particular, he seems to have really considered that the haustellum was entirely formed by the labrum, though, strictly speaking, he only says that the labrum forms the upper part (Decke) of it. But beyond this our authors furnish us with no details of this haustellum, from which we may safely conclude that they have not observed anything beyond the same confused image presented by our preparation.

Here, then, according to these authors, we have a mouth composed of the following parts:—(1) an haustellum—according to Erichson and Simon, provided with a pair of four-jointed palpi, but according to Landois exhibiting a bifid labrum armed with hooks at one extremity and reaching with the other far back into the head; (2) a pair of mandibles *underneath* the haustellum. Evidently this combination is fundamentally different from the mouth of any other known type of Arthropods; and as it always is a matter of hesitation to acknowledge as well founded morphological statements destroying a hitherto supposed harmony in the multifarious forms of nature, it might naturally have been expected, at least of Erichson, that he would enter more fully into the matter in this respect. However, neither he nor any of the other authors have said one word on this highly important part of the question.

Thus left to our own resources, let us once more look at our preparation. The haustellum apparently giving no immediate clue to a proper interpretation of what we observe, let us concentrate our attention on the so-called mandibles; and if in so doing we have the benefit of some knowledge of the general morphology of Arthropods, a number of considerations will soon present themselves which will gradually weaken the interpretation of these parts as mandibles, and at last prove altogether conclusive against it. For if we consider their *diminutive size* (their length in *P. vestimenti,* the largest of the species living on the human body, and the supposed cause of phthiriasis, is only $\frac{1}{20}$ to $\frac{1}{15}$ millim. by a breadth of $\frac{1}{80}$ to $\frac{1}{60}$ millim., and a thickness of $\frac{1}{300}$ to $\frac{1}{400}$ millim.)—their shape, which is that of a narrow band equally broad at both ends—their *complete want of teeth, articular processes, and muscles,* of which no vestige is discernible—we must aver that such organs cannot possibly be mandibles. Nor can we stop here: mandibles cannot be stuck on arbitrarily any more than any other organ; they must have their place in the plan of the organism, and harmonize with all its parts. A glance at the structure of the *Mallophagi,* which offer themselves most naturally for comparison, will show at once what is required for an insect having mandibles; and yet *Mallophagi* feed only on the youngest and softest sprouts of feathers and hair, whilst Lice are accused of eating their way through such a covering as the human epidermis. Not only would the equipment of tendons and muscles be required, which these so-called mandibles in reality lack, but, besides this, space would be needed inside the head for the muscles, and also a surface on which their fixed ends could find support; that is to say, the head would of necessity have to be broad, with a firm framework, which, again, would demand an entirely different structure of the thorax, limbs, &c. In short, if Lice had mandibles, they could not possibly be such soft creatures as they are, with a pointed head, strong climbing legs, and slow motion.

Nor do these conclusions, which, in my opinion, are incontestable, even yet exhaust the catalogue of improbabilities attaching to the theory of Lice being provided with organs for biting. For even those who advance this theory do not express any doubt that Lice live exclusively on blood, which they suck by means of an haustellum; but why, then, should they take the trouble of biting or gnawing holes in the epidermis by means of the mandibles, seeing that there is such a multitude of natural small openings in the human skin, that the haustellum, when inserted through one of these, at any rate need perforate only a part of the skin? Why should they, now and then at least, undertake the difficult task of entirely burying themselves in the skin? And, again, supposing even that they might thus more easily get at their food afterwards, it does not appear why they should do this only occasionally and in particular circumscribed places. The more we think of this theory, the more confused does it appear.

It is evidently high time to put aside as insufficient our preparation as well as the statements and illustrations of Erichson, Simon, and Landois, which are based on that preparation. Let us make only one short experiment more—one that requires but very little arrangement. Let us take a fresh head and examine it from beneath, but this time with a lower magnifying-power, by reflected light, and without the intervention of a thin glass. The first result is sufficiently surprising; for the "mandibles" are gone. By and by, however, we find them by slowly raising and depressing the compound body of the microscope; but hereby we discover at the same time that they are situated *underneath* the skin. And now there is an end of the "mandible" theory; for one need not be a naturalist to perceive that neither man nor beast can work forceps which cannot be opened. We must try some other way of finding the truth, and we will try the method pursued by honest painstaking Swammerdam.

Suppose, then, a sufficient number of *P. vestimenti* * to be

* Linnæus would not recognize more than one species of *Pediculus* in man (*P. humanus*), though he acknowledged two varieties or races—one of the head, and the other of the body. De Geer considered them two distinct species, and described them as *P. humanus capitis* and *P. humanus corporis*, which latter name Nitzsch proposed to change into *P. vestimenti*, which is now generally used. De Geer's statements as to their specific differences have since made the round of all later works, whether general manuals or special treatises, without any essential change. It is therefore high time to point out that they are not only insufficient, but erroneous, as nobody would be able to distinguish them by the words of Latreille, Simon, Burmeister, Gervais, &c.; for it is by no means the case that the dark colouring on the edges of the thoracic and abdominal segments is peculiar to *P. capitis*, and absent in *P. vestimenti*; the examination of a number of specimens will, on the contrary, show that *P. capitis* is occasionally without any dark colouring at all, and that *P. vestimenti* is not even generally without some, but, on the contrary, often as darkly tinged as *P. capitis*. In both species these extremities are connected by a gradual series of intermediate varieties. The two species are, upon the whole, so very closely allied, that their discrimination demands the greatest attention, and it is very difficult to fix reliable marks of distinction. The best means of distinction are, in my opinion, afforded by the abdominal segments, particularly the two last but one, which in *P. capitis* are more sharply separated towards the sides, whilst in *P. vestimenti* they join one another more evenly; but this point of difference (mentioned also by De Geer, though not made use of in his diagnoses) cannot be made appreciable except by means of good drawings. Further, it is necessary, for the proper

provided, which is both the largest and the most easily obtainable of the species living on the human body (I got mine from the workhouse), it will be advisable to let them hunger for three or four days. It is only with repugnance that one thinks of putting one of them on one's hand; but at last we summon courage, and soon the purely scientific situation from which to view the matter—man and his parasite—is obtained. Scarcely does the abominable little monster feel the heat of the skin before it lays aside its former disheartened attitude, and begins to feel at ease, its antennæ oscillate for joy, and it stretches all six legs complacently out from the body. But, though the pleasure and surprise at the sudden transportation into congenial surroundings for the first moment eclipsed everything else, hunger soon asserts its claim, sharpened as it is by the long fast which has rendered its stomach and intestines quite transparent. The animal raises itself on its legs, walks on a few steps, seeking and feeling its way with its antennæ, while we follow it with the magnifier. Presently it stops, draws in its legs a little, arches its back, bends the head down towards the skin at an oblique angle, while it pushes a small dark and narrow organ repeatedly forward, and draws it back through the fore end of the head; at last it stands still, with the point of the head firmly abutted against the skin. We seize the animal with a forceps and attempt to detach it loosely from the skin, whereby an appreciable, though of course weak, resistance is perceived before it lets go its hold with the head; we expect to see a protruding haustellum, but there is nothing to be observed*. We then leave the animal to its own devices, and it at once resumes the former position. Quite a new spectacle then presents itself.

---

discrimination between the two species, to take into consideration the sexual differences, which are not inconsiderable, and which are not quite the same in both species. Burmeister says that the legs are slenderer in *P. vestimenti*, and attempts to illustrate this difference by means of Nitzsch's figures; but I cannot discover it in the animals themselves; nor does it appear to me correct to describe the second joint of the antennæ as elongated in *P. vestimenti*, although I grant that the first two joints seem to be a little longer in that species than in *P. capitis*; but if these small differences are to be of use, the two species must be defined with far greater accuracy than hitherto.

* Swammerdam speaks of similar attempts with the same result. "But my object was to see the haustellum so much the clearer when I removed the louse from its place, in which, however, I never succeeded; so that at times I almost wished I had been able to use three hands, in order to investigate this more accurately, though there are several kinds of dissections and investigations which do not admit of a second person being present, which, besides, distracts the attention." (Biblia Nat. i. p. 79, quoted by the author in Dutch, but translated for the convenience of the English reader.)

At the top of the head, under the transparent skin, between and a little in advance of the eyes, a triangular blood-red point appears, which is in continual movement, expansion and contraction alternating with increasing rapidity. Soon this pulsation becomes so rapid that several contractions may be counted in a second. However, we must turn our attention elsewhere; for the whole digestive tube is now in the most lively peristaltic movement, filling itself rapidly with blood, as is easily observed; the long œsophagus is particularly agitated, throwing itself from one side to another inside the neck, bending itself so violently as to remind one of the coiling of a rope when being shipped on deck. We seize our most delicate scissors, and, without touching any other part of the animal or displacing the head in the least, the latter is divided by a transverse cut just in front of the eyes. The fore part of the head is still firmly attached to the skin, but is now slowly and cautiously taken away with the forceps and placed under the microscope. And now * we perceive a short, dark-brown, protruding haustellum, provided with hooks at its extremity, out of which an excessively delicate membranaceous tube, of varying length, is hanging. We naturally wish to use a higher magnifying-power, and cover the preparation with a thin glass; but in a moment all the protruding parts disappear, and we have the old image with "mandibles" and "palpi." Repeated attempts prove equally fruitless; the slightest pressure chases everything back into the head again. But we are evidently on the right scent. We choose for dissection the largest, for examination with the microscope by transmitted light the smallest and lightest specimens, whose skin is most transparent; we alternate with fresh specimens such as have been for some time preserved in spirit of wine, and at last we arrive at some certain knowledge of the whole mechanism.

The muscles inside the head appear to belong to four divisions. That those of the neck are very strong cannot surprise us, as we witnessed how the animal bent its head downwards so as to form an angle with the thorax, and kept it in that position during the whole act of suction; but neither these muscles nor those belonging to the antennæ concern us here. So much the greater attention must we bestow on the two other groups of muscles, viz. a large conical bundle filling up the greater part of that section of the head which is in front of the insertion of the

* Swammerdam warns us, at the beginning of his description of the mouth, against foregone conclusions: "But this proboscis is, on account of its diminutive size, not to be demonstrated except with great painstaking, and it is perhaps nothing but a piece of good luck if one succeeds in seeing it." (Bibl. Nat. i. p. 74.)

antennæ, and behind this, nearly in the centre of the head, a number of small, short muscles radiating in all directions.

This star of muscles belongs evidently to the little organ which was seen in such violent pulsation whilst the animal was sucking; and we have without doubt here met with a "*pumping-ventricle*"—that is, one of that kind of organizations of the swallow which have long ago been discovered in Araneæ and Tardigradi, and which, no doubt, are of frequent occurrence in Arthropoda living by suction. I have discovered them myself in those coleopterous larvæ which have powerful organs for biting, placed at a distance round a very minute mouth-opening, such as the larvæ of Carabi, Hydrophili, and Histri—as well as in the larvæ of Dytisci, which suck through the mandibles. Nor can we escape the supposition that an organ of which the function mechanically so much resembles that of a heart, must also in essential points be so far constructed like a heart, and consequently possess valves calculated to force the current of blood the right way. But we shall hardly succeed in clearing up this point with sufficient certainty with our present means of inquiry, because the diminutive size of the ventricle and its recondite position, deeply imbedded in a mass of muscles in the centre of the head, render a dissection a matter of very doubtful success, whilst the immense rapidity of the pulsation renders the observation during the suction unreliable—the thickness of the overlying parts at the same time preventing the use of very strong magnifying-powers. And thus we are compelled still to acknowledge the truth of the venerable Leeuwenhoek's words: "Præterea pro certo habentes adhuc millenas in capite pediculi esse res, quæ oculos nostros semper latebunt." (Arcana Naturæ, Epist. 77. p. 388, Jan. 1694.)

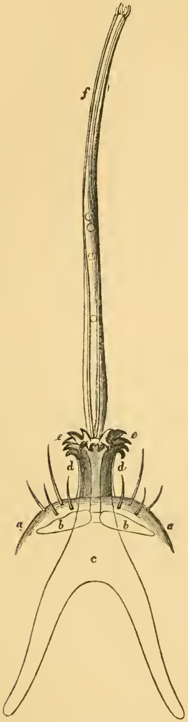
In the centre of the large conical bundle of muscles there is a set of slender chitinous organs, which at their roots are all bent to the sides, evidently in order to offer favourable points of insertion to the muscles by which it is to be protruded; for it is evident that these organs must be pushed forwards out of the head, at the contraction of those muscles which are fixed between their outwardly bent extremities and the part of the skull which is in front of them. And thus we can understand why the protruded organs of the mouth disappeared the moment a pressure from without was exercised on the head; for it is evident that the greater the pressure the more was that force paralyzed which kept these organs in their protruded position. But at the same time it will be understood that, whilst this arrangement renders it impossible to press the organs of the mouth out through the opening of the mouth, it renders it at the same time easy to pull them from behind out of the muscular bundle in which they are imbedded.

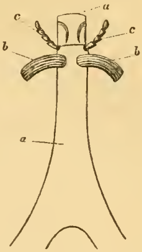
I have hitherto conducted this investigation as slowly and as cautiously as I thought necessary in a matter so difficult, complicated, and so disputed; but I think we have now arrived at a point from which we may without danger hasten more resolutely to the conclusion. In order to render my account as clear and perspicuous as possible, I shall in the sequel apply to all the different parts of the mouth those names which, from a morphological point of view, belong to them, forming as they do, in my opinion, a somewhat modified but nevertheless unmistakeable and complete mouth of the Rhynchote type.

Lice are no doubt to be regarded as *Bugs** simplified in structure and lowered in animal life in accordance with their mode of living as parasites, small, flattened, apterous, myopic, crawling and climbing, with a conical head, moulded as it were to suit the rugosities of the surface they inhabit, provided with a soft, transversely furrowed skin, probably endowed with an acute sense of feeling, which can guide them in that twilight in which their mode of life places them. The peculiar attenuation of the head in front of the antennæ at once suggests to the practised eye the existence of a mouth adapted for suction. This mouth differs from that of *Rhynchota* generally in the circumstance that the labium is capable of being retracted into the upper part of the head, which therefore presents a little fold which is extended when the labium is protruded. In order to strengthen this part, a flat band of chitine is placed on the under surface, just as the shoemaker puts a small piece of gutta-percha into the back of an india-rubber shoe; as, however, the chitine is not very elastic, this band is rather thinner in the middle, in order that it may bend and fold a little when the skin is not extended by the lower lip. The latter consists, as usual, of two hard lateral pieces, of which the fore ends are united by a membrane so that they form a tube, of which the interior covering is a continuation of the elastic membrane in the top of the head; inside its orifice there is a number of small hooks, which assume different positions according to the degree of protrusion: if this is at its highest point the orifice is turned inside out, like a collar, whereby the small hooks are directed backwards, so that they can serve as barbs. These are the movements which the animal executes after having first inserted the labium through a sweat-pore. When the hooks have got a firm hold, the first pair of setæ (the

* Many naturalists, although free from the error that the so-called habitus, without any further examination of its character and origin in every case, is of any weight in such systematic questions as the one before us, nevertheless hesitate when it seems to be left quite out of sight. I may remind such of *Aradus* and similar genera, in order to show that not even is habitus violated by ranking *Pediculini* amongst Bugs.

real mandibles transformed) are protruded; these are, towards their points, united by a membrane so as to form a closed tube, from





The larger figure represents the parts of the mouth, in a large specimen of *Pediculus vestimenti*, entirely protruding, and seen from above, magnified 160 times: *a a*, the summit of the head, with four bristles on each side; *b b*, the chitinous band, and *c* the hind part of the lower lip—such as they appear through the skin by strong transmitted light; *d d*, the foremost protruding part of the lower lip (the haustellum); *e e*, the hooks turned outwards; *f*, the inner tube of suction, slightly bent and twisted; the two pairs of jaws are perceived on the outside as thin lines; a few blood-globules are seen in the interior of the tube.

The smaller figure is a repetition of Erichson and Simon's figure of the organs of the mouth in *P. capitis*: *a*, the haustellum; *b*, the maudibles; *c*, the palpi. ('Die Hautkrankheiten,' tab. 7. fig. 4.)

which, again, is exserted* the second pair of setæ or maxillæ, which

* It will scarcely be possible to ascertain the details of the protruding mechanism by examination of the human species alone, as the parts are too small in these species. I had therefore wished to compare living specimens of the larger species inhabiting our domestic animals, particularly the horse and the pig; but I have been unable to obtain any at present. Very likely the mechanism may prove rather complicated. Without intending a close comparison, I shall here only, as an instance, advert to the exceedingly remarkable mechanism discovered by Lyonnet in *Melophagus ovinus*. (See his posthumous papers in the 'Mémoires du Mus. d'Hist. Nat.' tome xviii. p. 233, pl. 9.)

in the same manner are transformed into a tube ending in four small lobes placed crosswise. It follows that when the whole instrument is exserted, we perceive a long membranaceous flexible tube hanging down from the labium, and along the walls of this tube the setiform mandibles and maxillæ, in the shape of long narrow bands of chitine. In this way the tube of suction can be made longer or shorter as required, and easily adjusted to the thickness of the skin in the particular place where the animal is sucking, whereby access to the capillary system is secured at any part of the body. It is apparent, from the whole structure of the instrument, that it is by no means calculated on being used as a *sting*, but is rather to be compared to a delicate elastic probe, in the use of which the terminal lobes probably serve as feelers. As soon as the capillary system is reached the blood will at once ascend into the narrow tube, after which the current is continued with increasing rapidity by means of the pulsation of the pumping-ventricle and the powerful peristaltic movement of the digestive tube.

We can now easily explain what it is that Erichson, Simon, and Landois have mistaken for mandibles and palpi. When the labium is pressed down against the chitinous band above mentioned, it touches and covers precisely the thinnest middle part of it, whilst the firmer lateral parts of the band by the pressure become further removed from each other, or even entirely separated if the pressure is increased, and thus they assume the appearance which led to their being misinterpreted as mandibles. It is furthermore evident that the barbs of the labium must assume many different positions, according to whether the elastic part on which they are fixed is more or less protruding from or retracted into the head, or more or less unfolded or contracted in itself. When the labium only just peeps out of the head, a greater or smaller number of hooks may become visible in front of it, and then we have the image represented on Dr. Landois's figure of the mouth in *Phthirius inguinalis*. But if the elastic part of the labium be folded up and entirely retracted in the head, the hooks will show themselves, by pressure and transmitted light, generally forming an irregular heap, but sometimes more regularly grouped, and even placed in an oblique line on one or the other side of the middle field, though never quite symmetrically on both. It is such an accidental linear arrangement of the hooks that has been interpreted by Erichson and Simon as palpi.

How easily one may get upon a wrong scent by neglecting the study of the living animal, we can also learn from the statements of Burmeister, though he has come much nearer to the real truth. He founded his conclusions merely on dissection of the swine-louse, which certainly is much larger and stronger-built than the human species; and his result may be gathered from the following passage towards the conclusion of his treatise:—

"According to these statements, the louse must go through four quite different acts when feeding through its haustellum. First, it must protrude the fleshy cone provided with hooks, and fix the hooks in the skin. This done, the second step is to push the horny semitube with the setæ so far forward in the interior of the head as is necessary to let the more delicate sting appear outside the orifice of the fleshy cone. This act of protrusion is continued until the sting has reached the tissue containing blood, whereupon the inner tube, thirdly, acts as a drill and at the same time, moving forwards and backwards, causes the ascent of the blood, if not by suction, certainly by capillary attraction. The fourth act is the peristaltic movement of the œsophagus, which keeps up the current of blood, and despatches further into the body the quantity of blood received into the œsophagus. This movement is that rhythmic pulsation which Swammerdam has compared to a pendulum."—*Linn. Entom.* vol. ii. pp. 581, 582.

As the solid part of the labium, even by pressure, very easily detaches itself from the soft producible part on which the barbs are fixed, it is not surprising that they should have separated during the dissection without Burmeister observing it. Thus it escaped his attention that they belong one to another, and the inner part of the labium became to him an independent horny semitube. But thereby he lost the right way out of the old error (caused in some measure by the misunderstanding of a certain passage in Swammerdam) of a soft proboscis capable of protrusion—a vagina mollis, as Nitzsch says, or a "fleshy cone," as Burmeister expresses himself. This circumstance, finally, prevented him from perceiving the conformity of this structure of mouth with that prevailing amongst Rhynchota; nay, he does not even attempt to refer it to any known type of mouth, nor could such an attempt be successful as long as the imaginary "fleshy cone" had not been disposed of. Burmeister's statements concerning the structure of the inner tube agree tolerably well with my own; some smaller differences may with probability be explained as arising from the more considerable size and powerful structure of the swine-louse; they would at any rate agree very well with the differences between the skin of man and that of swine. His hypothesis concerning the use of the tube during suction, which he conjectures to be partly to act as a drill and partly as the brake of a pump, if closely examined cannot be pronounced free from confusion and self-contradiction; but it must in any case be remembered that that author, as indeed he expressly states in another part of his treatise, never witnessed the conduct of the animal during suction; consequently he could not know anything from his own experience concerning the organ which plays the principal part in that act. But he might have learned it from Swammerdam; for it is precisely the pumping-ventricle, and not the œsophagus, which Swammerdam accurately describes*, comparing its movement to that of the balance in a watch, in the place alluded to by Burmeister.

If, in conclusion, we now read Swammerdam's treatise with a little attention, we shall find that his investigation, as far as it goes, is not less ingenious and faultless here than elsewhere in his incomparable work; nor is the description less full, perspicuous, and vivid, nor less rich in pointed expressions and happy comparisons, written as it is in that *naïve* and communicative style which even a whole century later was still characteristic of many excellent observers of natural history. Of course one ought not to content one's self with the Latin translation, but study the Dutch original—an undertaking which at any rate to a Dane has no difficulty, and which he least of all could wish to evade.

XXV.—*On the Tubulation of the Valves of* Rhynchopora Geinitziana, *De Verneuil.* By Professor W. King.

In my former papers on *Rhynchopora Geinitziana*, I have described and inferred its histological character from surface-observations made with a Coddington lens†. But objections having been taken to a hand magnifier as possessing too low a power to settle unequivocally the question whether the above-named Permian fossil is, as I have all along maintained‡, characterized by tubes passing completely through its valves, I have felt it necessary to

* "Whenever the louse is busy sucking, we see a small current of blood just behind the sting (tab. 2. fig. 3 *u*), which shines through the head. Between and in front of the eyes, in the middle of the head, we perceive a tolerably large dilatation (*x*); so that the swallow, through the constantly ascending blood, in that place is appreciably distended. And then these parts contract themselves again so quickly that one scarcely sees any more blood. And this works so rapidly that one can hardly distinguish the expansion from the contraction: so that I cannot compare it to anything better than to the quick movement of the balance in a watch. Behind the eyes in the head, we see nothing but a similar diminutive current of blood pass through; and this passage is, in my opinion, properly the gullet (*f*), which follows the swallow, and which is again dilated in the neck of the louse, as shown in the drawing (*g*). And all this I have intentionally figured as a continued tube, in order that my description might be the clearer."—*Bibl. Nat.* i. p. 79.

† Through a misunderstanding, I have hitherto called this magnifier a "Stanhope lens."

‡ See Ann. & Mag. Nat. Hist. ser. 2. vol. xvii. p. 334, &c., ser. 3. vol. xvi. p. 124, &c.; Reader, No. 138, August 19, 1865.

make additional observations on some specimens from Gera, with one of Smith and Beck's highest-class binocular microscopes, for the use of which I am indebted to its owner, Dr. Rowney. I shall now relate the results of my last investigations.

In order to ensure an examination of the entire thickness of the valves, I operated on specimens partially imbedded in their matrix, which is siliceo-calcareous and granular.

Figure 1 represents a polished medio-longitudinal section of one of these specimens, about thrice its natural size. The interior is filled with calcite. The letter *a* refers to the matrix, which adheres to a considerable portion of the perforate valve. In this case, there can be no doubt that the extraneous mineral matter covers the original outer surface of the fossil. At the umbonal region, *b*, the external layers of the test are not present, having got detached along with the matrix before the specimen came into my hands: the surface exposed at this part, as well as that of the imperforate valve, displays numerous dark-coloured spots, resembling those resulting from tubulation in many Palliobranchs, particularly the Carboniferous *Spiriferina octoplicata,* in which, however, they are larger.

Fig. 1.

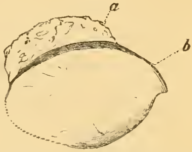


Figure 2 represents a portion, from below the letter *a*, of the last section, as seen under a magnifying power of 120. Two of the tubes are insufficient for our purpose, having been broken short of their length by the removal of the outer layers and matrix; but the next one is conclusive, as it passes completely through the valve. The fourth or adjoining tube does not appear to reach the exterior.

Fig. 2.

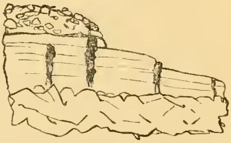


Figure 3 represents a portion of a similar longitudinal section, as seen under the same power. It shows two tubes traversing the thickness of the valve to the *outer surface,* and a third one apparently passing to within a very short distance of it. I strongly suspect that the last tube, as well as the "fourth" in fig 2, is not in reality any shorter than the others, because precisely where it appears to terminate the test loses its semitransparency (brought out by the

Fig. 3.

polishing) and becomes opaque: and there are strong indications that it sinks under this part, and consequently passes below the plane of the section, thus becoming intercepted or getting beyond the range of vision. Although this figure shows the tubes to increase in width as they approach the outer surface, I have no doubt that the appearance is caused by their axis not being parallel to the plane of section, or, in other terms, by the section cutting them obliquely. A similar appearance would be presented by a vertical section in which the tubes do not lie perpendicular to the surface of the valves. The middle tube is a case somewhat in point; and it is valuable in another respect, inasmuch as it shows, what *might have been readily conceived,* that vertical sections may be obtained in which *the tubes deviate from the plane of section,* presenting, in consequence, *an appearance as if they terminated before reaching the exterior.*

From what I have observed in other sections—longitudinal, transverse, and tangential—of *Rhynchopora Geinitziana,* it seems to be difficult to obtain one showing a number of tubes closely associated and passing through the entire thickness of the valves; at least, I have only seen from one to three—never more—cut by the plane of a single section*. This circumstance is to some extent accounted for by the occasional, perhaps general, inclination of the tubes†, also by the fact that, with rare exceptions, they are irregularly arranged: a quincunx or linear arrangement, a tendency to which has only once occurred to me, would, it is evident, bring a greater number into view. The incomplete infilling of the tubes, noticed presently, furthermore explains their rareness in the sections I have examined.

In my last paper in the 'Annals,' August 1865, p. 125, it is stated that "I am disposed to regard the dark colour of the tubes as due to the carbonaceous residuum of the membrane with which they were originally occupied." Recent observations, made with a power of 210, show, however, that what were taken for the remains of organic matter are aggregations of cubical crystals of pyrites.

It has also occurred to me that the tubes are often either faintly indicated, or rarely completely filled with pyrites, as most of them contain only here and there, throughout their length, separated clusters of crystals, while their remaining portion appears to have an infilling similar to the calcareous substance now composing the test. Hence, evidently, is explained the existence,

* Owing to the semitransparency of the test, the binocular occasionally discloses other tubes *reaching the surface* below the plane of section.

† This inclination is displayed in other sections that I have made of the present species; and it is well known to be frequent in other Palliobranchs.

mentioned in my last communication, of specimens showing little or no appearance of a tubular structure on their exterior.

In conclusion, if the surface-observations which I have hitherto brought under the notice of palæontologists have not been deemed sufficient to show that the valves of *Rhynchopora Geinitziana* are tubulated through and through, like those of species belonging to nearly every family of the *Palliobranchiata*, it is to be hoped that the clear evidence adduced in the present paper will be accepted as entirely removing all doubts on the matter.

Belmont, near Galway.
Feb. 14, 1866.

BIBLIOGRAPHICAL NOTICE.

Catalogue of the Coleopterous Insects of the Canaries in the Collection of the British Museum. By T. Vernon Wollaston, M.A., F.L.S. Printed by order of the Trustees. London, 1864. 8vo, pp. xiii & 648.

Coleoptera Atlantidum, being an enumeration of the Coleopterous Insects of the Madeiras, Salvages, and Canaries. By T. Vernon Wollaston, M.A., F.L.S. London: Van Voorst, 1865. pp. xlvii, 526, & 140.

Whether we are to regard the ancient traditions of an Atlantis as pure fables, or as springing from some germ of truth, there can be no doubt that its scattered islands, as the last relics of a great submerged continent, must ever be looked upon with interest by the naturalist. We cannot tell whether their summits were gazed upon by men when this country was under an icy sea and the reindeer wandered over Southern France, which would probably carry back the time

"When first Madeira trembled to a kiss"

to a period considerably earlier than that ascribed to this remarkable phenomenon by the Rev. Mr. Bowles; but we may justly regard the animal inhabitants of these islands as representatives, perhaps somewhat changed, of the great fauna of the lands now forming the sea-bottom of the Atlantic, crowded together upon the highest points to which they had access, and looking out, Deucalion-like, over the flood that has destroyed the home of their progenitors.

Looked at in this light, a sort of dramatic interest seems to surround these dwellers in the islands of the sea—an interest, however, which cannot but heighten our curiosity to know as much as possible about them; whilst at the same time the data to be obtained from their study, in connexion with the great question of the origin of species, are of such importance that their careful investigation must be considered one of the greatest services that can be rendered to philosophical zoology.

Already some of these islands had received a portion of the attention which they deserve, although the 'Histoire Naturelle des îles Canaries' of Webb and Berthelot cannot be looked upon as a very satisfactory performance, and it has been reserved for an English naturalist to appreciate the whole interest attaching to a thorough examination of the fauna of the Atlantic islands, and to devote himself with almost unexampled zeal to the task of investigating at least the most considerable portion of their terrestrial inhabitants, the Insects. For more than eighteen years (for his first visit to Madeira dates back to 1847) Mr. Wollaston has been engaged in a most careful study of the islands of the Madeiran and Canarian groups, resulting in an enormous addition to the number of known species of Insects; and his published works on the Coleoptera of these islands, the titles of the two latest of which stand at the head of this notice, must be regarded as among the most valuable additions to entomological literature ever made in this country.

The history of these publications is as follows:—In 1854, after three prolonged visits to Madeira, Mr. Wollaston published his 'Insecta Maderensia,' a magnificent quarto volume containing descriptions of all the Coleoptera known to inhabit Madeira, and illustrated by a series of beautiful plates. This was supplemented, in 1857, by a 'Catalogue of Madeiran Coleoptera,' published by the Trustees of the British Museum, and containing such additions as had been made to the list of Madeiran Beetles during the previous three years. The desirability of an examination of the Canary Islands then suggested itself to Mr. Wollaston, who subsequently spent two periods of more than six months each in those islands, and, collecting with his accustomed assiduity and success, brought home a mass of materials which showed the complete absurdity of the meagre list of Canarian Coleoptera given by Brullé in the great work of Webb and Berthelot. The elaboration of this material was the origin of the 'Catalogue of Canarian Coleoptera,' published in 1864 by the authorities of the British Museum, Mr. Wollaston's collections having been deposited in that establishment. But while this was in preparation, several entomologists, including two of our best British Coleopterists, the Messrs. Crotch, were engaged in collecting in the Canaries; and among the immense number of specimens obtained by them, a good many species were found which had not previously been detected. These were handed over to Mr. Wollaston for examination; and their elaboration has led to the publication of the second work indicated at the head of this article, the 'Coleoptera Atlantidum,' which contains a complete synonymic catalogue, with observations upon known, and descriptions of new species, of the members of the order Coleoptera hitherto discovered in the three northern groups of Atlantic islands—the Madeiras, Salvages, and Canaries.

When we come to examine the results of all this indefatigable work, both in the field and in the closet, we find that they are fully commensurate with the labour that their attainment has cost. M. Brullé, in the great French work above-mentioned, gives a list of only 179 species of beetles from the Canaries; and even some of these are considered by Mr. Wollaston, on apparently good grounds, not to belong to these islands at all. In his 'Catalogue of Canarian Coleoptera,' Mr. Wollaston raises this number to 930, which is enlarged in the 'Coleoptera Atlantidum' to 1007, by the addition of 77 newly detected forms. The Madeiran Islands and the Salvages may be regarded as having been virgin ground up to the time of our author's first researches in Madeira; by his own investigations, and those of others induced by his success, he has brought the number of described species from the former to 661; whilst the Salvages, consisting of bare storm-beaten rocks, have furnished 24 species, 13 of which are peculiar to them.

The total number of species of Coleoptera recorded by Mr. Wollaston as occurring in all the groups is 1449, of which 1234 have been captured by himself, whilst 935 were first described by him. The species belong to 423 genera, 82 of which were first characterized by the author. Out of this whole number a good many are of course common to the islands and various parts of Europe and Northern Africa; and when these are deducted we find that about 700, or nearly half the species, may be regarded as being what Mr. Wollaston terms "ultra indigenous," the positive autochthones of the soil. Singularly enough, when we consider the general faunal resemblance running through the Coleoptera of the whole archipelago, the entire number of species common to the Madeiras and Canaries is only 238; and of these 38 may be deducted as having been in all probability introduced by commerce, thus leaving only 200 presumably indigenous species common to the two groups. The generally European character of the forms met with is also remarkable; for, except in the two easternmost of the Canaries (Lanzarote and Fuerteventura), nothing of a truly African element is to be detected, the species and types not peculiar to the islands being either European or "Mediterranean" forms.

Mr. Wollaston dwells particularly, in the comparison of the Coleopterous fauna of the Atlantides and the nearest mainland, upon the circumstance that several of the Atlantic forms differ from their nearest continental allies by very minute characters, the permanence of which constitutes their claim to specific distinction, whilst their small importance seems almost to lead to the surmise that the so-called species may be only what Mr. Wollaston calls "local phases" of European species. Similarly several forms are indicated as differing in the same degree in the Canaries and Madeira, or even in different islands of the former group, as will be easily seen by reference to Mr. Wollaston's "Index Topographicus," where the supposed possible original species are pointed out by an arrow. Mr. Wollaston, in fact, seems to regard these forms as of the same nature as those denominated "phytophagic races" and "phytophagic species" by Walsh, although he is far from adopting the evolutional doctrines supported by that author, and maintains strongly the essential existence and *limited* variability of species. The author's remarks upon this interesting subject (Coleoptera Atlantidum, Introduction, pp. xxxviii–xlvi) are of much importance, and will well repay perusal. Nevertheless it does appear to us that we have here an example of gradually increasing segregation, probably extending over a very long period of time, with change of external conditions, resulting, at all events in some cases (if Mr. Wollaston's notion of these derivative species be correct), in the production of forms differing by slight characters from the original type. The Darwinist will say that the other forms, the specific rank of which, according to Mr. Wollaston, is not doubtful, have probably required and undergone a greater amount of modification to fit them for their altered conditions of existence. Under any circumstances, it seems to us that the insect fauna of the Atlantic islands furnishes naturally almost an experimental realization of the conditions necessary for the origin of species by evolution from preexisting types; and a good naturalist, without theoretical bias (if such a being can be found), might certainly do much towards the settlement of this *quæstio vexata* by a careful investigation of the 'Coleoptera Atlantidum,' under Mr. Wollaston's guidance. In connexion with this, the curious facts presented by the study of the dominant forms of Beetles in these islands (adverted to by the author in Col. Atlant. xxii–xxv) will be of particular importance.

This notice has already extended to such a length, that several points to which we might otherwise have referred must be passed in silence. We may, however, state in general terms that the whole introduction to the 'Coleoptera Atlantidum,' extending to 47 pages, is replete with interesting observations and remarks, and gives an increased significance to the systematic portion of the work. Both the 'Catalogue of Canarian Coleoptera' and the 'Coleoptera Atlantidum' contain descriptions of a great number of species: in the former work these are introduced in their places in the Catalogue; in the latter they are given in an Appendix, and only referred to in the body of the work. Both contain excellent topographical indexes,—that in the 'Catalogue' showing the species inhabiting the various islands of the Canarian group, whilst that appended to the 'Coleoptera Atlantidum' exhibits only the faunal relations of the three groups of islands. The latter work is illustrated with an outline map.

Thus in the two volumes now before us, and in his 'Insecta Maderensia,' Mr. Wollaston has fulfilled one of the highest tasks of the zoologist: he has worked out, in an almost exhaustive manner, the members of an extensive group of animals inhabiting a well-defined area; and having aimed at perfection in his work, it must be confessed that he has perhaps attained it as nearly as is possible to man. We can only hope that his present visit to the more southern islands of the Atlantic may lead to equally valuable results—a hope in which all entomologists will certainly agree with us.

MISCELLANEOUS.

Naturalization of Zosterops dorsalis *in New Zealand.* By Dr. J. E. Gray, F.R.S. &c.

Mr. Richard Taylor has sent to the British Museum a specimen of *Zosterops dorsalis*, with the following notes:—"A singular little bird, which has lately made its appearance in Wanganaui, New Zealand, and now abounds. It appears to be migratory, and, I fancy, is originally from Tasmania. Mr. Butler, an enthusiastic ornithologist, thinks it belongs to the south end of the middle island; but I was assured last summer, when visiting Dunedin, that it was equally a stranger there. I fancy, therefore, that he is mistaken. The bird bids fair to prove a blessing, by arresting the rapid progress of the American blight, which is destroying all our apple-trees. It stays the winter with us, and, we suppose, passes the summer at Taupo."

The Boar Fish (Capros aper).

A fine specimen of this fish was taken on the 24th of January, near Swanage, on the coast of Dorsetshire. The colour is very brilliant when alive. The specimen has been presented to the British Museum by the Rev. J. M. Colson.—J. E. G.

On the Occurrence of Paludicella Ehrenbergi *in Shropshire.*

To the Editors of the Annals of Natural History.

Gentlemen,—I have lately discovered the very interesting freshwater Polyzoon *Paludicella Ehrenbergi* in the Shropshire Union Canal near my house. It is the first time I have met with this species, though I have been on the look-out for some years. Allman remarks that this Polyzoon is very widely distributed, and says he can scarcely account for its having so long escaped notice, except by supposing that its resemblance to some of the Confervoid Algæ caused it to be overlooked. *Paludicella* is certainly, as the above-named naturalist observes, "a very timid little animal, and a specimen may be for hours under observation before the polypides will venture to issue from their cells, and then it is often for only a few seconds at a time that they will continue visible."

I may here remark that the most successful method of procuring freshwater Polyzoa, according to my own experience, is to hunt for the characteristic statoblasts (which may in most cases be found in great numbers at the surface of the water in winter and spring), and to take a supply of this water, with aquatic weeds, and place all together in a glass vessel, which should be kept in subdued light in a moderately warm room. The statoblasts will soon germinate and afford specimens for examination. In this way I have obtained young specimens of *Cristatella* and various species of *Plumatella*. Indeed the naturalist will find it well worth his while to take at random a can of water and a handful of freshwater weeds at any time during the open weather in winter, and to keep a glass vessel or two of this water and weed in his sitting-room for a few weeks. He will be rewarded by discovering rare forms of minute aquatic life. On examining a vessel of water brought from the canal, I discovered, in about a fortnight's time, the rare and beautiful *Stephanoceros*, several *Melicertæ*, *Paludicella* and young *Cristatellæ*. *Paludicella*, like *Fredericella*, is an exception to the rest of the family, being perennial.

I remain, Gentlemen,
Yours sincerely,
W. Houghton.

General Considerations on the Circulation of the lower Animals. By M. Lacaze-Duthiers.

It is difficult to take up and irritate any mollusk, such as a snail or slug, but especially a marine mollusk, without observing that the animal, affected by the violent contractions caused in it by the instinct of self-preservation, allows to flow from its body a liquid often sufficiently abundant to moisten and bathe the hands of the observer. What is this liquid? whence does it come? how does it escape?

It may be asserted that there exist a great number of animals of low organization, which, for purposes sometimes unkown, but often appreciable, deprive themselves, by bleeding, of a great part of the liquids of their economy. But it must be remarked that the same things do not take place in all groups, and that, to obtain an exact notion of the circulation in the lowest divisions of the animal kingdom, it is necessary to take our examples at once from the Mollusca, the Annulata, and the Zoophytes.

In the first place, with regard to the Mollusca, positive facts now prove, beyond the least doubt, that there is a communication between their circulatory apparatus and the exterior world. MM. Langer and Gegenbaur have seen this in a Lamellibranch and in some Pteropoda; and I believe the former has demonstrated the existence of perfectly definite external orifices of the apparatus of circulation, serving for the issue of the blood or for the entrance of water, in the Gasteropoda, which are comparatively very high in the scale of Mollusca.

The importance of such an arrangement will be understood without difficulty, and it will be seen how necessary it is to take it into account in studying the nutrition of these animals. We can hardly, therefore, bring too many proofs in support of the demonstration of a fact so unprecedented and so little in accordance with what we observe in the higher animals.

The new observations which I have the honour to present to the Academy are not isolated; they are related to an *ensemble* of zoological researches upon the Gephyrea, Zoophytes, and Mollusca which I have pursued for a long time; they were made at Cette in the months of August and September last.

If the existence of external orifices of the apparatus of circulation in the Mollusca does not appear to be doubtful, it is nevertheless very difficult to ascertain. *Thetys leporina* of the Mediterranean, the history of which possesses so much interest in various ways, presents the most remarkable organic arrangements from the point of view which now occupies us.

It bears on its back, placed symmetrically on each side, from fourteen to twenty pairs of branchiæ, elegantly twisted into a spiral, between which may be observed an oval pit of a more delicate texture and more transparent than the rest of the integument of the body, upon the middle of which there rises a small mamilla pierced by an orifice like a button-hole.

If the extremity of the pipe of a syringe be applied to this orifice, and an injection be made with much care, so as to avoid injury and consequently all causes of error, the coloured liquids or air employed are soon seen filling the venous system. If the animals are in favourable conditions, the veins may even be injected merely by directing the stream of coloured liquid from a distance upon the mamilla of the oval interbranchial fossa.

The *Thetys* bearing, as we have just seen, from fourteen to twenty pairs of branchiæ on each side of the body, may therefore at pleasure introduce water into its blood, or get rid of a portion of this nutritive fluid, in front, behind, or towards the middle of its length, by means of from twenty-eight to forty orifices. Hence, when we take up this animal well expanded and developed, can we be astonished to see it, in the hands which it inundates with fluid, change its form, retract itself, and gradually lose more than one-third of its volume? It is sufficient, however, to consider this in order to understand that, if the animal could not reject a portion of the liquids which impregnate its tissues like the water imbibed by a sponge, it would be impossible for it to diminish its volume.

In *Thetys leporina*, as in all the naked Mollusca the observation of which is easy, effects may be produced by irritation which it is very useful to study. When a part of their body is touched, it is seen, under the influence of irritation, to contract and return upon itself, driving off the liquid lodged in the meshes of its tissues, and causing the dilatation or inflation of some other part. If the latter be irritated, the same thing takes place, it contracts in its turn; and by multiplying the points of contact, the blood, being driven in all directions, and no longer finding any place in the economy, is forced to escape outwards: if orifices exist, it is through them that it issues; and if these orifices are insufficient, it ruptures the tissues in order to make a passage for itself. Direct observation can leave no doubt upon this latter fact.

But when the issue of the blood is not violent, but natural, it is subjected to a veritable appreciation on the part of the animal. Of this the organization of the orifices furnishes a proof. In *Dentalium* and *Pleurobranchus* I have described two muscles and a valve which oppose the escape of the blood when the animal does not consider it desirable. Here a muscle with circular fibres forms a sphincter sufficiently developed to produce the mamilla of the oval fossa. It is indeed this sphincter, which is usually much contracted, that retains the liquids injected into the nervous system, and renders the detection of the orifices very difficult, causing us still to be ignorant of their position in most species.

In studying in detail the nervous system of *Thetys*, I have ascertained that two very distinct and comparatively very large nerves pass to each of the sphincters of the orifices, and that sometimes, before penetrating into the muscle, they even become inflated into a very small centre or nervous ganglion. I should add that these nerves have their origin from the central parts of the nervous system of the life of relation, and not from the great sympathetic.

From this anatomical arrangement we must evidently think that the opening of the orifices is not effected without a direct influence emanating from the nervous centres, and that the animal certainly appreciates the occasion for the relaxation of the sphincter and the escape or admission of fluids.

But things do not go on in the same way in all the lower animals.

In the Gephyrea, and especially in *Bonellia*, I have shown that one liquid fills the general cavity of the body, and is distinct from a second, contained in proper vessels. The former can be poured out by the orifices of reproduction and by the terminal cups of the renal glands, which present a very curious arrangement. Imagine a racemose gland of which all the grains or *acini* are terminated, not as in ordinary glands, cæcally, but by elegant cups or urns, covered with vibratile cilia causing currents from the outside to the inside of the gland through a little canal,—imagine, besides, the kidney floating in the midst of the general cavity of the body, giving it a portion of the elements of the secretion, and on the other hand taking from it directly, by means of its vibratile cilia, a portion which it rejects outwardly,—and we shall have an idea of the very remarkable renal apparatus of *Bonellia*.

In no other animal belonging to a high order of the animal series has there been described a similar organ effecting direct depuration by motory organs, and independent of any physiological act of secretion properly so called.

In the Cœlenterate Zoophytes, again, things take place differently. The liquids which circulate in the innumerable canals hollowed out in the sarcosoma of these composite animals come directly from the stomach, without the intermediation of absorption. They pass through orifices pierced in the walls of the digestive cavity, and are thus poured directly into the apparatus of circulation ; they may also be rejected by the way through which they penetrated, namely the mouth.

From the preceding facts we may conclude that the conditions under which nutrition is effected in these low animals differ profoundly from those which correspond with the same function in the higher animals ; for the blood of the Mollusca, Gephyrea, and Zoophytes must be very different from that of the Vertebrata, even in consequence of the direct relation which it has with the outer world.—*Comptes Rendus*, December 18th, 1865, pp. 1101–1105.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 100. APRIL 1866.

XXVI.—*On Germination at different Degrees of Constant Temperature.* By M. Alph. de Candolle*.

[Plate IV.]

Two motives gave rise to my undertaking a series of experiments upon germination at different degrees of temperature. First, I desired to continue and complete my earlier experiments upon the duration of the germination and of the germinative power of seeds of different species or families†. I also wished to study in a direct manner, and in regard to a particular function, the effect of time in compensating a low temperature, and that of an elevated temperature in diminishing the amount of time required for one function. It is well known how this problem has engaged the attention of agriculturalists and naturalists for some years; but, in almost all the known facts, there is always an inextricable mixture of several functions considered collectively, either of the influence of light mixed with that of heat, or of temperatures which are continually varying. My aim has been to eliminate all these complications; and if I have been anticipated by a judicious observer, M. F. Burckhardt‡, in some experiments which the perusal of my 'Botanical Geography' appears to have suggested to him, it will be seen that my experiments bear out his, that they apply to a larger number of species submitted to more normal conditions, and that they consequently lead to more extended and more certain conclusions.

* Memoir read at the General Meeting of the Swiss Society of Natural Sciences at Geneva, on August 21, 1865. Translated from the 'Biblioth. Univ. de Genève,' 1865, p. 243.

† "Tables of the duration of the Germination of 863 Species observed in the Botanic Garden of Geneva," by Alph. de Candolle (in the 'Physiologie Végét.' of Aug.-Pyr. de Candolle, vol. ii. pp. 640 & 646).

‡ On the Determination of the Zero of Vegetation (Verhandl. d. Naturforsch. Gesellsch. Basel, 1858, vol. ii. 1. pp. 47–62.

I will first describe my experiments, and afterwards give the results.

§ 1. *Details of the Experiments.*

I first procured the seeds of ten species, in good condition, and belonging to several different families of plants. They were of or below the average size, some suitable for germinating at low temperatures, others requiring heat—at least according to the ordinary modes of culture. I selected three Cruciferæ (*Lepidium sativum, Sinapis alba,* and *Iberis amara*), one of the Polemoniaceæ (*Collomia coccinea*), one of the Linaceæ (*Linum usitatissimum*), one of the Cucurbitaceæ (*Cantaloup Melon*), one of the Ranunculaceæ (*Nigella sativa*), one of the Sesameæ (*Sesamum orientale*), one of the Leguminosæ (*Trifolium repens*), and one of the Graminaceæ (*Zea maïs,* var. *præcox*). Notwithstanding the importance of the last two families, I preferred a single species only of each. The Leguminosæ are well known for their irregular germination. It is not an uncommon circumstance, in the same sowing of the lupine or *Vicia,* to see the seeds sprout up week after week, month after month, and even until the following year, without our being able to account for it*. The Graminaceæ germinate somewhat slowly, and are furnished with an envelope (pericarp) adherent to the grains, which perhaps complicates the physiological phenomena.

After having convinced myself that all my seeds were susceptible of germination, they were deposited in a dry place, where the temperature varied but little, and from which they were removed for each experiment. In each case they were sown upon sand in an earthen vessel, a wooden box, or a glass bottle, according to circumstances. The seeds were laid upon the dry sand, and each sowing, thus prepared, was left for twenty-four hours at least in the medium the mean temperature of which they were to acquire; they were then watered with water of the temperature wished for in the experiment. The first watering was always copious, so that the seeds might be rapidly penetrated by the moisture—a necessary condition for their germination being induced by the temperature and the oxygen. The seeds were covered with a thin layer of sand, but the watering nearly always uncovered them. In fact, I have not remarked any difference in regard to the period of germination between the seeds upon the surface and those which remained covered by a thin layer of

* I formerly pointed out to M. Vilmorin, senior, that *Vicia narbonensis* was a plant which would form excellent forage if its proper cultivation could be carried out. This skilful horticulturist took great trouble, and after having proved the real merits of the species, was compelled to renounce it, because he could not succeed in making the seeds gathered and sown together spring up at the same time.

sand—a proof that uniformity of temperature was preserved in these two positions, in consequence of the favourable arrangement of the experiments.

The determination of the moment at which germination takes place is a delicate point, and to a certain extent arbitrary. The embryo alters within the seed before it appears outside, the radicle elongates more or less quickly, and, according to the species, the young plant shows itself in various ways. I have regarded as the moment of germination, that at which, the spermoderm being ruptured, the radicle begins to escape*.

Several thermometers were at my command, most of them being graduated upon the tube itself. Although they were carefully made, I verified in each case the correction requisite to be made at zero; and for the higher degrees, I compared them at every ten degrees with a very accurate standard thermometer, belonging to the Geneva Society for the construction of philosophical instruments. This thermometer had been verified by M. Louis Soret, by passing a drop of mercury from place to place in the inner column. The principal cause of error arises from the difficulty of determining the fractions of degrees in thermometers constructed of thickish glass, when placed in various positions, and when the eye is not always perpendicular to the tube. I hope, however, that the numbers are accurate to within one-tenth of a degree†.

The object of my experiments being to observe the germination at different but constant temperatures, I had an apparatus constructed under the direction of Professor Thury, which was satisfactory as regards the temperatures near 0°, but which was not found sufficient for the other circumstances. This apparatus consists of a cubical zinc reservoir, 44 centimetres in each dimension, surrounded by sawdust and contained within a large wooden box. The reservoir could be filled with ice or water of a given temperature, and the vessels or bottles containing the seeds could be arranged either in the reservoir or in the sawdust, or even in the compartments of a zinc projection springing from one of the faces of the box. This lateral addition did not answer, because its cavities did not afford fixed conditions of temperature and it occasioned a loss of part of the advantages, in

* M. Burckhardt, in the experiments alluded to above, and with which I was not then acquainted, regarded the moment at which the cotyledons became exposed as the period of germination. This is rather a period of vegetation. It may be of value in the comparison of the same species under different conditions, but it varies greatly in the case of different species, certain embryos remaining for a long time recurved under the surface of the soil or with their cotyledons imprisoned in the remains of the spermoderm.

† The degrees are always those of the Centigrade thermometer.

regard to heat, of the isolation of the reservoir. The box was placed in an arched deep cellar, having no other outlet than a door opening into a vault. The temperature was therefore naturally very steady, at least entirely removed from the influence of daily and even weekly variations.

The temperatures near 0° were maintained with steadiness in the reservoir as long as I wished, by renewing the ice every three days; but in the case of other temperatures, especially from 18° upwards, the apparatus was unsatisfactory. Water at 50° or 55° very rapidly loses its heat; and the apparatus being difficult to move, I gave up its use, preferring to take advantage of the succession of the seasons for placing the sowings sometimes in the cellar, at others in the open air, then in rooms or cupboards where the temperature scarcely varies from day to day, which has allowed me to continue the observations to about somewhat less than 24°; and for the higher degrees, I had recourse to the artificial heat of a lamp.

Temperature of 0°.

Three small vessels to contain the sowings of the seeds were placed in a large glass bottle closed with a cork. This floated in the reservoir of melting ice, without ever entirely emerging or becoming submerged. The temperature of 0° was maintained in the interior of the apparatus with remarkable steadiness. Even when a somewhat larger proportion of ice than usual was allowed to melt, the thermometer immersed in the vessels containing the seeds indicated exactly 0°. Another cylindrical box, made of tin, which floated in the same reservoir and contained some sowings, also retained the temperature of 0° with great steadiness.

The experiment lasted from 4 o'clock on the 7th of March until the same hour on the 11th of April, *i. e.* thirty-five days. The results in the case of ten species are subjoined*.

The following did not germinate at all:—*Collomia, Lepidium, Linum,* maize, the melon, *Nigella, Sesamum, Trifolium,* and *Celosia.*

Two sowings were made of *Trifolium,* one in the vessels contained in the large bottle, the other in the tin box.

The only species which germinated was the *Sinapis,* of which also two sowings were made, one in the bottle, the other in the box. Of the former, some seeds (five out of thirty) germinated from the 23rd to the 25th of March, the mean being the seventeenth day. In the box, in which the sowing only took place on the

* The *Iberis* was not sown in some of my experiments, one of the Amaranthaceæ (*Celosia cristata*) being substituted for it.

evening of the 16th of March, some of the seeds germinated on the 27th in the evening, *i. e.* the eleventh day, and others continued to sprout successively. It is difficult to determine to what this difference of from eleven to seventeen days was owing; for the surrounding temperature was 0° in both cases. I suspected that the seeds in the second sowing were not brought sufficiently near 0° at the moment at which they were placed in the soil, which was of this temperature. They were also but few in number, and too crowded. It may be that the outer temperature had not surrounded them with sufficient rapidity at first, and that, a certain chemical change having ensued, the approximation of the seeds had produced a local heat sufficient to alter the supposed conditions. For these reasons, the result of the first experiment (seventeen days) appears to me to be most probably correct.

At the end of thirty-five days, being obliged to absent myself, I ceased to renew the ice in the apparatus; but the experiment had lasted sufficiently long. And what proves it, was, that at my return nearly a month later, on the 9th of May, I found the vessels in the apparatus at 7°·7, and no other species except the *Sinapis* had germinated. Several might have sprouted at similar temperatures, as we shall see presently; but in such a prolonged experiment they had probably rotted. *Lepidium* and linseed germinate at ordinary temperatures, almost as soon as *Sinapis,* and would certainly have germinated between the seventeenth and the thirty-fifth day of the experiment if the temperature of 0° had not formed an obstacle.

There are probably alpine species which sprout below a temperature of 0°, especially nival species, as *Soldanella* for example. We are advised to sow the seeds of rhododendrons in melting snow, and foresters sometimes sow in the same way the seeds of trees on mountain-slopes. Undoubtedly, in the natural course of things, the rays of the sun between whiles may cause a rise of temperature above 0° at the expense of the water of the snow; but we may believe that, as in the instance of *Sinapis,* certain species germinate whenever water comes into contact with them, even at 0°. On the other hand, according to my experiments, several do not germinate at so low a temperature. It still remains to be determined whether they really cannot germinate, or whether they require so long a time that their tissue usually passes into a state of putrefaction which reaches the embryo.

Temperature of 1°·4 *to* 2°·2.

Four small porous earthen vessels were immersed up to the rim in the sawdust surrounding the reservoir of ice. On the 7th of March, at 4 p.m., the seeds of all the above species, except the melon and *Trifolium repens,* were placed in them. The first would certainly not have sprouted; the second did not then appear to me disposed to germinate with sufficient uniformity to be worth trying. I have since found that it would have been better not to reject it.

The first vessel contained the seeds of *Collomia* and *Celosia*. Its temperature varied but very slightly, from 1°·6 to 2° (mean 1°·8). The seeds did not germinate. The experiment lasted thirty-five days. Afterwards the temperature gradually rose to 8°. This temperature of 1°·8 to 8°, having lasted twenty-eight days, did not induce germination.

The second vessel varied in temperature from 1°·4 to 1°·9 (mean 1°·65). It contained sowings of *Lepidium* and linseed. The former sprouted on the thirtieth day, in tolerable abundance, the latter on the thirty-fourth day*.

The third vessel varied from 1°·5 to 2° (mean 1°·75). It contained seeds of maize and *Nigella*. None germinated. After the experiment had lasted thirty-five days, the temperature being slowly raised during twenty-eight days as high as 8°, they still had not germinated.

Lastly, the fourth vessel, containing the seeds of *Sesamum* and *Sinapis*, varied from 1°·6 to 2°·2 (mean 1°·9). The *Sesamum* did not germinate; neither did it germinate during the twenty-eight days of 1°·8 to 8°, subsequent to the experiment. The *Sinapis*, however, germinated on the sixteenth day. The mean of these sixteen days was 1°·9, as that of the entire experiment.

These facts, which are nearly all negative, help to confirm and explain the experiment at 0°. The germination of *Sinapis* on the sixteenth day, at 1°·9, shows that its true germination at 0° was rather the seventeenth day than the eleventh.

At temperatures of 2°·6 *to* 3°·2.

The three cylindrical and lateral cavities nearest the reservoir of ice contained the same species, sown, in three vessels, from the 6th of March.

The cavity α contained seeds of *Collomia* and *Lepidium*. The temperature varied from 2°·8 to 3°·2 (mean 3°) during the thirty-six days which the experiment lasted. The *Collomia* did not germinate. Some of the seeds of *Lepidium* germinated on the eleventh day†; they then perished; others, somewhat fewer in number, germinated on the sixteenth day; lastly, three germinated on the thirty-first day. Hence about half the seeds germinated, in succession.

* In saying that a species germinated on the thirty-fourth day, I mean that thirty-four complete days were required for the radicle to show itself.

† I mean the end of the eleventh day. The same applies to all that follows.

The cavity β, sown with linseed and maize, varied from 2°·8 to 3°·2 (mean 3°). During the seventeen first days the temperature was steady at 3°·1, and the linseed germinated on the seventeenth and eighteenth days, in tolerable quantity. The maize did not germinate.

The cavity γ contained *Nigella, Sesamum,* and *Sinapis.* The temperature usually varied between 2°·6 and 3°·2; but on the sixth day of the experiment an accidental cause of increased heat occurred, raising the temperature to 5°. The *Nigella* and *Sesamum* did not germinate. Three seeds of *Sinapis* germinated on the ninth day, or rather on the eighth and a half day; on the seventeenth one more germinated; the rest were unchanged. Finding the experiment useless, I again sowed *Sinapis,* at 2 o'clock on the 18th of March, in an additional vessel placed in the cavity γ. One seed germinated on the sixth day, another on the thirteenth, subsequently two more, which proves but little, for 60 or 80 grains were sown. After the experiment the temperature gradually rose to 8° during twenty-eight days, and the seeds which had not previously germinated did not then do so.

At temperatures of 4°·2 to 6°·1.

The same species were placed in the lateral cavities furthest from the reservoir of ice, also in three vessels.

α varied from 4°·6 to 6°·1 (mean 5°·35). It contained *Collomia,* which germinated on the seventeenth day in tolerably large proportion (nearly half), and *Lepidium,* which germinated on the eighth day in tolerable abundance.

β varied only from 4°·7 to 4°·9. It contained maize, which did not germinate, and linseed, which germinated on the seventeenth day in the proportion of nearly a fifth of the seeds sown.

γ varied from 4°·2 to 4°·9 (mean 4°·55). It contained *Nigella, Sesamum,* and *Sinapis.* None of these germinated, not even the *Sinapis.* Evidently the seeds of the latter species, which sprout so readily, had suffered; for a month afterwards, when the temperature had risen to 8°, only a single individual showed itself out of thirty or forty sown on the 6th of March.

The moisture had probably been too great in these three cavities, as in those in which the mean was from 2°·6 to 3°·2, just alluded to. On the 9th of May, twenty-eight days after the experiment, of all the sowings there only remained a single plant belonging to *Sinapis.*

At a temperature of about 5°·7.

From the 6th of March to the 11th of April, the temperature of the cellar in which the experiment was made varied only from

5°·4 to 6°. The mean temperature every two days was 5°·68, say 5°·7.

All the species were sown on the 9th of March, upon a basis of sand, in a large box. They were wetted with water of the surrounding temperature.

At higher temperatures evaporation would lower the mean of the soil in which the seeds were sown, which circumstance was taken into account, in the following experiments, by measuring the temperature of the soil instead of the air. At 5° or 6° this cause could be of but little importance, but it would give rise to the presumption that the mean was a little below 5°·7.

The following were the results to the 11th of April:—

Collomia. Some seeds germinated on the fourteenth day; the others failed.

Lepidium. Germinated abundantly on the fifth day.

Linum. Germinated abundantly on the sixth day.

Maize. Did not germinate.

Nigella. Germinated on the twenty-seventh day.

Sesamum. Did not germinate.

Sinapis. Germinated abundantly on the fourth day.

Iberis. Germinated on the fourteenth day.

Trifolium. Germinated on the tenth day.

Melon. Did not germinate.

From the 11th of April to the 9th of May the temperature of the cellar gradually rose to 8°. Still the seeds of maize, *Sesamum*, and melon did not germinate. Those of the *Sesamum* had perhaps suffered from the damp; but those of the maize and melon were hardly swollen, and some of them were mouldy.

At a temperature of about 9°.

In the middle of May the temperature of the cellar had risen to nearly 9°. I took advantage of this to sow, at 1 o'clock, on the 17th, all the species, in a broad box, exposed to the free air. On the 18th, at half-past 2, I watered them, and allowed the experiment to continue. From the 18th of May to the 2nd of June the thermometer in the open air only varied 0°·6. In the sand containing the sowings the variation was 0°·8. The humidity caused by the watering always lowered the temperature of the soil relatively to that of the air, which induced me to determine, as exactly as possible, the temperature of the upper layer of soil. On making every correction with the standard thermometer, I found 9°·2 to be the most probable temperature to which the seeds had been subjected. The following are the results:—

Collomia. Germinated six days and three-quarters after the sowing.

Lepidium. Germinated on the third day.

Linum. One seed commenced on the second day, several others on the fourth.

Maize. One seed on the tenth day, two others on the twelfth, and others subsequently.

Melon. Did not germinate.

Nigella. Germinated on the fifteenth day.

Sesamum. Did not germinate.

Sinapis. Germinated at the end of three days and a half.

Iberis. On the sixth day.

Trifolium. Some seeds on the fifth day, others on the sixth, the eighth, &c.

At a temperature of 12° *to* 13°.

The same kinds of seeds were sown and watered on the 15th of July, in the same manner as the preceding, but at a temperature which in the cellar, from the 15th to the 30th of July, was 13°·66 in the air, and 12°·6 in the soil,—the extreme variation in the air being 1°·0, and in the soil 0°·8. During the first three days, the mean in the soil was 12°·9 : this refers especially to four of the species mentioned below. The results were :—

Collomia. Germinated on the sixth to the seventh day.

Lepidium. Germinated after about a day and three-quarters.

Linum. Germinated in about two days and three-quarters.

Maize. Two seeds out of seventeen germinated at the end of the fifth day; and on the seventh day half had germinated.

Melon. Did not germinate, not only from the 1st to the 31st of July, but also during the month of August.

Nigella. The ninth day (at the end) a fourth part of the seeds germinated.

Sesamum. Germinated abundantly at the end of the ninth day.

Sinapis. Germinated after one day and three-quarters.

Iberis. From three and a quarter to four days.

Trifolium. Germinated at the end of the third day, unequally.

The uncertainty which existed in regard to four of these sowings, induced me to repeat the experiment at once.

Lepidium, at 12°·9, sprouted in one day and three-quarters, as before.

The *linseed* failed; but on again repeating the experiment at 13°·5, it germinated at the end of one day and three-quarters. The mean, with the preceding experiment, is two days and a quarter, at 13°·2.

Sinapis. Germinated in about forty hours. The mean, with the preceding experiment, is forty-one hours, at 12°·9.

Trifolium. In three days, *minus* about three hours, at 13°·0.

At a temperature of about 17°·

Some sowings were placed, on the 15th of May, in a room where the temperature of the air varied 1°·3 to the end of the month, and that of the sand in which the seeds were placed, also, 1°·3. During the first three days, the mean to which the seeds were subjected was 17°·2; the *Lepidium* and *Sinapis* germinated towards the end of one and a half to one and three-quarters day; the *linseed* and *Trifolium* at the end of the second day. Considering the rapidity of the phenomenon, I wished to repeat the experiment with still more exactness, and I found that, the means being 16°·9,

Lepidium germinated in thirty-six hours.

Linseed sprung up partially at the end of the fourth day.

Sinapis at the end of three days and a half.

Trifolium at the end of about three days and a quarter.

Under a mean temperature of 17°·3, in a third experiment, the *Sinapis* germinated at the end of the second day. The mean of these three results, in the case of *Sinapis*, is one day and seven-tenths [? 2·33 days], at 17°·2.

The mean of two experiments gives for the other species, at 17°·05:—

Lepidium. One day and a half.

Linum. Three days.

Trifolium. Two days and six-tenths.

The other species gave, at 16°·9:—

Collomia. Five days and a half.

Maize. Three days and three-quarters.

Melon. Commenced at the end of nine days and a quarter, and continued to spring up on the subsequent days.

Nigella. The sixth day.

Sesamum. The third day.

Iberis. The fourth day.

At a temperature of about 20° *to* 21°.

Similar sowings were made in a room in which the temperature was tolerably constant. The seeds, placed in an open box, were copiously watered, covered with moistened brown paper, and the whole shut in a drawer. The shape of the box allowed the thermometer to be placed obliquely in the superficial layer of sand in which the seeds were placed. At 4 p.m. on the 2nd of August, when the experiment was begun, the temperature was

22°·1; the next morning at 10 o'clock it was 21°·2, and on the following day at 10 it was 19°·9. 21°·1 may be considered the approximative mean. The following are the results:—

Lepidium. Germinated in thirty-eight hours.

Linseed. Germinated in about thirty-six hours.

Maize. Two seeds germinated on the forty-second hour, and others followed.

Nigella. In four days and a quarter.

Sesamum. Germinated in from thirty to thirty-six hours, without my being able to determine accurately, in the middle of the second night.

Sinapis. One seed germinated in eighteen hours, and the others followed; say, twenty-two hours for the first of them.

Trifolium. Some seeds germinated in forty-two hours.

On the 5th of August the temperature had fallen, and the mean of the 2nd of August, from 5 in the afternoon till 10 in the morning, may be estimated at 20°·4. *Iberis* germinated under these conditions in two days and three-quarters.

Collomia did not sprout. Its seeds were kept and watered at temperatures of from 18°·8 to 20°·4 (mean from the beginning 19°·6), and on the 18th of August (fifteen days and a half after the sowing) one germinated.

To be sparing of the melon-seeds, of which very few were left, I did not then sow them, but began again on the 16th of August; and at a mean of 19°·4, having varied from 18°·8 to 20°·4, two seeds out of ten germinated in two days and twenty hours.

At a temperature of from 24° to 25°.

On the 19th of July, a sowing was made in a room the temperature of which was about 26°, and subsequently, from the 22nd to the end of the month, 23° to 24°. The seeds were placed upon the sand in a drawer which shut tightly, and to guard still more against external variations, they were covered with sheets of brown paper. The sand was watered, and the paper moistened. The temperature in the sand remained for three days between 24°·9 and 25°·2 (mean 25°·05). Under these conditions,

Linseed germinated in thirty-eight hours.

Maize. One seed out of twelve germinated in twenty-three hours; but half the seeds had not germinated until after forty-four hours.

Melon. Two seeds out of ten germinated in forty-four hours, the others followed.

Sesamum germinated in from twenty-one to twenty-two hours and a half. This extreme rapidity having prevented me from determining accurately, I immediately made a fresh sowing at a temperature of 24°·4 to 24°·9; it sprouted in twenty-two hours and a half.

Sinapis appeared to have germinated in thirty-six hours; but it was in the night, and the moment was not ascertained.

Trifolium germinated about the forty-second hour.

Nigella and *Iberis* escaped observation, from an accident.

Lepidium presented a singular fact, probably resulting from an error of observation or the accidental choice of more tardy seeds than the others. This species, which germinates rapidly at low temperatures, only commenced partially to germinate (two grains out of ten) towards the end of the sixth day, and most of the seeds sprouted between the sixth and the seventh day. The temperature of the seven days varied from 22°·1 to 25°·1, the mean being about 23°·6 or 23°·7. The construction of the curve (Plate IV.) shows that this fact is not in harmony with those deduced from higher or lower temperatures, consequently that there was some error or accident. To satisfy myself further, I repeated the experiment in November in another form, with a lamp placed under a large flask of water, in which a bottle containing a sowing of *Lepidium* floated. The mean temperature was 21°·1, with insignificant variations, and the *Lepidium* germinated after thirty-eight or thirty-nine hours, exactly as in the above-mentioned experiment. At a temperature of 26° to 27°, which unfortunately rose much higher (43°) during some hours, the *Lepidium* began to sprout at the sixteenth hour. Hence we may conclude that the experiment at 25° was inaccurate.

Lastly, *Collomia* did not germinate in July. The temperature of the sand remained, from the 24th of July to the 3rd of August, between 22°·5 and 22°·1; on the 8th of August it fell to 18°·5, and then rose on the 14th of August to 28°·6. The seeds had been preserved and watered. I thought they would not germinate; but on the 15th of August two of them did so. The mean temperature varied too much for the experiment to be satisfactory. Assuming it to be accurate, it would be necessary to admit that, at a mean of 21°·5, *Collomia* requires a period of twenty-seven days, which agrees moreover with the observation at 19°·6, as shown in the tracing of the curves in the Plate. It might be questioned, as in the case of *Lepidium*, whether the temperature of the second half of the period, which was momentarily lowered to 18°·5, had not caused the germination which the heat prevented in the preceding period. I doubt this, however, because the germination took place when the mean had returned to 20°·6. Moreover the duration of twenty-seven days agrees tolerably with that of the experiment at 17° to 18°, as is well shown by the curves.

Temperature of about 28°.

Being unable at Geneva, even in a very hot summer, to obtain in the open air constant means above 24°, I had recourse to artificial heat for the higher temperatures.

A basin, nearly filled with warm water, was placed upon a support heated by a lamp, which required to be renewed only three times in twenty-four hours. A porcelain cup filled with sand was immersed two-thirds in the water of the basin to receive the seeds. The temperature remained pretty constant between 29° and 30°. I then sowed the seeds, at an equal distance from the edge of the cup, and, after having allowed them to acquire the temperature of the sand, I watered them well with water at 30° which had not been boiled. The experiment, which was begun at midnight on the 2nd of August, was stopped at noon on the 6th. During this period, the mean temperature of the room fell from 21° to 18°. This cause, as also the evaporation from the more or less moist sand, and the unavoidable alterations in the source of heat, induced a variation of temperature from 27° to 29°, and in the morning of the last day it fell to 26°·3; but this could not have had any influence upon most of the seeds, which had already germinated. The results were:—

Lepidium. Two seeds germinated in thirty-nine hours; one or two others sprouted afterwards; but most of them did not germinate.

Linum. One seed germinated at the end of two days and a half; at the end of the third day three only had germinated; the majority, about four-fifths, did not germinate.

Maize. Up to the thirty-sixth hour single seeds sprouted, but after the second day almost all the seeds sprouted vigorously.

Melon. One seed evolved its radicle at the end of the third day, and at the end of the third day and a quarter the majority germinated regularly.

Sesamum. The germination began at the end of twenty-two hours; it was abundant during the three or four following hours.

Sinapis. Two seeds only out of ten germinated at the end of the third day; six hours afterwards a third showed its radicle; most did not germinate.

Trifolium. Some seeds germinated at the end of the third day; most did not germinate.

Collomia and *Nigella* did not germinate. To prolong the experiment, I left these seeds as they were, but under such conditions that the temperature varied from 32° to 37°, until the 10th of August. Two or three of *Trifolium* and one or two of *Linum* sprang up, but neither *Collomia* nor *Nigella.*

On the 4th of August, at 5 p.m., I sowed and watered some seeds of *Sesamum* in a little cup placed so as to maintain a temperature of 27° to 28°. At the end of thirty-one hours, one seed germinated. The experiment was not continued.

Temperature of 40° *to* 41°.

The seeds were sown on the 6th of August, at 8 p.m., in a glass vessel, filled with dry sand, placed in the centre of the porcelain cup containing the moist sand of the preceding experiment. At 11½ p. m. I watered them freely with water at 41° which had not been boiled, The temperature of the sand was maintained, until the 10th of August at 5½ p.m., between 39°·6 and 45°·4, but it only rose to this temperature in the evening of the 7th of August, and the mean, taken every twelve hours, was 40°·6.

Two seeds of *Sesamum* germinated at the end of ten hours and a half, and others followed immediately. The mean during these ten hours and a half must have been 40°·7. None of the other species germinated; and as the seeds of the maize and the melon had assumed a dark tint (especially those of the maize), which indicated a change, I removed the glass vessel and placed it upon a marble mantlepiece, where it rapidly acquired the surrounding temperature of 20° to 21°. To my great surprise, four hours and a half afterwards, three melon-seeds germinated! The other species did not sprout during the following days, up to the 12th of August; it is thus probable that the melon-seeds would have germinated at 40°·6, if I had not interrupted the experiment. They would then have required, under these conditions, four days *minus* two hours, or ninety-four hours.

At higher temperatures.

It appeared to me useless to continue the experiments at higher temperatures, except as regards *Sesamum*, which seemed best to resist an extreme heat. The experiments of Lefébure, as well as of Edwards and Colin, have proved that most seeds undergo a change at temperatures of 50° and upwards when the soil is moist—a change so great that they are incapable of germinating when subsequently placed under favourable circumstances. Seeds heated in the dry state in a stove are capable of bearing a heat approaching the point of combustion*; but in water they lose their power of germinating at 55° or 50°, and perhaps below, according to the species, and especially according to the duration of the immersion†. In moist earth the seed is changed, according to the abundance of water, at various degrees of the thermometer. Thus, with the method of experimenting which I had adopted for a certain purpose, the seeds, always being copiously watered, would lose their power of germinating at 50°, 45°, and

* Edwards & Colin, *l. c.*; Théod. de Saussure in the 'Mém. Soc. de Phys. et d'Hist. Nat. de Genève, iii. part 2.

† Lefébure, p. 120 *et seq.*; Edwards & Colin, *l. c.*; Fr. Burckhardt, *l. c.*

perhaps 44° or 43°, as is proved by the preceding experiment, without its being possible to regulate and to determine this limit exactly.

I therefore confined myself to pursuing the trial of the *Sesamum*-seeds to about 57°, and the following were the results :—

A sowing was made, at 7 p.m., in sand which had been slowly heated, with the seeds in the dry state, to 51°. I watered copiously with water at this temperature. The temperature of the soil rose to 57°; it varied from 50° to 57°, mostly remaining between 51° and 52°. Some of the seeds were accidentally lost. One of five which were left germinated at the end of twenty-five hours and three-quarters. In a final experiment, in which the *Sesamum*, watered in the same way, was exposed to a more fixed mean of 43° to 45° for twenty-six hours, and afterwards left at temperatures of from 18°·5 to 22°, three seeds out of a dozen germinated at the end of six days after sowing; two more followed, and the majority did not germinate, which shows to what extent the heat of from 43° to 45° had been prejudicial.

§ 2. *Deductions and Conclusions.*

1. *Some seeds germinate at* 0°.

MM. Edwards and Colin, in 1834, stated in their memoir :—"No seeds are known which are capable of germinating at the point of melting ice." M. de Seynes, in his very interesting treatise on germination*, repeats, in 1863, "No seeds of the Phanerogamia are known which germinate at 0°." My experiments prove that out of ten species, taken at hazard, one has been found which germinates at 0° (*Sinapis alba*).

The fact is the more singular, as it does not refer to a plant belonging to the polar regions or high mountains. Probably there are other species similarly circumstanced, especially among those which live in the neighbourhood of snow; but we can scarcely become acquainted with this in the ordinary course of events. In fact, the persistence of a temperature of 0° is very rare in nature. A sun's ray or the proximity of a body of a temperature above 0° is sufficient to raise the temperature of a stream springing from melted snow. It is well known how difficult it is to maintain a temperature of 0° in a basin filled with ice, when it is required to verify the zero-point of a thermometer. Only by attentive observation in a prolonged experiment can it be determined whether a species germinates at 0°. There are even some seeds for which an experiment lasting thirty-five days, like mine, is not sufficient.

2. *Necessity of a minimum for each Species.*

Sinapis alba germinated at 0°. Perhaps this species might

* De la Germination, 8vo, Paris, 1863.

have germinated even at a somewhat lower temperature, provided the water were liquid; but this kind of experiment appeared to me too difficult to be attempted*.

Lepidium and *Linum* germinated at a mean of 1°·8, but did not sprout at 0°.

Collomia, which does not germinate at 3°, does so at 5°·3.

Nigella, Iberis, and *Trifolium repens,* which did not germinate at 5°·3, sprouted at 5°·7.

Maize, which did not germinate at 5°·7, did so at 9°.

Sesamum, which did not germinate at 9°, did so at 13°.

Lastly, the seeds of the *melon,* which did not germinate at 13°, did so at 17°.

Some seeds of the *cotton-tree,* at least two years old, which I thought were beyond the condition for germinating, because they had resisted a previous experiment at 18° for several days, sprang up when placed upon a stove the temperature of which was very variable but at times reached 40°.

Lefébure decided upon 5° to 6° C. as the minimum for radish-seeds placed in a moist soil. MM. Edwards and Colin state that they made winter-wheat, barley, and rye germinate at 7° C.; but they do not assert that this is the minimum; and it is highly probable that barley at least would germinate at a lower temperature by prolonging the experiment.

Species therefore require a determinate minimum for germination. Assuredly agricultural practice would give rise to this idea; but we are not sure whether the germination of seeds sown too early in spring is merely retarded, or rendered slower, or whether their subsequent development is absolutely impossible. Experiment shows that in this case germination is impeded; it also shows how necessary it is, in calculations upon temperature in regard to plants, to take as the basis facts deduced from constant and prolonged temperatures †, and then to consider certain temperatures useless for each species, at least as far as relates to germination. Certainly there exist facts in accordance with which the same applies to the foliation, the inflorescence, and the maturation; only, these facts are less exact.

In my experiments, all the species which required the highest *minima* belong to warm countries. They are excluded for this reason from cold countries; for if they germinated in them, it

* Natural philosophers are able to keep water in a liquid state below 0°, as shown by M. L. Dufour's beautiful experiments; but it is almost impossible to preserve this state of things, ensuring at the same time sufficient oxygen for the germination of the seeds.

† M. H. Hoffmann (Witterung & Wachsthum, &c., 1857, p. 525 &c.) doubts the existence of a minimum proper to each species; but he confined himself to experiments under variable temperatures, the means of which he regards as equivalent to a constant temperature.

would be too late in the spring, and the ripening of the seeds would not take place before winter. Among those species which germinate at low temperatures, some belong to temperate countries. They do not advance so far as the polar regions, either from causes not relating to germination, or because, germinating too soon, the herbaceous parts are attacked by the cold.

3. *Existence of a maximum.*

When the temperature remains at a certain rather high degree, some seeds are no longer able to germinate. Thus, in my experiments, the seeds of *Nigella* and *Collomia* did not sprout when the mean exceeded 28°. Most of the seeds of *Trifolium repens* did not germinate at 28°, whence it might be supposed that at about 30° none would have sprouted. Maize must cease at about 35°, for at 40° the seeds became brown and as if burnt. One, however, of the seeds which had been rendered brown by a heat of 50° to 57°, germinated on the eleventh day, when, the experiment having been abandoned, the temperature fell to 18° or 20°. The seeds of the melon and, especially, *Sesamum* bear 40°; but they assume a brown tint, which indicates a certain change, and it is probable that at about 42° in the case of the former, and 45° in that of the latter, germination would usually be impossible. However, some of the *Sesamum* and melon-seeds which had reached 45°, and were subsequently left at 18° to 20°, sprouted.

As stated above, the limit depends greatly upon the moisture. When long immersed in water at 50°, and even 45°*, many of the seeds would suffer. They are still capable of germinating in moist earth; and as the quantity of moisture is very variable, and this could not in my experiments be observed at each degree of elevated temperature during a somewhat considerable length of time, I did not attempt to obtain greater exactness.

Lefébure fixed the maximum for the seeds of the radish sown in moist earth at 38° C. MM. Edwards and Colin found that all the seeds of winter-wheat, spring wheat, barley, rye, and oats, sown at 40° in slightly moist sand, sprouted, that at 45° only a part of them did so, and at 50° none germinated.

4. *Amplitude between the minimum and the maximum.*

If we designate as *amplitude* the number of degrees between the minimum necessary for the germination of a species and the

* None of the seeds of the Leguminosæ and Graminaceæ submitted to experiment by MM. Edwards and Colin were capable of germinating after immersion for a quarter of an hour in water at 50°. According to M. F. Burckhardt's experiments, the seeds of *Lepidium* and linseed were susceptible of germination after immersion for half an hour in water at 50° (49°·6 to 51°·4), but not for the same period in water at 60° (57° to 62°).

maximum beyond which it is impossible, we find differences between one species and another. Thus *Collomia* and *Nigella* have 23° of amplitude, maize 26° or 27°, the melon 24° or 25°, *Sesamum* about 30°, and *Sinapis* nearly 40°. The maximum being variable according to the moisture, no great value can be attached to these numbers. A short amplitude is evidently unfavourable to the geographical extension and cultivation of a species.

5. *Differences between seeds of the same species and origin.*

Sometimes natural philosophers reproach naturalists with neglecting the experimental method and constantly following that of observation. Here we have an instance justifying naturalists.

Nothing is easier to submit to experiment than seeds; nothing appears more homogeneous, more comparable, in the same species. And yet seeds derived from the same source, preserved in the same way, and sown together, germinate in succession*. The fact is of common occurrence; I have met with it many times in my experiments. Agriculturists are well acquainted with it. In some families, for instance the Leguminosæ, it occurs, as already stated, to a very inconvenient extent. It is because seeds from the same crop, the same plant, the same capsule, are not identical either physically or chemically. Their organization is very complicated, as is also their evolution, although other physiological facts are still more so. Natural philosophers reason upon homogeneous bodies; naturalists upon heterogeneous bodies. A metal melts at a constant temperature, because it is composed of similar parts. An organized body never presents this complete similitude of all the parts of the same organ. Hence there is less exactness in the experiments, and almost constant necessity of comparing numerous facts, *i. e.* of observing.

In my experiments, one, two, or several seeds have been observed germinating in succession, out of ten or twenty; and I have called germination, somewhat arbitrarily, the second or third appearance of the radicle among the seeds. If the temperature is very favourable, that of several seeds takes place simultaneously. Near the maximum and, especially, the minimum, the seeds germinate more irregularly, and a still larger number do not germinate.

6. *Influence of the albumen.*

The structure of each kind of seed, especially the absence or presence of albumen, and its nature when it exists, must exert a certain influence in accelerating or retarding the action of heat; but the small number of species upon which I experimented has not allowed me to determine this point sufficiently.

* See Cohn, 'Symbola ad Seminis physiologiam,' 8vo, Berlin, 1847.

Six of the species observed have no albumen, viz. the three Cruciferæ, *Cucumis, Trifolium,* and *Sesamum;* the four others, *Nigella, Linum, Collomia,* and *Zea Maïs,* have an albumen. That of maize is considerable; that of linseed, on the other hand, is very small.

The three species which have a more or less considerable amount of albumen, require a minimum of 5°, and sometimes more, for germination. *Sinapis, Lepidium,* and *Linum,* which germinate at very low temperatures, have no albumen, or very little. On the other hand, it is a striking circumstance to find that the seeds of *Sesamum,* which greatly resemble those of the Cruciferæ in the absence of albumen, in texture, and in size, require from 10° to 12° to germinate.

A temperature of 17° to 18° is favourable for all these seeds. At this temperature, germination took place in the following order:—*Lepidium, Sinapis, Trifolium, Sesamum* and *Linum, Iberis, Maize, Collomia, Nigella,* and *Melon*; which shows better that the albumen has a certain retarding influence. The melon, it is true, is the slowest, although free from albumen; but the coriaceous nature of its envelopes must impede development.

7. *Relation of the temperature to the time required for germination.*

All the species presented a tolerably similar progress as regards its duration at different temperatures.

Near the minimum, a slight increase of temperature notably abridges the time of germination. Under more favourable means, the acceleration is slight. Lastly, near the maximum, the intensity of the heat becomes injurious and retards germination. The latter is impossible at a higher degree. MM. Edwards and Colin had already remarked this*; and it is evident at a glance on constructing curves expressing the results of my experiments (see Plate IV.).

The Centigrade degrees being marked on the vertical line, and the days (of twenty-four hours) on the horizontal line, I have set down each observation by means of a point indicating the moment at which the seeds of each species germinated, at each constant temperature. These points are connected by straight lines, which indicate, with the aid of a little imagination, what the normal curves would be if founded upon more numerous and perfectly exact observations.

It is at once evident that my observations at from 3° to 6° and at 17° are not very satisfactory, for they have given the curves an irregular form. It may also be seen that the linseed has presented several anomalies, perhaps arising from the somewhat irregular rupture of the spermoderm at a certain stage of the evolution of the embryo.

* Ann. d. Sc. Nat. sér. 2. vol. i. p. 270.

Omitting these irregularities, the curve of each species ascends at first slowly, and the difference between each species is somewhat considerable. Subsequently all the curves become approximated and nearly parallel to the line of temperatures; and finally they diverge and separate towards the top.

Hence it results that the *relative* order of evolution of the seeds is different, according to whether the low, the mean, or the high temperatures are considered. The lines cross, like the limits of the distribution of the species in geographical botany, and partly from the same causes.

It has been proposed, for the purpose of measuring the temperature required for vegetative functions, considered either individually or in the whole of the life of a plant, to add the thermometric degrees day by day, from the commencement to the end, either of the function or of the life of the individual. According to the calculations of M. Boussingault upon cultivated annual species, and those which I have published upon some indigenous species, nearly the same sum of degrees is found for the performance of one function as for all the functions of the same species. If the temperature has been higher, vegetation will have proceeded more rapidly, and *vice versâ,* so that one of the numbers nearly compensates the other. As temperature and time are absolutely different elements in their essence, as we adopt them in part only of their infinite extension, and we arbitrarily divide this part into degrees and days, there is no *à priori* reason why the days of duration should exactly compensate the degrees. If that happens, it is a fact, at first suspected, then proved; and that is all. The question is to determine to what point this law, which is empirical in its nature, is founded in reality; and, as I stated at the commencement, there is a certain interest in acquiring assurance by direct observations, in regard to a function which is less complicated than the others, and where heat exerts its influence without light. The calculation may be made in two ways—either by adding together all the degrees above zero, or by deducting the degrees which are useless to the species in the function in question, and then adding the other degrees, up to the moment at which the function is accomplished. The latter mode appears, *à priori,* more logical; but the state of ignorance in which we nearly always are, in regard to the minima, prevents our employing it. The following are the numbers in relation to the species observed. I shall quote only three species, the remainder presenting analogous facts.

*Trifolium repens** at 5°·7 requires ten days (of twenty-four

* This species is not indicated in the plate, to prevent complication. It proceeds parallel with linseed in the lower degrees; afterwards, from 21° to 25°, it is almost identical with maize; and still higher, it separates from it.

hours) to germinate. Ten times 5°·7 gives the number fifty-seven, but it has been determined that at 5°·5 the species no longer germinates; hence the truly useful temperature would be only 0°·2 during ten days, which produces a total number of 2° only. Similar calculations being made upon germinations of *Trifolium* observed at 9°, 13°, 17°, &c., have yielded as follows:—

Temperature.		Days.		Calculating above 0°	Deducting the minimum 5°·5.
5°·7	×	10	=	57	2
9·2		5		46	18
13·2		3		39	23
17·0		2·6		44	30
21·1		1·75		37	27
25·0		1·75		44	34
28·0		3		84	67

In both methods of calculating, the first and the last numbers present a disparity with the others; *i. e.* near the minimum and near the maximum the relation of the temperature to the duration of the germination differs from the ordinary one; in other words, the germination is then more difficult and becomes extremely slow. Under the other conditions of temperature, the numbers do not present greater diversity than is admissible in physiological facts, where so many causes exert their influence and where errors of observation inevitably creep in. In opposition to what I had supposed, the numbers in the present instance differ more from each other if the useless temperatures are deducted than if this is not done.

Lepidium, which requires about 1° to be able to germinate, gives the following numbers*:—

Temperature.		Days.		Calculating above 0°.	Calculating above +1°.
1°·65	×	30	=	49	19
3·0		11		33	22
5·7		5		28	23
9·2		3		28	25
13·2		1·75		23	21
17·0		1·50		25	24
21·1		1·58		33	32
28·0		1·6		44	43

Let us also take *Sesamum*, which requires a very high minimum, from 10° to 12° (say 11°)—

Temperature.		Days.		Calculating above 0°.	Calculating above 11°.
12°·6	×	9	=	113	14
16·9		3		51	17
21·1		1·4		29	14
24·6		0·94		23	13
28·0		0·92		25	15
40·7		0·44		18	13

* M. Burckhardt obtained higher numbers; but he regards as germina-

In these two instances, especially in the latter, the numbers become much more equal on deducting the degrees of temperature below the minimum. Probably this correction becomes more requisite as the minimum becomes higher.

When in these three calculations the numbers of the beginning and the end, which are often in non-accordance with the others, are abstracted, germination takes place, in widely different species, under the influence of tolerably similar conditions of time and temperature; for the numbers are comprised between fourteen and thirty-four when the minima are deducted. They are slightly less in the case of the species which requires the most initial heat, but in very unimportant proportion.

Definitively, the method of the sums of temperature applies with moderate accuracy to the facts of germination. What is essentially required to be known in the case of each species, in regard to this function, is the requisite minimum. The rest differs but little in the various plants; and it is easy to foretell the effects of an increase of temperature when once germination is possible, without having recourse to calculations or direct observations in the case of each species. The same probably does not apply to the other functions, nor to the assemblage of functions, from germination to maturation. This would form a point to be decided by experiment. Unfortunately I am unacquainted with any means of causing a phanerogamous plant to undergo regular development at a certain temperature, *without light*. It would be requisite at least to be able to furnish a species with light which is uniform and of the same kind for several weeks. With the progress of knowledge, this will be possible sooner or later; but until then our calculations upon the sums of heat in botanical geography, in agriculture, and in horticulture will be contaminated with hypotheses and manifold causes of inexactitude*.

8. *Variable temperatures.*

I have not yet experimented upon germination at variable temperatures. I even endeavoured to maintain more constant temperatures than M. Burckhardt had done, so as to eliminate as much as possible the errors which might arise from variations.

---

tion a more advanced phase of development, that at which the cotyledons become exposed.

* If the other functions agree with germination, the numbers calculated from the extreme limit of the species must be distrusted. We see, in fact, that near the point at which vegetation is arrested, much more time is required to compensate for the loss of heat. The numbers calculated near the limits would only serve for comparison with each other, and the numbers deduced from the centre of a habitat must not be confidently applied to express the necessary conditions at the limits.

We may infer, from the demonstrated existence of a minimum, that a mean temperature does not produce the same effect as the same constant temperature, unless, perhaps, the question is that of a mean calculated above the minimum requisite for the species and below the degree at which the heat becomes injurious to it. On deducting the useless and unfavourable degrees, the means may possibly act as a similar constant temperature. I see, however, a reason for doubting this. It is that temperatures which are too low for the germination of a species, are probably not so as far as relates to some particular detail of the function of germination. Low temperatures appeared to me injurious to the absorption of water by the surface of the seeds; however, slight absorption might occur, which would be beneficial subsequently when the temperature rises for a time. The same holds good in the case of other internal phenomena of the seed. Each of them is a function in the general evolution of the germination, and each has its minimum and maximum. Nothing in nature is simple, even in that which appears comparatively very simple.

9. *Analogy between seeds and eggs.*

Some naturalists have ventured to affirm the existence of a kind of identity between a seed and an egg. There is, however, in a physiological point of view, this great difference, that the embryo is almost entirely stationary and inert in the interior of the seed, while atmospheric influences act upon the animal contained in the egg, and must act to prevent the animal from perishing. The egg constantly disengages carbonic acid and aqueous vapour. It therefore requires air, while the seed can dispense with it.

However, to all the existing points of resemblance, it must be added that zoologists are at present content, like botanists, with rather vague notions of the effects of temperature upon the germs. If I have been well informed, and I have consulted good authorities, exact and slightly varied experiments upon incubation at definite thermometric degrees have not been made. There is, however, a memoir upon rearing silkworms, by MM. Millet and Robinet and Madame Millet, which contains precise details upon one species. These authors say that, "to hatch silkworms, the eggs must be subjected to a temperature of $+9°$ C. The number of degrees necessary for incubation diminishes at the same time as the number of days employed in producing them. In other words, if it is required to distribute the number of degrees of heat between fifty days on the one hand and one hundred on the other, this number is found to be more than sufficient in the first case, and the hatching takes place before the employment of all the heat; or, again, a temperature of 20° during ten days, which makes 200°, has more influence upon the development of the worm than a temperature of 10° during twenty days, which also amounts to 200°. The 200° are insufficient in the latter case and superabundant in the former."

We here see the influence of a minimum, which exists in the instance of the egg as also of the seed: if the silkworm requires 9°, it is evident that a mean of 10° is of little use.

10. *Analogy of germination with combustion.*

The production of carbonic acid by means of the oxygen of the air has always caused germination, like respiration, to be classed with phenomena which may be termed generally combustion. For the sake of analogy, the necessity of a certain initial heat must also be added in the case of germination; only, in seeds the minimum of temperature is low: mustard-seed burns at 0°. As regards the more or less rapid progress of germination, the seed must be compared to a combustible which is acted upon slowly and successively within by heat. There are two envelopes, and frequently cellular tissue gorged with starch, surrounding the embryo, which must evidently retard the influence of heat, as also of oxygen and moisture, upon the internal organs.

11. *Peculiar nature of germination.*

At first sight, every one is inclined to regard germination as something extraordinary and inexplicable, *i. e.* vital, in which heat and oxygen reanimate the young plant, which is well-known, however, not to be dead. I fear that this kind of consideration must be left to poets; for the more germination is studied, the more it seems to be composed of solely physical and chemical phenomena.

It is true that I have not examined the modifications undergone by the tissues of seeds at the different temperatures to which I have subjected them. This kind of research would be of great interest, and would require explanation by means of the microscope, with the same care as that used by M. Arthur Gris in his recent papers on the anatomy of seeds beginning to germinate. We should like to know what alterations the seeds undergo below their minimum of germination, above their maximum, also in the intermediate degrees which favour more or less each partial function, of which the sum total constitutes germination. It is true, that the external appearance indicates part of these phenomena. Below the minimum, seeds kept in a moist medium and being unable to germinate, slowly decay; above 45° to 50° they begin to be carbonized. It is easy to understand that these external alterations reach the internal tissue, the substances deposited in the cells, and even the embryo. Thus the young plant in the seed exists as a prisoner confined in a small space. Physical and chemical causes separate the walls of the prison, rendering them flexible, penetrable, and sometimes transforming the encumbering matters into liquid and nutritive substances. If these physical and chemical operations do not take place too slowly or too suddenly, if they do not tend to a putrid fermentation or to the carbonization of the tissues, if the materials of the albumen or the cotyledons are properly and suitably resolved, the young plant enlarges. Its nutrition had been trammelled, or almost suspended; it is so no longer. This is the whole secret. Hence this phenomenon appears more easily understood in accordance with the ordinary laws of matter than numerous others relating to animal and vegetable life, although undoubtedly it is still very complicated and in part imperfectly understood.

XXVII.—*On the* Menispermaceæ.

By John Miers, F.R.S., F.L.S. &c.

[Continued from p. 138.]

26. Antizoma.

Under this name I separated from *Cissampelos*, in 1851 (Ann. Nat. Hist. 2 ser. vii. 41), a small group of South-African plants possessing a very peculiar habit: two of them had been described by De Candolle,—one as *Cissampelos calcarifera* of Burchell, of which the male flower only was known; the other being the *Cissampelos angustifolia* of the same botanist, from a specimen of which I derived a knowledge of the female flower: to these, three other new species were then added. They are all small, erect shrubs, with somewhat the habit of *Lycium*, having almost simple stems or subscandent branches. The leaves, unlike those of other *Menispermaceæ*, are linear, with extremely abbreviated petioles; they are opake, thick, revolute on their margins, both surfaces being shagreened with extremely minute and crowded granulations. At each node, below the point of insertion of the petiole, there is a short, rigid and somewhat reflected spine—a feature peculiar to this genus, and quite singular in this family. The male inflorescence consists of one or two very short peduncles springing out of each axil, which bear on their summit from three to six minute flowers on short closely approximated pedicels; these male flowers differ in no respect from those of *Cissampelos*. The inflorescence and the structure of the female flower are, however, very different: this I found in a unique specimen in

Dr. Burchell's herbarium, where on each axil one or two very short pedicels bear separately a single minute flower, with two oval concave sepals, placed oppositely, with their margins somewhat imbricated in æstivation; at the base within, and opposite to each sepal, is a very minute scale-like fleshy petal, placed at the base of a central ovary, which is nearly the length of the sepals, without any style, and with an obsolete stigma. This structure will be seen to offer much analogy to that of the genus *Peraphora*, and places them in a position intermediate between *Cissampelos* and *Homocnemia*, differing from the former in having double the number of floral parts, and from the latter in having half as many. Messrs. Bentham and Hooker were evidently unacquainted with the facts here shown when, in their 'Genera Plantarum' (p. 38), they amalgamated this genus with *Cissampelos*. The structure of the female flower, with a different kind of inflorescence, and the peculiar habit of all its species, certainly claim for *Antizoma* the rank of a distinct genus.

Antizoma, nob.—*Flores* dioici. *Masc. Sepala* 4, cuneato-obovata, petalo 3-plo longiora. *Petalum* unicum, cyathiforme, depressum, margine crenulatum, carnosulum. *Stamen* unicum; *filamentum* centrale, breve; *anthera* peltata, horizontalis, 4–10-loba, lobis rima extus dehiscentibus.—*Fœm. Sepala* 2, opposita, ovata, valde concava, carnosula, æstivatione paulo imbricata. *Petala* 2, sepalis opposita, minuta, squamiformia, orbiculata, carnosula, hypogyna. *Ovarium* unicum, obovatum, subcompressum, sursum conicum. *Stylus* nullus. *Stigma* fere obsoletum, aut vix obtuse bilobum. *Fructus* ignotus.

Frutices *Africæ australis, humiles, erecti vel subscandentes;* caulis ramulique *sæpius virgati,* spina *infra petiolum muniti;* folia *alterna, plerumque parvula, linearia vel oblongo-lanceolata, integerrima, coriacea, breviter petiolata:* racemi ♂ *axillares, brevissimi;* pedunculus *flores paucos minutos pedicellatos approximatos gerens;* pedicelli ♀ *axillares, gemini, 1-flori.*

The following species are described in the third volume of the 'Contributions to Botany:'—

1. *Antizoma calcarifera*, nob.;—Cissampelos calcarifera, *Burch. Trav.* i. 389; *DC. Prodr.* i. 102.—In Africa australi extratropica.
2. —— *Burchelliana*, nob.—In Africa australi extratropica.
3. —— *Harveyana*, nob.—In Africa intertropica.
4. —— *angustifolia*, nob.;—Cissampelos angustifolia, *Burch. Trav.* i. 389; *DC. Prodr.* i. 102.—In colonia Capensi.
5. —— *Lycioides*, nob.;—Cissampelos angustifolia, *E. Mey.* (*non Burch.*); *Linn.* xix. 601.—In colonia Capensi.

27. Dissopetalum.

This genus is proposed for a species belonging to Mauritius and Madagascar, long since known, but imperfectly examined—the *Cissampelos Mauritiana* of Thouars, a plant not common in collections, but which has been much confounded with others of African and Asiatic origin. It differs from *Cissampelos* in its female flowers, which have two distinct petals, placed one on each side of a single sepal, so that they alternate with the latter, and a solitary ovary. This is admitted by Thouars in his original description of the typical plant, where he says the corolla is 2-lobed. In *Antizoma* we also find two petals; but then there are two sepals placed immediately behind and opposite to them, and a single ovary. In *Homocnemia* there are four sepals, four petals, also with a solitary ovary; while in *Ileospermum* we find three sepals, and three petals, placed round a central ovary, as in *Stephania.* In the two former the structure of the male flower is like that of *Cissampelos*; in the two latter it is unknown. In order, therefore, to maintain consistency in so extensive a genus as *Cissampelos,* it becomes necessary to maintain the several genera above mentioned; and *Dissopetalum* claims as high a title to distinction as any of them. Its structure must not be confounded with a peculiar anomaly I have observed in one species of *Cissampelos,* which might easily be mistaken for a *Dissopetalum*; it occurs in *C. testudinaria* from the Galapagos, where the petal appears double, owing to its being deeply cleft into two equal segments; but on attentive examination it is seen that the two segments are seated upon a single claw, fixed to the base of the sepal; the two lobes of the petal are therefore quite anterior and opposite to the sepal, not lateral and alternate with it as in *Dissopetalum.* It is probably to this exceptional case that the authors of the 'Flora Indica' allude when they affirm (p. 198) that they have several times seen the petal in *Cissampelos* "bipartite to the base." I have carefully examined and drawn the analyses of many hundreds of flowers of *Cissampelos,* but, with the exceptions above mentioned, I have invariably found only a single complete petal fixed to the claw of a single sepal. There is seen in the genus *Peraphora,* which will shortly follow, another anomalous departure from the normal structure of *Cissampelos,* where in the ♂ flower there are two minute petals, or none at all, and a campanular sepal, and in the ♀ two equal saccate sepals, without any petal, with an ovary in the centre.

The name of the genus under consideration is derived from the feature of its twin petals; its characters, as far as they are known, are thus enumerated:—

DISSOPETALUM, nob.—*Flores* dioici. *Masc.* omnino *Cissampelidis* structura.—*Fœm. Sepalum* unicum, oblongum, subcarnosum. *Petala* 2, æqualia, dimidio breviora, late orbicularia, imo breviter unguiculata, sepalo utrinque lateralia. *Stamina* nulla. *Ovarium* oblongum, gibbum, 1–loculare, 1–ovulatum. *Stylus* longiusculus, erectus. *Stigma* trifidum, laciniis acutis, reflexis. *Fructus* ignotus.

Frutex *Madagascariensis et Mauritianus, scandens;* folia *subpeltata, subcordata, suborbicularia, vel ovata, petiolo limbo subæquilongo;* paniculæ ♂ *axillares, plurimæ, fasciculatæ, composite ramosæ, et corymbosæ, necnon cum ramulo florifero racemiformi;* flores *minuti:* racemi ♀ *axillares, petiolum excedens, bracteati;* bracteæ *foliiformes,* floribus 5–9 *pedicellatis fasciculatis minimis donatæ.*

The single species, *Dissopetalum Mauritianum,* is described in the third volume of the 'Contributions to Botany.'

28. CLYPEA.

This genus was established by Blume, in 1825, upon six species from Java; but only one of these is congeneric with his type, the rest belonging to Loureiro's genus *Stephania,* with which he does not seem then to have been acquainted. Wight and Arnott, in their 'Prodromus,' placed all the species of *Stephania* in *Clypea,* while, contrariwise, the authors of the 'Flora Indica' merged the latter genus into *Stephania,* on the ground that the number of its floral parts is inconstant. In this opinion they were supported by Prof. Asa Gray, who stated that he found in *C. Forsteri* trimerous as well as tetramerous flowers on the same plant. I have since examined the ♂ flowers of the same species, which were kindly sent to me by Dr. Asa Gray, and found most of them regularly tetramerous, while the others were more or less irregularly affected by metamorphic influence; but in no one instance was I able to detect the decidedly trimerous structure of *Stephania**. I obtained similar results from the typical spe-

* In one head of twelve ♂ flowers, it appeared to me that there were six which had each eight sepals, four petals, and one stamen; one had nine sepals and five petals, one with seven sepals and four petals, one with six sepals and four petals, one with seven sepals and three petals, and one double flower with fourteen sepals, eight petals, and two stamens, one of which was much dwarfed: hence there existed, in all, twelve stamens, forty-eight petals, and ninety-one sepals, averaging for each flower the number of more than seven and a half sepals, four petals, and one stamen. If account had been taken of the rudimentary parts, dwarfed to a size so minute as to escape ordinary observation, the full normal proportion of floral parts would be complete. In this species the sessile flowers are so

cimens, now in the British Museum, collected by Forster and Solander. Additional evidence of the tetramerous or dimerous structure in *Clypea* is afforded by the structure of its ♀ flowers, which Dr. Gray does not appear to have seen: these have each four sepals, two petals, and one ovary, with two stigmata, each bifid*; while *Stephania* has three sepals, three petals, and an ovary with three or six stigmata. We have also a different development of the putamen in *Clypea*, where the hippocrepical ring that forms the seminal cell has externally upon each face a single series of centrifugal spines, which stand out beyond the flattened edge that forms the periphery of the cell; whereas in *Stephania* there is a double series of tubercles on each side; moreover in *Clypea* the condyle is a plane or slightly concave entire disk, which is not perforated in the middle, the latter character being peculiar to *Stephania*. I have found these characters constant in all the six species here enumerated; so that we have sufficient evidence upon which the right of *Clypea* to rank as a distinct and good genus can be maintained.

All the plants of *Clypea* have deeply peltate leaves, as in *Stephania* and *Cissampelos*. The inflorescence is dichotomously branched, or more frequently simply or repeatedly umbellate, as in *Stephania*; but very often, as just stated, the ultimate rays and pedicels become confluent into a disciform tumescence at the summit of the umbel, on which the flowers are sessile and closely aggregated into a subglobular head—a circumstance which probably suggested the name of *Clypea*, as this agglutination is very conspicuous in Blume's typical species, *C. acuminatissima*. When the plants and flowers are pubescent, the hairs are all articulated.

Clypea, Blume.—*Flores* dioici. *Masc. Sepala* 8, biseriata, spathulato-oblonga, apice rotundata vel truncata, lateribus interdum undulatis, sæpe pilis articulatis extus vestita, æstivatione

---

closely compacted upon the fleshy disk, that it is almost impracticable to separate them without confounding some parts of one with those of another; the only sure mode of analysis is therefore to count the whole number of parts in one capitulum, and take their average. In other species (for instance, in *C. oxyphylla*), where the flowers are approximated (not agglutinated together), and therefore easily separable, the floral parts are constantly and unquestionably tetramerous.

* In the ♀ inflorescence of *C. Forsteri*, the flowers are agglutinated together upon a fleshy mass, as in the ♂; so that it is equally necessary to analyze the whole capitulum as if it were a single flower. In this way I found in a single ♀ head fourteen ovaries and eighty-four floral scales, of which one-third were smaller and darker than the remaining more membranous two-thirds, which gives four sepals and two petals to each ovary.

subimbricata. *Petala* 4, cuneato-obovata, sepalis 4-plo vel dimidio breviora, iis opposita, carnosula, glaberrima. *Stamen* unicum, centrale; *filamentum* subbreve, erectum; *anthera* 4–8-locellata, locellis circa connectivum peltatum in annulum connexis, rimis totidem horizontalibus bivalvatim dehiscentibus et sæpe minime interruptis suturam continuam simulantibus. —*Fœm. Sepala* 4, spathulato-oblonga, glabra. *Petala* 2, spathulato-oblonga, dimidio minora, glabra. *Stamina* nulla. *Ovarium* unicum, valde gibbosum, 1-loculare, 1-ovulatum. *Stylus* nullus. *Stigmata* 2–4, subsessilia, recurvatim divaricata. *Drupa* carnosa, gibba; *putamen Cissampelidis* et illo *Stephaniæ* diversum, *condylo* imperforato notatum.

Frutices *scandentes, in India, in Japonia, in insulis Asiaticis et Sandvicensibus crescentes;* folia *peltata, oblonga vel suborbicularia, subcordata, apice sæpius acuta, petiolata, glabra vel pubescentia;* inflorescentia *in utroque sexu axillaris;* pedunculus *sæpius solitarius, simpliciter vel iterum umbellatus;* flores *numerosi, minuti, puberuli, crebre capitato-aggregati, plerumque e pedicellis confluentibus in discum carnosum conglutinati.*

The following species are described in the third volume of my 'Contributions to Botany:'—

1. *Clypea acuminatissima,* Bl.;—v. s. in hb. Hook. ♂, Java (Lobb).
2. —— *oxyphylla,* nob.;—v. s. in hb. variis, ♂, Nepal (Wall.).
3. —— *Forsteri,* nob.;—Cocculus Forsteri, *DC.*;—v. s. in hb. Mus. Brit., Tahiti (Solander); ♀ (Forster, planta typica); *id.* (Banks and Solander); in hb. Hook. ♂, Tahiti et Tongataboo (Wilkes).
4. —— *consummata,* nob.;—v. s. in hb. Hook. ♀, Nagasaki (Oldham, 760).
5. —— *subovata,* nob.;—v. s. in hb. Hook. ♀, Rino Ohosimo (Oldham, 346).
6. —— *effusa,* nob.;—v. s. in hb. Hook. ♂, Kurg (Hook. & Th.).

[To be continued.]

XXVIII.—*Notulæ Lichenologicæ.* No. IV.

By the Rev. W. A. Leighton, B.A., F.L.S.

Some highly interesting and instructive discoveries respecting the organization of the fructification of the *Verrucariæ* have been made known by Dr. Giuseppe Gibelli, Professor of Natural History in the Royal Lyceum of Pavia, in his valuable paper entitled "Sugli Organi Reproduttori del Genere *Verrucaria,*" Milan, 1865, of which we propose to offer a summary.

If a vertical section of the apothecium of a *Verrucaria* having unilocular spores be made, a carbonaceous ring is obtained, the upper portion of which is internally clothed with a spermatigerous apparatus, whilst the lower portion of the same ring bears internally the asci and spores, or the sporigerous apparatus. In the centre of the upper portion of the carbonaceous ring is a small ostiolum, or opening, through which the reproductive spores issue in maturity. The spermatigerous apparatus lines the whole internal surface of the upper portion of the carbonaceous ring, but leaves a vacant space internally, corresponding to the ostiolum, and hangs on all sides like an expanded fringe above the sporigerous apparatus.

This structure is noticed by M. Tulasne in his "Mémoire sur les Lichens," in 'Ann. Sc. Nat.' sér. 3. vol. xvii. (1852), and also, as existing in the genus *Sphæria*, in his subsequent work on those Fungi. A similar organization was also discovered by Leighton in *Endocarpon sorediatum*, Hook. See Brit. Ang. Lich. p. 18 (1851).

It may be useful to note the manipulation adopted to obtain the very thin section necessary for this investigation. To about an ounce of the common stearine of a candle a few drops of liquid asphalt were added. A stratum of the liquefied mixture was smeared on a small piece of paper, and on this stratum was laid the apothecium, which was then covered with another stratum of the mixture. When consolidated, the mass was removed from the paper, and with a sharp razor a very delicate section was made, which being placed in a drop of water, was easily freed from the asphalt, and made ready for the microscope.

The microscopical examination of the section so obtained showed that the carbonaceous ring consisted of a united tissue, which gradually passes from the external hard black carbonaceous stratum to an internal stratum formed of a very delicate, white, mucilaginous network containing cells with oily nuclei. This internal stratum is overspread with a semiorganized substance abounding in granulations differing in form and dimensions according to the species, and constituting that which the author names the stratum of the hymeneal corpuscles. Repeated observations showed with certainty that these granulations or nuclei are destined to become either a sterigmatic tube or a sporigerous ascus, according to their position in the upper or lower portion of the section.

The spermatigerous apparatus consists of the stratum of hymeneal corpuscles compressed into a kind of mucous mass, of the sterigmatic tubes, and the spermatia. The sterigmatic tubes are swollen at the base, and bulbiform at the point where they unite with the hymeneal stratum, and comprehend, exactly, in this swelling one or two of the hymeneal nuclei. These tubes are simple or branched and tortuose, segmented into three or four cellules at their base, though sometimes formed of a single cavity. Their free extremities are enlarged, rotund or clavate. Iodine turns them yellow; and with the addition of sulphuric acid they become brown, but never blue with either.

The spermatia are cylindriform corpuscles borne on the free extremities of the sterigmata. In the hermaphrodite *Verrucariæ*, and, with few exceptions, in those which he terms diclinous, they are very slender, and cylindrical, in length 0·0032 millim., and in diameter 0·00052 to 0·00104 millim. They possess a lively Brownian movement, but no spontaneous motion as in spermatozoa. In the hermaphrodite *Verrucariæ* the spermatia cannot be seen, under the microscope, attached to the sterigmata, as the least touch causes them to fall and disperse in the water in which the section is viewed.

But the most original part of Prof. Gibelli's observations is this. He has observed that all the species furnished with distinct paraphyses are *diclinous*; *i. e.* they possess the spermatigerous apparatus in a separate conceptacle termed a *spermogonium*. On the other hand, all the species destitute of distinct paraphyses possess the spermatigerous apparatus within the same apothecium, in the form of a fringe pendent from the upper portion of its cavity, the lower portion producing the asci and spores, and are therefore termed *hermaphrodite*. Such are all the species with unilocular spores. This fact he has verified by an examination of the following, viz.:—*V. submersa*, Hepp. (Rab. 344); *V. Leightonii*, Hepp. (Hepp. 95); *V. Harrimanni*, Ach. (Anzi, Lich. Ven. rar. 147); *Ticothecium fuscellum*, Flot. (Garov. hb.); *V. nigrescens*, Ach. (Hepp. 434); *Ticothecium nigrescens*, Flot. (Garov. hb.); *Lithoicea nigrescens*, Mass. (Lich. Ital. 172); *V. nigrescens*, Pers. (Anzi, Lich. Ven. rar. 158); *V. catalepta*, Ach. (Hepp. 433); *Lithoicea maura*, Bagl. (Critt. Ital. 392); *Lithoicea macrostoma*, DC. (Mass. Exs. 194); *V. macrostoma*, Duf. (Anzi, Lich. Ven. rar. 159); *V. diffracta* (Anzi, Lich. Langob. 241); *V. viridula*, Schær. (Hepp. 91); *Amphoridium dolomiticum*, Mass. (Exs. 250); *V. rupestris*, Schrad. (M. & N. 951); *V. Hochstetteri*, Fr. (Garov. hb.); *Amphoridium baldense*, Mass. (Exs. 251); *V. epipolæa*, Gar. (Garov. hb.); *V. neglecta*, Gar. (Garov. hb.); *V. platyspora*, Gar. (Garov. hb.); *V. maculiformis*, Hepp. (Garov. hb.); *V. aberrans*, Gar. (Garov. hb.); *V. mauroides*, Schær. (Garov. hb.); *V. muralis*, Schær. (Garov. hb.); *V. orbicularis*, Gar. (Garov. hb.); *V. elæomelæna*, Mass. (Rab. 333); *V. fusco-atra*, Wallr. (Rab. 700); *V. Hoffmanni*, Hepp. (Exs. 431); *V. Dufourei*, DC. (Hepp. 436), &c., together with all those in the herbarium of Prof. Garovaglio which have served as the basis and are enumerated in the synonymy of the first fasciculus of his Monograph of the genus *Verrucaria*.

Of the species with bilocular spores without paraphyses, he has repeatedly noticed as hermaphrodite:—*Pyrenula olivacea*, Schær. (Garov. hb.); *V. olivacea*, Gar. (Garov. hb.); *Acrocordia decussata*, Krmphbr. (Rab. 646); *Sagedia olivacea*, Fr. (Anzi, Langob. 408).

Of the species (saxicolar) with quadrilocular, large, not fusiform spores, he has found as hermaphrodite:—all the varieties of *V. pseudo-Dufourei*, Gar.; *V. cryptarum*, Gar. (Gar. hb.); *V. Leonina*, Anzi (Lang. 242); *Sagedia bubulcæ*, Mass. (Anzi, Lich. Ven. 136).

To these must be added the saxicolar species with multilocular or muriform spores, whether 2- or 8-spored, as *V. maculiformis*, Krmphbr. (Anzi, Lang. 367); *Sagedia Sprucei*, C. Bab. (Anzi, Lang. 286); *Thelotrema quinqueseptatum*, Hepp. (Exs. 99); *Sagedia pyrenophora*, Ach. (Hepp. 97).

And also all the species in herb. Garovaglio which the Professor has described as *V. fissa*, Gar.; *V. Catalepta*, Ach.; *V. rufa*, Gar.; *V. intercedens*, Nyl.; *V. pallide-lutea*, Gar., &c.

All the foregoing are saxicolar species, and all absolutely *without paraphyses*.

Most of the corticolar species which he has examined have paraphyses; and all are *diclinous*. He has discovered spermogonia in all the following corticolar *Verrucariæ* furnished with paraphyses:—*V. gemmata*, Ach.; *V. epidermidis*, Ach.; *Pyrenula nitida*, Ach.; *Sagedia byssophila*, Körb. (Hepp. 695); *Arthropyrenia fraxini*, Mass. (Exs. 288); *Sagedia candida*, Anzi (Lich. Lang. 221); *V. punctiformis*, Pers., var. *diminuta*, Flot. (Garov. hb.); *V. cinerea*, B. *atomaria*, Flot. (Garov. hb.); *V. cinereo-pruinosa*, Schær. (Garov. hb.); *V. carpinea*, Pers. (Garov. hb.); *Sagedia carpinea*, Pers., Mass. (Anzi, Lich. Ven. 139); *V. conoidea*, Fr. (Garov. hb.). And he doubts not that further examination will detect them in all the other species having paraphyses.

The spermogonia are sometimes plurilocular, and the sepiments are not formed of cellules with black carbonaceous walls, like that which limits the spermogonia externally, but of a mass of hymeneal corpuscles cemented by a mucilage which organizes itself into cellular walls or into sterigmatic tubes. All the spermatia are cylindrical and straight, except those of *Pyrenula nitida*, Ach., *P. glabrata*, and their allies, which are filiform, incurved. Proportionately to the size of the apothecia, the spermatia of the diclinous species are much larger than those of the monoclinous or hermaphrodite species.

He supposes that in the hermaphrodite species the spermatia are first of all developed, and that fecundation is effected by the spermatia falling upon the base of the apothecium and fecundating the hymeneal corpuscles, which afterwards have the faculty of investing themselves with a membrane, and thus progenerate the asci and within them the spores.

In the diclinous species, further investigations are needful to ascertain the mode of fecundation.

On the above subject Dr. W. Nylander thus writes in the 'Flora' of Dec. 9, 1865, p. 579:—"Notare liceat, spermatia, quæ videre crediderunt clarissimi Garovaglio et Gibelli in supera parte cavitatis apotheciorum apud *Verrucarias*, nulla talia sistere vera. Filamenta ostiolaria sæpissime apice fragmenta tenella compressione secernere conspiciuntur, hocce autem longe distat ab elementis spermogonicis (cf. Nyl. in Flora, 1864, p. 354, et ibidem p. 358 exemplum allatum paraphysium et filamentorum ostiolarium optime consociatorum in eodem perithecio)."

XXIX.—*On the Pleistocene Fossils collected by* Col. E. Jewett *at Sta. Barbara* (*California*); *with Descriptions of new Species.* By Philip P. Carpenter, B.A., Ph.D.

The study of the recent and tertiary mollusks of the west coast of America is peculiarly interesting and instructive, for the following reasons. It is the largest unbroken line of coast in the world, extending from 60° N. to 55° S., without any material salience except the promontory of Lower California. Being flanked by an almost continuous series of mountain-ranges, the highest in the New World, it might reasonably be supposed that the coast-line had been separated from the Atlantic from remote ages. The almost entire dissimilarity of its faunas from those of the Pacific Islands, from which it is separated by an immense breadth of deep ocean from north to south, marks it out as containing the most isolated of all existing groups of species, both in its tropical and its temperate regions. When we go back in time, we are struck by the entire absence of anything like the boreal drift, which has left its ice-scratchings and arctic shells over so large a portion of the remaining temperate regions of the northern hemisphere, and also by the very limited remains of what can fairly be assigned to the Eocene age. The great bulk of the land on the Pacific slope of North America (so far as it is not of volcanic origin) appears to have been deposited during the Miocene epoch. Here and there only are found beds whose fossils agree in the main with those now living in the neighbouring seas. To trace the correspondences and differences between these and their existing representatives may be expected to present results analogous to those now being worked out with such discerning accuracy from the various newer beds of modern Europe.

The first collection of Californian fossils seen in the east was made near Sta. Barbara by Col. E. Jewett in 1849; but no account was published of them before the list in the British Association Report (1863), p. 539. They consist of forty-six species, of which twenty-nine are known to be now living in the Californian seas, and others may yet be found there. The following ten are Vancouver species, some of which may travel down to the northern part of California:—

Margarita pupilla,	*Priene Oregonensis,*
Galerus fastigiatus,	*Trophon Orpheus,*
Bittium filosum,	*Chrysodomus carinatus,*
Lacuna solidula,	*C. tabulatus,* and
Natica clausa,	*C. dirus.*

Some of these are distinctly boreal shells, as are also *Crepidula grandis* (of which Col. Jewett obtained a giant, $3\frac{1}{2}$ inches long, and which now lives on a smaller scale in Kamtschatka) and *Trophon tenuisculptus* (whose relations will be presently pointed out). So far, then, we have a condition of things differing from that of the present seas, somewhat as the Red Crag differs from the Coralline. But in the very same bed (and the shells are in such beautiful condition that they all appear to have lived on the spot, which was perhaps suddenly caused to emerge by volcanic agency) are found not only tropical species which even yet struggle northwards into the same latitudes (as *Chione succincta*), but also species now found only in southern regions, as *Cardium graniferum* and *Pecten floridus.* Besides these, the following, unknown except in this bed, are of a distinctly tropical type, viz.:

Opalia, var. *insculpta.*	*Pisania fortis.*
Chrysallida, sp.	

From a single collection made only at one spot, in a few weeks, and from the very fragmentary information to be derived from the collections of the Pacific Railway surveys (described by Mr. Conrad, and tabulated in the Brit. Assoc. Report, 1863, pp. 589–596), it would be premature to draw inferences. We shall await with great interest the more complete account to be given by Mr. Gabb in the Report of the California Geological Survey. With the greatest urbanity, that gentleman has sent his doubtful Pleistocene fossils to the writer, to be compared with the living fauna; but it would be unfair here to give any account of them, except that they confirm the foregoing statements in their general character.

The following are diagnoses of the new species in Col. Jewett's collection.

Turritella Jewettii.

T. testa satis tereti, haud tenui, cinerea rufo-fusco tincta; anfr. subplanatis, suturis distinctis; lirulis distantibus (quarum t. jun. duæ extantiores) et striolis subobsoletis spiralibus cincta; basi parum angulata; apertura subquadrata; labro tenui, modice sinuato.

Hab. Sta. Barbara, Pleistocene formation (*Jewett*). San Diego, on beach (*Cassidy*).

This species comes nearest to *T. sanguinea*, Rve., from the Gulf, but differs in the faintness of the sculpture. Mr. Cassidy's specimens may be washed fossils, or very poor recent shells.

Bittium ?asperum.

B. testa *B. quadrifilato* forma, magnitudine, et indole simili, sed sculptura intensiore; eodem vertice nucleoso abnormali; sed, vice filorum, costulis spiralibus costas spirales superantibus, subnodulosis; t. jun. costulis ii. anticis majoribus, alteris minimis; postea plerumque iv. subæqualibus, interdum iii. interdum aliis intercalantibus; sculptura basali intensiore; costis radiantibus subarcuatis.

? = *Turbonilla aspera,* Gabb, in Proc. Acad. Nat. Sc. Philadelphia, 1861, p. 368.

Hab. Sta. Barbara, fossil in Pleistocene beds; abundant (*Jewett*). S. Pedro, S. Diego, Catalina Is. 30–40 fms. (*Cooper*), State Col. no. 591 *c*.

Mr. Gabb informs me that his *Turbonilla aspera* is a *Bittium.* Unfortunately the type is not accessible; and as the diagnosis would fit several closely allied species, it cannot be said with precision to which it rightfully applies. As this is the commonest of the group, it is presumed that it is the "*Turbonilla*" intended. Should the type, however, be recovered, and prove distinct, this shell should take the name of *B. rugatum,* under which I wrote the diagnosis, and which was unfortunately printed in the Brit. Assoc. Report, p. 539. The fossil specimens are in much better condition than the recent shells as yet discovered.

Bittium armillatum.

B. testa *B. aspero* simili; anfr. nucl. ii. lævibus, tumentibus, vertice declivi, celato; dein anfr. ix. normalibus planatis, suturis impressis; t. adolescente seriebus nodulorum tribus spiralibus extantibus, supra costas instructis; costis radiantibus circ. xiii. fere parallelis, seriebus, a suturis separatis, spiram ascendentibus; t. adulta, costulis spiralibus, interdum iv., intercalantibus; costulis radiantibus creberrimis; costis suturalibus ii. validis, haud nodosis; basi effusa, liris circ. vi. ornata; apertura subquadrata; labro labioque tenuibus; columella vix torsa, effusa, vix emarginata.

Hab. Sta. Barbara, Pleistocene, 1 sp. (*Jewett*). S. Pedro, S. Diego (*Cooper*).

The sculpture resembles *Cerithiopsis*; but the columella is pinched, not notched.

Opalia (?*crenatoides*, var.) *insculpta.*

O. testa *O. crenatoidei* simili; sed costis radiantibus pluribus, xiii.–xvi., in spira validis; anfr. ult. obsoletis; sculptura spirali nulla; punctis suturalibus minus impressis, circa fasciam basalem lævem postice, non antice continuis.

Hab. Sta. Barbara, Pleistocene, 1 sp. (*Jewett*).

Very closely related to *O. crenatoides,* now living at Cape St. Lucas, and, with it, to the Portuguese *O. crenata.* It is quite possible that the three forms had a common origin.

Trophon tenuisculptus.

T. testa *T. Barvicensi* simili, sed sculptura minus extante; vertice nucleoso minimo; anfractibus uno et dimidio lævibus, apice acuto; normalibus v., tumidis, postice subangulatis, suturis impressis; costis radiantibus x.–xiv., plerumque xii., haud varicosis, angustis, obtusis; liris spiralibus majoribus, distantibus, quarum ii.–iii. in spira monstrantur, aliis intercalantibus, supra costas radiantes undatim transeuntibus; tota superficie lirulis incrementi, supra liras spirales squamosis, eleganter ornata; canali longiore, subrecta, vix clausa; labro acutiore, postice et intus incrassato, dentibus circ. v. munito; labio conspicuo, lævi; columella torsa.

Hab. Sta. Barbara, Pleistocene formation (*Jewett*).

This very elegant shell is like the least-sculptured forms of *T. Barvicensis,* from which it appears to differ in its extremely small nucleus. It is very closely related to *T. fimbriatulus,* A. Ad., from Japan, but differs in texture, and is regarded by Mr. Adams as distinct. It stands on the confines of the genus, there being a slight columellar twist, as in *Peristernia.*

Pisania fortis.

P. testa *P. insigni* simili, sed solidiore; crassissima, sculptura valde impressa; anfr. norm. v., parum rotundatis, suturis distinctis; costis radiantibus t. juniore circ. xii., obtusis, parum expressis, postea obsoletis; liris spiralibus validis, crebris (quarum t. juniore v., postea x., in spira monstrantur), subæqualibus, anticis majoribus; canali recurvata; lacuna umbilicali magna; labro intus crebrilirato; labio conspicuo, spiraliter rugose lirato.

Hab. Sta Barbara, Pleistocene formation (*Jewett*).

Col. Jewett's single specimen is in very fine condition, and is confirmed by a fragment obtained by Mr. Gabb, the palæontologist to the California State Survey. Although resembling *Purpura aperta* and congeners in the irregular rugose folds of the labium, and *Siphonalia* in the strongly bent canal, Mr. H. Adams considers that its affinities are closest with the *Cantharus* group of *Pisania*. That genus is extremely abundant in the tropical fauna, but does not now live in California. It is the only distinctly tropical shell in the whole collection; and its presence, along with so many boreal species and types, appears somewhat anomalous, like the appearance of *Voluta* and *Cassidaria* in the Crag fauna. It is distinguished from the extreme forms of *P. insignis* by having the spiral liræ pretty equally distributed over the early whorls, by the close internal ribbing of the labrum, by the absence of the stout posterior parietal tooth, and by the great development of the columellar folds.

Note.—Unfortunately, during the long interval which has elapsed between the transmission of the MS. and receipt of the proof, the types have been returned to the owner, and (with the remainder of Col. Jewett's invaluable collection of fossils) have become the property of a college in New York State. As they are packed in boxes, and at present inaccessible, I am unable to give the measurements; but the unique specimens were drawn on wood by Mr. Sowerby for the Smithsonian Institution.—P. P. C., Montreal, Feb. 22, 1866.

XXX.—*On the Float of the* Ianthinæ. By Dr. H. Lacaze-Duthiers*.

Fabius Colonna was the first to indicate the existence of the peculiar float of the *Ianthinæ*, under the name of *spuma cartilaginea*. Cuvier proved that this organ had no organic connexion with the body. "It is attached," he says, "to the posterior part of the foot, almost immediately beneath the spot where the operculum of other genera occurs. I should be very willing to think that it is a vestige of the operculum which has undergone, in its form and tissue, changes similar to those with which nature presents us in so many of her other productions." We shall recur to this last notion, which does not appear to be quite correct. Cuvier evidently had not observed the living animal,

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' série v. tome iv. pp. 328–341.

but his investigation had been made upon individuals preserved in spirits. He adds, "The organ has no direct communication with the interior of the body; it is a mere appendage of the integuments. And it does not appear that the animal can at pleasure empty or fill it with air; it can only compress it by drawing it into the shell, or leave it to its natural elasticity by allowing it to escape"*.

I have been able to examine animals in the expanded and contracted states—even strongly contracted, such as those which the sea had rolled upon the beach; and it is impossible to admit that the float enters entirely within the shell; it follows the *Ianthina* as it withdraws, but it is not introduced into the shell as a part of the organism.

All differences of opinion will be easily explained when we have shown what is the real origin of this curious object. It will be seen how erroneous was the opinion of Bosc† (already justly criticised by Cuvier) when he said that *the animal absorbs the air from its vesicles and inflates them at pleasure.* Cuvier adds, "This assertion of Bosc is only a supposition, and not a fact ascertained by direct experiments." Even the very presence of the organ did not appear to the celebrated naturalist to be absolutely necessary; for he says distinctly, "All individuals do not possess this organ: I have three which do not show the least trace of it."

Bory Saint-Vincent had no doubt observed the living *Ianthina* in his voyages; and he says, "I have not observed that the animal had the faculty of emptying or filling it at pleasure and with promptitude"‡. The same observer adds that he has seen *Ianthinæ* "in which the organ had been crushed, or reduced one-fourth, without their appearing to have suffered." And Cuvier, who cites this opinion, remarks that "its nature is in fact such that *Ianthinæ* deprived of it by violence would probably experience no other inconvenience than that resulting from the difficulty of rising to the surface of the water."

All this is in accordance with its anatomical nature—that is to say, the independence of the tissue and of the float, but not with its origin and nature. Thus, when Cuvier adds, "But I have reason to believe that there are some which are naturally deprived of it," he makes a supposition, and his opinion expresses doubt when he seeks to give its explanation. Thus he invokes age and the season of the year to explain its absence, his reason being that he was unable to "perceive any cicatrix

* Cuvier, "Mémoires pour servir à l'Histoire et à l'Anatomie des Mollusques" (Mém. sur la *Ianthine* et la *Phasianelle*, p. 4).

† Coquilles, tome iv. p. 74.

‡ Voyages, tome i. p. 241.

or residue of this part in the individuals in his possession which wanted it."

Dr. Coates confirmed Cuvier's opinions, and showed that there was no anatomical relation between the body and the float*. He also found that the latter was entirely secreted by the foot, and that when a portion is removed the damage is quickly repaired.

The last author who has paid attention to the float of *Ianthina* is Mr. Adams†; his work is recent, dating only three years ago. It contains numerous facts which are perfectly correct and prove that the author observed the living animal. He says, "The float is attached to the under surface of the caudal end of the foot, where what appear to be the muciparous follicles give it a striated appearance. . . When the animal is weakly or dead, the the float readily becomes detached, for there is no organic connexion between it and the foot." This perfectly correct notion always recurs, and all the observers who have closely examined the matter come to the same conclusion as Cuvier.

As to the origin of the float, Mr. Adams is less positive. He says, "The vesicles are probably formed in the same manner as the frothy spume of the little green Homopterous larva which is seen on bushes in the spring, and which, in Hampshire, usually goes by the name of 'Cuckoo-spit.' When a portion is cut off, the float is enlarged at the end next the foot of the animal, and is not regenerated at the excised part." We shall see, however, that it may be repaired at the point which has been destroyed, but that this depends entirely on the position occupied by this point. Mr. Adams adds, "With a pair of sharp-pointed scissors I made incisions into the floats, and allowed the air to escape, when the animals gradually descended and remained helpless at the bottom of the vessel; the floats were not regenerated or renewed during the period the animals remained alive." I call particular attention to this passage, which very correctly indicates a fact, and which I shall cite in favour of the opinion that I shall maintain. Lastly, Mr. Adams remarks that crepitating portions continue floating until the air which they contain gradually escapes and they collapse, and, finally, that the floats, when pounded in a mortar, are readily reduced to a mucus. Such are the observations that have been made upon the float of *Ianthina*.

The following are the facts that I have ascertained, and from which I deduce the consequences that will be found in this article. In the first place, I was struck with the fact that all the *Ianthinæ* absolutely destitute of aëriferous vesicles remained

* Journ. Acad. Nat. Sci. Philad. vol. iv.

† Annals & Mag. Nat. Hist. ser. 3. vol. x. p. 417 (1862).

at the bottom of the water, although they were quite alive—that some of the more lively ones crept, although with difficulty, with their foot applied to the walls of the vessels, arrived at the surface, then turned themselves up, but most frequently without succeeding in reconstructing their float, and finally fell heavily to the bottom of the water.

I never saw them swim, as so many Mollusca are seen to do, by alternately dilating and contracting the foot. Perhaps in the open sea things may proceed differently, but of this I can say nothing; everything seems to indicate that the shell and the animal are of a weight which does not allow them to swim without a float; and it must be added that the *Ianthinæ* which remained at the bottom of the water quickly died there.

The unsuccessful efforts made by the animals either to return to the surface, or probably to reconstruct their float, gave me the idea of placing them in different conditions, and which, as it appeared to me, must be those sought by them.

I first of all endeavoured to ascertain exactly the constitution of the frothy mass, and, like preceding writers, I soon found that there was no organic relation between it and the body, but that it was merely adherent to the foot, and consequently that the air which it contained, as it could not be the product of a secretion, must have been imprisoned or mechanically enclosed within the vesicles. The thing to be sought, therefore, was the means or mechanism by which the animal was able to introduce a bubble into each vesicle.

The float is very regularly formed; the cells composing it are polyhedral in consequence of the mutual pressure which they exert upon each other, but they are always perfectly spherical in the part that remains free. This may be very well seen, for example, in all the vesicles of the circumference of the organ, upon the upper surface, and especially in the newly-formed cells. Moreover in the arrangement of these vesicles there is a well-marked order: they form nearly straight lines running from one end of the mass to the other, and the greatest length of which is in a direction from before backward.

By carefully observing the anterior extremity (that is to say, that nearest the head), one may exactly count the number and positively ascertain the volume, form, and relations of these terminal cells or vesicles. We may then trace and judge of what takes place when the animal is at work in restoring or increasing its float.

The foot is very distinctly divided into two different parts: the posterior and larger one is flat, and it is this which furnishes the insertion for the float; the other, or anterior one, is rounded in front and hollowed beneath by a canal which changes its form every moment, in consequence of the folding of its margins downwards*. It is the moveable anterior portion that constructs the float; and this is effected as follows:—

It is seen at first to become elongated in front, then to curve and become elevated, pass to the right and left, and embrace in its concavity the anterior extremity of the float, upon which it moulds itself. In its movements of elongation, this part of the foot often acquires the form of a small club, especially when it rises above the surface of the water. The position of the foot upon the anterior extremity of the float has been indicated by Mr. Adams.

But it is especially necessary to follow the succession of the movements or manœuvres of the anterior part of the foot when it issues from the water and approaches the float. The foot is first of all seen to elongate itself, so as to issue from the water in a direction nearly opposite to that of the float, then the animal lifts it up and causes it to project above the liquid. At this moment the organ presents the appearance of a cup at its extremity; it becomes hollowed into a canal by the approximation of its margins beneath, and slightly wrinkles its anterior portion. All these movements of course take place without interruption, but their succession may be observed without difficulty.

When the foot has issued from the water, the animal moves it backward, causing it to describe an arc, which removes it from the head and approximates it to the float; but at the same time the animal bends it in such a manner that the channel and the cup, which were turned upwards, become inferior. Then this extremity of the foot encloses beneath it a certain quantity of air, like an inverted glass or bell immersed under water....In this position the foot gradually approaches the top of the float, and it is then that we see it spread out and slide gently in all directions, as if it was gluing the surface of the float by creeping upon it.

When this manœuvre, which Mr. Adams observed, without, I think, appreciating its purpose, has continued for a certain time,

* We must apply a clear and precise meaning to the words "above" and "below," in order to render the descriptious intelligible. The *Ianthina*, when swimming suspended from its float, is reversed, like a *Limnæa*, which swims by gliding with its foot at the surface of the water. Hence, when we speak of the inferior surface of the foot, we mean of the foot in its natural position; and when, in the preceding paragraph, it was said that "the foot is hollowed into a canal *beneath*," this relates to the position of the animal supposed to be erected and creeping upon the foot. For if we take the position of the animal beneath the float absolutely, this ought to be described as the superior surface. It will be remembered, therefore, that the words "above" and "below" relate not to the reversed animal, but to the animal supposed to be in the normal position of a Gasteropod.

the foot withdraws, quite gently, under water, to remain there if its operations cease, or to move forward again and recommence if its work is to be continued.

When we have counted the number of vesicles at the extremity of the float, and thoroughly observed their arrangement before the manœuvres just indicated, we see, when they have ceased, that another cell has been glued on in front of those which we had ascertained to be the furthest towards the mouth. This first fact proves incontestably that the growth of the float takes place longitudinally and at its anterior extremity. It proves also that it is the foot which manœuvres in such a manner as to add the new vesicles towards this extremity; and the process of growth is, no doubt, as follows:—The foot, first of all curled up into a cup, had, when applied to the float, a certain thickness of air between it and the latter; by secreting a layer of mucus and then spreading out, it must necessarily join this viscous layer to the rest of the float, and thus keep the air-bubble imprisoned.

We may form an idea of what takes place when we observe a garden-snail or slug creeping upon a body covered with dust: we often find, beneath the train of mucus left behind it by the animal, a bubble of air which is imprisoned between the unmoistened surface of the body and the lamella secreted by the foot. Here we have something produced, mechanically speaking, perfectly similar; but in the former case it is accomplished by design and for a particular purpose.

The mucosity is evidently insoluble in water; and as it dries in the emergent portion, it acquires a certain consistence, which has led to the supposition that it was cartilaginous.

If we admit the process of the formation of the float to be as just described (and it seems difficult to me not to regard it as true, since at each new movement of the foot we count a fresh bubble added), we may easily explain the dissidences of authors, their opinions, and most of the facts which they relate. Thus we understand why the animal, when once at the bottom of the water, is incapable of forming a new float. Most probably the *Ianthinæ* which have lost their float are fated to die, unless they be carried to the surface by some cause which I shall not attempt to imagine.

* * * * * *

To verify the notion which has just been put forward, it was necessary that experiments, varied in several ways, should furnish its confirmation.

Having taken an *Ianthina* upon a small iron hook and suspended it, not out of the water, but at about that depth below the surface which it occupies when it swims freely suspended from its float, I remarked that when the first movements preceding its being placed in this position ceased, and the animal believed itself out of danger, it issued by degrees from its shell, extended its foot, and commenced the manœuvres described above. I had the satisfaction of seeing the opinion that I had formed confirmed in every point, by observing the animals in these normal conditions; for I was able to be present, with the help of patience, at the origin and formation of a float. I saw that, in proportion as one bubble was added to another, the animal became specifically lighter, and was less immersed in the water. And I ascertained that, under these circumstances, the *Ianthinæ* which could not reach the surface made vain efforts and movements to form bubbles; and when, under these circumstances, I very gently raised the shell by means of a small hook, as soon as the foot issued from the water, air was imprisoned, a bubble added to the float, and the animal began to reascend. Now, nothing of this could have taken place without the assistance which I gave it.

I have had many individuals of which the floats, being partially destroyed by storms, were insufficient to bring the body of the *Ianthina* near enough to the surface, and allowed the animals to perish floating at mid water, exactly like those which fell to the bottom of the vessels when completely deprived of aëriferous vesicles.

Dr. Coates, cited by Forbes and Hanley, and already mentioned, supposes that the young *Ianthinæ*, on issuing from the capsules suspended beneath the float, in which they passed their first embryonic period, get upon the back of the float, and then attempt the formation of the apparatus which subsequently enables them to do without their mother. This supposition, from what we have just seen, appears to be perfectly legitimate as a supposition. Nevertheless, as this matter is not proved by direct observation, we must not forget that the Gasteropods in an embryonic state have locomotive organs, which enable them to move about, and to come even to the surface of the water; for they are very active. It may be, therefore, that at the moment when the organs of locomotion bring the young *Ianthinæ* to the surface of the water, they begin to form with their foot a few bubbles containing air which serve as their first floats.

As all authors have stated, the floats of the *Ianthinæ* are delicate; they must be affected by the attacks of the numerous and voracious inhabitants of the sea, and consequently they must also be constantly repaired. It is plain, indeed, that constant secretion would either be too late for the necessities of the economy of the animal, or in advance of it, producing a too great and inconvenient flotation. Hence the restoration of the float must be entirely subject to the will of the animal, to its appreciation, if I may so speak; and this is really the case, as it never makes use of the mucosity of its foot except when it feels its float to be insufficient, just as the spider employs the silk with which its spinnerets furnish it only when injuries have rendered its web unfit to capture the prey which is necessary for its existence.

It is unnecessary to say that a gaseous secretion is inadmissible, and that there is nothing to warrant its existence.

From all that precedes, I may justly be asked whether I have seen in my aquaria *Ianthinæ* entirely deprived of their floats reconstruct new ones. I reply that the animals did not live long enough for this; it is with them as with the spider to which I have just referred: if we destroy its web, it reconstructs this, but at the expense of its body; and if we continue without allowing it to capture a prey, if its organization does not provide itself with what is necessary to repair the losses caused by secreting silk, it is seen to die of inanition. In the same way here: the *Ianthinæ* are animals of the high sea; they find in these regions their proper food, which they did not meet with, in all probability, in my aquaria; hence they only lived a short time, exhausted by their exertions and by the want of nourishment.

In conclusion, I will remark that Cuvier's opinion, so full of reserve and doubt, cannot be maintained. The float of the *Ianthina* cannot in any way represent an operculum, or even its distant analogue.

XXXI.—*Descriptions of some new Species of Diurnal Lepidoptera in the Collection of the British Museum.* By Arthur G. Butler, F.Z.S., Assistant, Zoological Department, British Museum.

Limenitis Calidasa, n. sp.

L. Calidasa, Moore, MS.

Alæ supra fuscæ, fascia media irregulari albo-viridescente, anticarum maculas octo inæquales formante, posticarum integra, in medio latiore; area basali fascia media interrupta rubra nigro circumdata, basi fascia simili obscura; area apicali fascia submarginali rubra, maculis nigris utrinque marginata; margine postico pallido, lunulis nigris marginato.

Corpus fuscum; antennæ nigræ, rubro acuminatæ.

Alæ anticæ subtus area basali viridi, fascia media rubra a vena media partita, lineaque basali obliqua nigra; area apicali cinerea, venis apud costam rubris, linea rubra undata, maculisque nigris submarginata; fascia media velut supra nigroque utrinque marginata;

margine postico albo, linea fusca marginato, angulis alternis; ciliis albis venis nigro acuminatis.

Alæ posticæ area basali viridi, lineis sub vena costali duabus, puncto inter nervulos subcostales lineisque quatuor intra cellam nigris; fascia media latiore, lunulis brevibus nigris marginata; area apicali cinerea, fascia rubra velut supra; margine postico albo, lineis duabus fuscis marginato, angulis alternis, venis nigro acuminatis.

Corpus viride; antennæ ferrugineæ.

Alar. exp. unc. $2\frac{7}{8}$.

Hab. Ceylon.

This species is allied to *Limenitis Zulema,* Doubl. & Hewits. (North India).

Euodia Joanna, n. sp.

Alæ anticæ supra fuscæ; macula parva apicali nigra purpureo pupillata, maculaque apud angulum analem majore simili; fasciis duabus fulvis de costa currentibus, una cellam terminante, similique apud apicem; fascia conspersa fulvo inter cellam angulumque analem currente.

Alæ posticæ fuscæ, ocello parvo apicali nigro ferrugineo circumdato, maculaque apud angulum analem majore violaceo pupillata.

Alæ anticæ subtus fuscæ, fasciis subcostalibus ad angulum analem productis; ocellis ochreo circumcinctis; margine postico lineis duabus pallidis marginato.

Alæ posticæ velut in *Euodia Abeona,* Donov. (Australia), *Hipparchia? Abeona,* Doubl. (List Lep. Brit. Mus.), ocellis autem majoribus.

Alar. exp. unc. $2\frac{7}{16}$.

Hab. Australia.

Closely allied to *E. Abeona,* Donov., of which it has been hitherto supposed to be a variety; but I can discover no proofs of the identity of the two insects, and have therefore described it as distinct.

It differs from *E. Abeona* above in having the distinct orange band of the front wings replaced by two pale-yellow streaky bands, and the anal ocellus of the hind wings much larger.

Below, the orange band of the front wings is replaced by a narrower and indistinct pale-yellow band, and the ocelli are more distinctly encircled by pale brown. In the hind wings the ocelli are proportionably much larger and brighter.

Lasiommata mirifica, n. sp.

Alæ anticæ supra fuscæ, fascia ochrea obliqua lata irregulari, de costa post medium ad angulum analem currente; macula alba inter venas discoidales apud marginem posticum.

Alæ posticæ fuscæ, ocello magno apud angulum analem nigro albo pupillato ferrugineoque circumcincto.

Alæ subtus fuscæ, cinereo variæ; *anticæ* fascia ochrea lata maculaque alba; *posticæ* punctis albo pupillatis inter venas post alarum medium dispositis.

Alar. exp. unc. $2\frac{5}{8}$.

Hab. —— ?

This species is most closely allied to *Lasiommata Merope*, Boisduval (Australia). Our specimen is unfortunately in very bad condition.

We have a female specimen of an insect somewhat more closely allied to this species: it differs from the usual form of *L. Merope* in having the apical half of the front wings black, the anal spot being small and quite distinct from the basal ferruginous portion of the wing; and the yellow spot below the front-wing ocellus is also replaced by a white spot.

XXXII.—*Some Account of a new Species of Fern* (Polystichum Maderense) *recently discovered in the Island of Madeira.* By James Yate Johnson, Cor. M.Z.S.

I am indebted to Mr. Joad, a zealous collector and student of Ferns, who has lately spent a few months in this island, for being permitted to examine and describe a Fern, of which he found a single specimen in the Ribeiro de Janella. The two or three fronds submitted to me show that the Fern is exactly intermediate between *Polystichum falcinellum*, Presl, and *P. angulare*, Presl, both of them natives of this island, the former being, as far as is known, peculiar to Madeira. Widely as these two forms appeared to be separated, they are certainly brought into close contact by the Fern which I now shortly describe.

The facies of the frond at once suggests an alliance with *P. angulare*. It is lanceolate, lax, and subbipinnate; that is, the pinnæ are divided nearly to the midrib, and the lobes are narrowed, but not stalked, below. Each lobe has at its tip a short but conspicuous aculeus. The first lobe on the upper side of each pinna is elongate; and here we have an approach to *P. falcinellum*, a resemblance which is further displayed in the form of the pinnæ at the upper end of the frond, and in the structure of the scales on the rachis, which are long and somewhat hair-like. The arrangement of the sori are more like what is seen in *P. falcinellum* than in *P. angulare*. The indusia are those of the genus.

The fronds of the specimen are upwards of 24 inches in length.

Further researches may show that this is only a variety of *P. falcinellum*; but for the present it seems best to register it as a distinct species.

Madeira, March 3, 1866.

XXXIII.—*Contributions to an Insect Fauna of the Amazons Valley.* Coleoptera: Longicornes. By H. W. Bates, Esq.

[Continued from p. 201.]

Group *Pogonocherinæ.*

Genus Prymnosis, nov. gen.

Body elongate, plane above, and clothed with short, fine, erect hairs. Head small, depressed on the crown between the antenniferous tubercles, prolonged some distance below the eyes, and contracted at the occiput behind the eyes. Antennæ filiform, nearly twice the length of the body, and clothed throughout with fine, stiff hairs, longest on the underside of the joints; the basal joint elongate, nearly as long as the third, the third a very little longer than the fourth, and the rest very slightly diminishing in length. Thorax oblong, and armed on each side with a stout, porrect and acute spine. Elytra plane above, shoulders armed with a short spine, tapering thence to the apex, which is truncated, with the external angles prolonged each into a spine. Legs moderately elongated, thighs slightly clavate, tarsal joints triangular, claws divergent. Mesosternum narrowed and elevated behind; sockets of anterior coxæ widely angular externally.

Prymnosis bicuspis, n. sp.

P. elongata, postice attenuata, supra plana, punctata, fusco-castanea, vertice, thorace et scutello linea dorsali flava; elytris apice truncatis, angulis externis spinosis divaricatis, supra sublineatim punctatis, cinereo confluenter maculatis; pedibus rufo-testaceis. Long. 4 lin.

Head very coarsely punctured, black, depressed between the antenniferous tubercles; occiput constricted and marked with a yellow central vitta, which is continuous over the thorax to the scutellum. Antennæ nearly twice the length of the body, clothed sparingly throughout with fine, stiff hairs; reddish. Thorax oblong, armed on each side with a stout spine, surface very coarsely punctured, dark castaneous, with a yellow central line. Scutellum yellow. Elytra narrowed in a straight line from base to apex; shoulders armed with a small spine; apex truncated, external angles produced each into a long slightly diverging spine; surface punctured partly in lines, dark castaneous, sprinkled with grey confluent spots, which leave an oblique belt about the middle spotless. Body beneath shining, thinly pubescent; thoracic segments coarsely punctured, black; abdomen reddish, faintly punctured. Legs testaceous red, clothed with fine hairs.

Santarem and Ega.

Genus Esthlogena, Thomson.

Thomson, Systema Cerambyc. p. 107.

In this genus the body is elongated, subdepressed, and parallelogrammical or slightly narrowed behind, with the apex of the elytra more or less truncated, and sometimes dentate. The hairy clothing usual in this group is, in some of the species of *Esthlogena*, short and bristly. The head is small, with no depression between the antenniferous tubercles; the face is short and convex, and very slightly prolonged below the eyes. The thorax is armed on each side with a conical tubercle. The legs are moderately long and stout, with subclavate femora and short, triangular tarsal joints. The claws are only semidivergent—a character which, together with the more elongated body and linear elytra, distinguishes this genus from *Estola*, to which it is very closely allied. The antennæ, as in *Estola*, are scarcely longer than the body, hairy, with the fourth joint a little longer than the third, and the remaining joints becoming gradually and slightly shorter. The basal joint is short and thick, and narrowed at the base.

1. *Esthlogena pulverea*, n. sp.

E. elongata, angustata, postice paulo attenuata, breviter setosa, cinereo-ochracea; antennis corpore haud longioribus, articulis apice fuscis; thorace supra sparsim punctato, vittis sex obscuris brunneis, lateribus utrinque tuberculo lato apice spinoso; elytris sparsim punctatis, apice breviter sinuato-truncatis, angulis externis productis, cinereo-fuscis, sutura maculaque apicali cinereo-ochraceis. Long. $4\frac{1}{4}$ lin.

Head small, clothed with laid ashy-ochreous tomentum. Antennæ about as long as the body, clothed sparingly with stiff hairs, ashy ochreous, tips of the joints, from the fourth, blackish. Thorax as wide as head and elytra, slightly uneven on the surface; sides each with a broad dentiform prominence in the middle; disk marked with a few scattered punctures; ashy ochreous, disk with two, and sides each with two, obscure brownish vittæ. Elytra elongate, narrowed before the apex, which is briefly sinuate-truncate, with the outer angles dentiform; surface clothed with fine bristles, marked with a few widely scattered punctures, ashy brown, with the suture and a spot near the apex ashy ochreous. Body beneath and legs ashy ochreous.

Santarem.

2. *Esthlogena mucronata*, n. sp.

E. elongata, postice paulo attenuata, dense breviter hirsuta, castaneo-fusca; pedibus piceo-rufis; elytris confertim cinereo confluenter maculatis, punctato-striatis, apice sinuato-truncatis, angulis externis spinosis; tibiis dilatato compressis. Long. 5–6 lin.

Head dark pitchy, thinly pubescent, and marked with large scattered punctures. Antennæ about as long as the body, setose, pitchy red, becoming darker towards the apex, with the joints pale ashy. Thorax closely covered with large deep punctures, leaving a smooth longitudinal dorsal space scored by an impressed line; lateral prominence small, dentiform; surface thinly clothed with ashy pubescence, forming faint lines. Elytra elongate, subdepressed, tapering behind; apex sinuate-truncate, with the outer angles spiniform; surface very thickly clothed with erect hairs springing from punctures arranged in lines; the colour is dark blackish chestnut, shining and varied throughout with cinereous confluent specks. Body beneath castaneous, thinly clothed with ashy pile. Legs reddish; intermediate and posterior tibiæ broad and compressed from base to apex.

Ega, on dead branches.

3. *Esthlogena sulcata*, n. sp.

E. elongata, subdepressa, postice paulo attenuata, undique breviter setosa, nigro-castanea; capite, thorace et scutello cinereo-fulvo vittatis; elytris cinereo confluenter maculatis, punctato-striatis, striis postice fortiter impressis, apice truncatis, angulis externis spinosis; pedibus rufo-castaneis. Long. 7 lin.

Head very coarsely punctured; forehead strongly convex; vertex with two ashy-tawny stripes. Antennæ about as long as the body, castaneous, clothed with grey pubescence; apices of the joints, from the fourth, black. Thorax broadened in the middle, and having on each side a distinct acute tubercle; surface covered with scattered punctures, leaving a smooth space along the middle; clothed with ashy pubescence arranged in vittæ, the central vitta (continuous to the scutellum) tawny. Elytra elongated, closely covered with short bristles (like the rest of the body); apex squarely truncated, with the external angles produced into an acute tooth; surface punctate-striate, the striæ more deeply impressed posteriorly and the interstices costate, dark blackish castaneous, covered with small confluent spots of grey tomentum. Body beneath blackish, thinly clothed with grey pile. Legs reddish; tibiæ simple.

Santarem, dead branches of trees.

4. *Esthlogena linearis*, n. sp.

E. linearis, dense longe hirsuta, fusco-castanea; thorace foveolato, linea dorsali lævi, lateribus breviter spinosis; elytris lineatim punctatis, cinereo irroratis, apice sinuato-truncatis, angulis vix productis; antennis pedibusque testaceo-rufis, illis articulis apice obscurioribus. Long. $3\frac{1}{2}$ lin.

Head coarsely punctured, clothed with tawny-brown pubescence. Antennæ as long as the body, reddish testaceous; apices of the joints, from the fourth, darker. Thorax sparsely covered with large and deep punctures, leaving a smooth dorsal line; sides each with a small acute spine; colour blackish chestnut. Elytra linear, narrowed close to the apex, the latter sinuate-truncate, with the angles acute, but not distinctly produced; surface clothed with long, stiff hairs very dense towards the apex, punctured in rows, dull castaneous, sprinkled with greyish confluent spots. Body beneath dull reddish brown; legs testaceous red; tibiæ simple.

Santarem. There are two undescribed species, closely allied to this, found in the province of Rio Janeiro*.

Genus Estola, Fairmaire.

Fairmaire, Ann. Soc. Ent. Fr. 1859, p. 524.

This genus is very closely allied to *Esthlogena*, the shape of the head, form and proportion of antennal joints, clothing of body, and general appearance offering no points of difference worthy of mention. The body, however, is less elongated, the elytra being shorter and subtrigonal. The tarsal claws in all the species that I have examined are fully divergent—a character which will at once distinguish the present genus from the preceding.

1. *Estola basinotata*, n. sp.

E. elongato-oblonga, postice attenuata, setosa, brunneo-fulva; thorace basi utrinque maculis duabus, elytris singulis basi macula rotundata, nigro-velutinis; pedibus rufescentibus. Long. 3–$4\frac{1}{2}$ lin.

Head thickly punctured and clothed with tawny-brown pubescence. Antennæ as long as the body, fringed beneath with

* *Esthlogena obtusa.* Elongata, parallelogrammica, setosa, nigro-castanea, griseo irrorata. Caput grosse punctatum. Antennæ dense setosæ, rufo-testaceæ, articulis a tertio basi pallidioribus. Thorax grosse punctatus, niger, linea dorsali lævi et interstitiis griseo pubescentibus; tuberculo laterali apice unguiculato. Elytra linearia, apice obtuse truncata, lineatim punctata, interstitia lævia, nigro-castanea, griseo confluenter maculata. Corpus subtus nigrum, nitidum, sparse tomentosum. Pedes rufi. Long. 5 lin. *Hab.* in Rio Janeiro (D. Squires).

Esthlogena prolixa. Elongatissima, linearis, sparsim setosa, nigra, fusco-grisco tomentosa. Caput sparsim punctatum. Antennæ nigræ. Thorax supra subplanus, punctis magnis paucis notatum, tuberculis lateralibus brevibus, latis, obtusis. Elytra apice recte truncata, angulis externis spinosis; supra sparsim punctata, postice costata. Corpus subtus et pedes nigra. Long. 6 lin. *Hab.* in Rio Janeiro.

stiff hairs; reddish, joints from the third tipped with dusky, eighth joint white, tipped with dusky. Thorax slightly narrowed at the base; sides each with a conical, acute tubercle; surface punctured, setose, tawny brown, base on each side with two velvety blackish spots margined with ashy. Elytra narrowed from base to apex, the latter rounded; surface setose, punctate-striate, punctures elongated; uniform tawny brown, base of each with a rounded, velvety, purplish-black spot. Body beneath blackish, clothed with fine grey pile, and setose; legs reddish, setose.

Forests of the Tapajos.

2. *Estola variegata*, n. sp.

E. elongato-oblonga, postice attenuata, setosa, nigro griseo et fulvo læte variegata. Long. 4 lin.

Head coarsely punctured, setose, black, varied with fulvous spots and spotted with grey behind the eyes. Antennæ as long as the body, sparingly setose, dark reddish, bases of the joints testaceous; eighth joint whitish, tipped with brown. Thorax slightly narrowed behind; lateral tubercles large, with apex acute and slightly recurved; surface setose, coarsely punctured, but leaving small smooth interspaces, black, varied with clear, large, fulvous spots. Elytra tapering from base to apex, the latter rounded; surface setose, punctured in lines; third interstice costate behind, minutely varied with black, clear fulvous, and grey, the last colour prevailing along the suture, and a light fulvo-testaceous spot lying across the suture towards the apex. Body beneath black, thinly clothed with grey pile; legs reddish, varied with greyish and fulvous.

Ega.

3. *Estola lineolata*, n. sp.

E. elongato-oblonga, postice attenuata, setosa, fusca, griseo-fulvo variegata; antennis pallide annulatis; thorace basi utrinque lineola obliqua griseo-fulva; elytris punctato-striatis, apice angustatis, obtusis. Long. 3–4½ lin.

Head coarsely and irregularly punctured, blackish, thinly clothed with coarse tawny-brown pubescence; in brightly coloured individuals obscurely variegated. Antennæ fringed beneath with stiff hairs, dull reddish or testaceous; apices of all the joints dusky, sometimes variegated with grey; eighth joint greyish testaceous, tipped with dusky. Thorax very coarsely punctured; lateral tubercles acute; surface setose, dingy brown, sometimes varied with dull reddish, clothed with scanty tawny-brown pubescence, the base at each side having a short, thin, pale line running obliquely towards the disk, and in fresh examples surrounded by blackish. Elytra tapering to the apex, which latter is narrow and obtuse, almost truncated; surface setose, coarsely punctate-striate, with the third interstice costate before the apex, dingy brown or blackish or partially dull reddish, more or less varied with tawny spots, in fine examples minutely varied with blackish and tawny. Body beneath dingy black; legs reddish, thighs and tibiæ varied with black.

Banks of the Tapajos, common. Also found at Cayenne, and existing in some French collections under the names of *Hebestola annulicornis* and *Leprieurii*. I have a specimen also which was taken by Mr. Squires at Rio Janeiro, where several other species are found allied to this, three of which have truncated elytra*.

4. *Estola porcula*, n. sp.

E. oblongo-ovata, hispida, obscure brunnea, griseo confluenter maculata; antennis testaceo annulatis; elytris antice confuse, postice sublineatim punctatis, apice obtusis. Long. 2–3¼ lin.

Head thickly punctured, blackish, clothed with coarse greyish pubescence and rigid hairs. Antennæ dusky; fourth, sixth, eighth, and tenth joints ringed with pale testaceous. Thorax convex, thickly punctured, setose, and clothed with dull-greyish tomentum; lateral tubercles small, acute. Elytra oblong, scarcely narrowed behind, apex obtusely rounded; surface closely setose, minutely varied with dingy grey and dusky brown, punctured, the punc-

* *Estola truncatella.* Elongato-oblonga, parce setosa, nigro-fusca, griseo obscuro tomentosa. Caput angustum, punctatum. Antennæ ciliatæ, fuscæ, articulo octavo albo annulato. Thorax parvus, spina laterali acuta; supra crebre punctatus, griseo-fuscus, unicolor. Elytra elongato-oblonga, prope apicem angustata, apice oblique truncata, angulis haud productis; supra tenuiter setosa, griseo-fusca, grosse punctato-striata, interstitio tertio postice costato. Pedes nigri, griseo pilosi. Long. 4½ lin. *Hab.* in Rio Janeiro.

Estola acricula. Elongata, postice attenuata, parce setosa, cinereo-fulva, nigro punctata. Caput punctatum. Antennæ corpore breviores, testaceæ, articulis apice brunneo variegatis, articulo octavo testaceo. Thorax grosse punctatus, spinis lateralibus longiusculis acutis. Elytra punctato-striata, cinereo-fulva, nigro punctata, apice oblique truncata, angulis externis breviter spinosis. Long. 4½ lin. *Hab.* in Rio Janeiro.

Estola varicornis (Dj. Cat.). Elongato-oblonga, postice vix attenuata, setosa, nigrina, griseo obscuro variegata. Caput punctatum, inter antennas valde concavum. Antennæ ciliatæ, nigræ, articulis basi pallide testaceis; articulo octavo testaceo, apice nigro. Thorax crebre grosse punctatus, tuberculis lateralibus brevibus acutis. Elytra punctato-striata (interstitio tertio postice acute costato), nigrina, griseo obscure variegata, apice oblique truncata, angulis internis rotundatis, externis distinctis. Corpus subtus nigrum. Pedes nigri, griseo variegati, tarsis rufescentibus. Long. 3–4 lin. *Hab.* in Rio Janeiro.

tures confused except towards the apex, where they are partly arranged in rows. Body beneath and legs dusky, clothed with coarse greyish pile.

Lower Amazons, at Santarem and Villa Nova, on dead twigs.

Genus Epectasis, nov. gen.

Body greatly elongated, narrow, cylindrical, clothed throughout with erect, fine hairs. Head small, face convex, vertex depressed between the bases of the antennæ; eyes reniform, rather distant on the crown. Antennæ as long as the body, filiform, clothed both above and beneath with long and fine hairs; basal joint short and thick, but narrowed at the base; third joint considerably shorter than the fourth, the following joints gradually and successively shorter. Thorax elongate, cylindrical; lateral tubercles nearly obsolete. Elytra elongated, cylindrical, apex obliquely truncated. Legs short; thighs scarcely clavate, basal joint of the posterior tarsi cylindrical, as long as the second and third taken together; claws semidivergent. Sterna narrow, plane.

The chief points of distinction between this genus and the two preceding are the elongated cylindrical form of body, the hairy antennæ, both above and beneath, and the unarmed thorax. The insect known in collections under the MS. name of *Euteles lurida*, might be included in it, as it offers most of the characters, with the exception of the fourth antennal joint not exceeding in length the third.

Epectasis attenuata, n. sp.

E. elongata, cylindrica, hirsuta, obscure castaneo-fusca; antennis piceo-rufis, articulo terminali dimidioque penultimi pallide testaceis; thorace crebre punctato, medio late cinereo-fusco vittato; elytris grosse confuse punctatis, prope apicem cinereo plagiatis, apice oblique valde truncatis. Long. 4 lin.

Head small; face convex, hairy, and clothed with dingy-greyish pubescence, punctured. Antennæ dull pitchy red, basal half of tenth joint and the whole of the eleventh greyish testaceous, bases of several preceding joints also greyish. Thorax cylindrical, elongate, sides slightly conical in the middle; surface closely punctured, dull blackish castaneous, middle with an obscure dull-ashy vitta. Elytra elongate, cylindrical, hirsute, covered with large punctures, dull chestnut-brown; apex with a greyish patch and obliquely truncated. Body beneath and femora blackish, tibiæ and tarsi reddish, hirsute, and clothed with dingy-ashy pubescence.

Ega, on a dead twig.

Group *Apomecyninæ.*

Genus Agennopsis, Thomson.

Thomson, Archives Entom. i. p. 302.

This genus is tolerably well known to students of the Longicornes under the name of *Talæpora* of Dejean's catalogue. The body is of an elongate-elliptical shape with obtusely rounded elytra, the apex of which is adorned in most of the species by a black spot, margined anteriorly with pale ashy, the pale streak existing in those species which are destitute of the black spot. The antennæ, as is usual in the Apomecyninæ, are much shorter than the body, and filiform, with the terminal joints much abbreviated, and the third of great relative length. The thorax is unarmed, the head small, with rounded vertex and forehead and retracted face. The claws of the tarsi are short and scarcely divergent.

1. *Agennopsis pygæa*, n. sp.

A. elongato-elliptica, brunnea; thorace grosse vage punctato, lateribus cinereo-brunneis; elytris vage punctatis, nigro cinereoque obscure irroratis, apice macula rotundata communi nigro-velutina antice cano marginata. Long. $3\frac{1}{2}$–$5\frac{1}{2}$ lin. ♂ ♀.

Head retracted beneath, sprinkled with large punctures, and clothed with tawny-brown pubescence. Antennæ about half the length of the body in the female, two-thirds the length in the male, filiform; third joint as long as the three following taken together, dark brown. Thorax narrowed anteriorly and rounded on the sides, marked with large evenly distributed punctures, which leave a narrow impunctate dorsal space; colour brown, sides each with a broad ashy-brown vitta. Elytra considerably broader than the thorax at the base, scarcely widened beyond the middle, then narrowed to the apex; surface smooth and marked with scattered punctures not arranged in lines; colour light brown, obscurely speckled with dusky and pale ashy, apex ornamented with a rounded velvety black spot, narrowly margined anteriorly with ashy white. Body beneath and legs dingy brown; abdomen with a black spot on each side of the second to the fourth segments.

Santarem, Lower Amazons. Also found at Rio Janeiro.

2. *Agennopsis sordida*, n. sp.

A. elongato-elliptica, brunnea; thorace grosse vage punctato, lateribus cinereo-brunneis; elytris lineatim punctatis, interstitiis subcostatis, ante apicem utrinque lineola transversa cinerea. Long. 4 lin. ♀.

Head marked throughout with very large punctures. Antennæ about half the length of the body, dingy brown. Thorax slightly narrowed anteriorly and scarcely rounded in the middle; surface thickly marked with large punctures, leaving no smooth dorsal line; brown, sides each with a broad ashy-brown vitta. Elytra considerably broader than the thorax, scarcely widened beyond the middle, then narrowed to the apex; surface punctured in rows from base to apex, with some of the interstices elevated; colour brown, obscurely spotted with black and ashy; apex concolorous, and near the apex on each elytron a short oblique ashy line. Body beneath and legs ashy brown; abdomen with a black spot on each side of the second to the fourth segments.

Santarem.

3. *Agennopsis cylindrica*, n. sp.

A. elongata, cylindrica, obscure fusca; capite thoraceque lateribus fulvis; elytris lineatim punctatis, prope apicem linea transversa flavescente. Long. 4 lin.

Head irregularly punctured, clothed with yellowish-tawny pubescence. Antennæ black, three basal joints (except the apex of the third) tawny. Thorax cylindrical, covered with coarse, large punctures; dark brown, sides tawny. Elytra linear, singly rounded at the apex; surface punctured in rows, with a mixture of large punctures; dull brown, with a straight transverse yellowish line near the apex, the space between the line and the apex studded with large black punctures. Body beneath coarsely punctured, dark grey; legs blackish.

Santarem.

Subtribe Saperditæ.

Group *Callianæ*.

Genus Eumathes, Pascoe.

Pascoe, Trans. Ent. Soc. n. s. iv. p. 251; Journal of Entom. i. p. 354.

The characters of this genus are well defined by Mr. Pascoe, in the Journal of Entomology as above referred to. Its position is not so well ascertained. The form of the tarsal claws (widely divergent, with a broad, acute tooth at the base) points to an affinity with the Callianæ; and as I think this feature outweighs in importance the dissimilarity of general form and facies, I have placed the genus in the Callianæ group, rather than amongst the Pogonocherinæ, with which it agrees in some points. The body is elongate-oblong, narrowed behind, depressed above, and beset with short bristles. The head is short, the crown, in profile, not forming an angle with the forehead, and the face very little prolonged and narrowed below the eyes, which latter are large and convex. The thorax has a distinct acute tubercle on each side in the middle. The elytra are singly rounded at the apex. The antennæ are half as long again as the body, filiform, and setose, the basal joint short and forming an oblong club, the third joint a little longer than the fourth, and the rest very gradually decreasing in length. The legs are moderately long, the thighs slightly clavate; the tarsi moderately short, with the claws, as before mentioned, armed each at the base with a large, acute tooth.

Eumathes Amazonicus, n. sp.

Eu. elongato-oblongus, supra planus, setosus, viridi-cinereus, obscure fusco maculatus; elytris dense et confuse punctatis; maris tarsorum posticorum articulo primo valde elongato. Long. 5–5½ lin.

Head coarsely punctured, clothed with grey pubescence. Antennæ dingy grey. Thorax irregularly punctured on its surface, light-greenish ashy, obscurely varied with dusky; lateral tubercles small, acute. Elytra slightly narrowed behind, plane above and free from costæ, rather thickly but irregularly covered with small punctures, especially on the basal half, and clothed with short bristles; pale-greenish ashy, obscurely varied with dusky spots of various sizes. Body beneath and legs clothed with ashy pubescence. First joint of the hind tarsi in the male as long as the remaining joints taken together.

Ega. I am indebted to Mr. Alexander Fry for pointing out the differences between this species and its near relative *Eumathes undatus* (Pascoe) of Southern Brazil. The great length of the basal joint of the posterior tarsi in the male, and the closer punctation of the elytra, are the chief distinguishing characters.

Genus Chalcolyne, nov. gen.

Closely allied to *Gryllica*, Thoms. (Classif. des Cérambyc. p. 120), but differs in the thorax being armed on each side with an acute spiniform tubercle. Body oblong, clothed with short, stiff hairs; elytra subtrigonal, rounded at the tip. Head with long, slightly retracted face; mouth projecting; palpi elongate, pointed; eyes ample both above and beneath, and nearly approximating on the crown; antenniferous tubercles distinct, divergent. Antennæ scarcely so long as the body, stout, the joints simple and gradually tapering to the apex, basal joint thickened gradually from base to apex. Thorax subcylindrical, finely wrinkled transversely, sides each armed with an acute spiniform tubercle. Legs moderately elongated, thighs clavate, middle tibiæ simple on their outer edge; tarsi about half the length of the tibiæ, broad, not compressed; basal joint in all the feet short, triangular; claw-joint slender, projecting beyond the third joint to an extent equal to the length of the third joint; claws widely divergent and strongly curved, furnished at the base on the inner side with a broad square enlargement. Prosternum narrow, simple; mesosternum rather broad, bituberculated, and vertically inclined anteriorly.

Chalcolyne metallica, Pascoe.

Onocephala (?) *metallica*, Pascoe, Trans. Ent. Soc. n. s. iv. (1858).

C. oblonga, nitens, nigro-æenea, breviter fusco setosa; elytris viridi-æneis, striato-punctatis; thorace subcylindrico, elytris multo angustiore, antice leviter angustato, supra transverse rugoso, lateribus utrinque tuberculo acuto armatis. Long. 5 lin. ♂?

Found only at Ega, Upper Amazons, on the stem of a slender tree in the forest. The insect is very similar in form to *Gryllica flavo-pustulata*, Thoms., but differs not only in the spinose thorax and metallic colours, but in the basal joints of the antennæ not being compressed.

Genus Eumimesis, nov. gen.

Body oblong, above plane, clothed with short, stiff hairs. Elytra oblong, broadly rounded at the tip. Head with long, slightly retracted face; mouth somewhat projecting; palpi elongate, pointed; eyes ample, but distant on the vertex; antenniferous tubercles distinct, divergent. Antennæ short; basal joint oblong-quadrate, compressed; second joint rather abruptly dilated from the middle; third joint curved and dilated at the apex; fourth with the upper edge enlarged into a short foliaceous expansion; remaining joints very short, simple. Thorax subcylindrical, thickly punctured, sides each armed with an acute spiniform tubercle. Legs moderately elongated, thighs clavate, middle tibiæ simple on their outer edge, tarsi short and uncompressed, claw-joint slender and short; claws divergent and strongly curved, furnished at the base on their inner side with a broad tooth. Prosternum narrow, simple; mesosternum much broader, bituberculate, steeply inclined anteriorly.

This genus, as will be seen by the above description, harmonizes with *Chalcolyne* in the majority of its characters. Mr. Alexander Fry, who has paid especial attention to the Saperditæ and their allies, having examined my specimens, is inclined to think that the insect on which I have founded the genus *Chalcolyne* is a male individual of a species of *Eumimesis*. The great difference in the antennæ, in the absence of positive evidence of identity, forbids, however, the fusion of the two forms into one genus.

Eumimesis heilipoides, n. sp.

E. speciebus *Heilipi* generis Curculionidarum simillima, oblonga, fusco-ferruginea, dense breviter setosa; thorace utrinque vitta lata, elytris vitta lata basali et macula magna subapicali sordide albis. Long. 6 lin. ♀?

Head dark red, hispid and thinly clothed with whitish recumbent pile. Antennæ dark red, fifth joint and apices of third to eleventh joints black, bases grey. Thorax subcylindrical, a little narrowed in front; sides each armed with a small acute tubercle, thickly punctured, rusty brown, each side marked with a broad tawny-white vitta. Elytra oblong, broadly rounded at the apex, surface in the middle depressed and very closely punctured, the sides over the tomentose whitish parts sparsely punctured, over the naked parts closely so; from the base to beyond the middle of each runs a tawny-white stripe, thickest in the middle, and within the apex is a similarly coloured rounded spot composed of dense tomentum, the edges of the elytra and a large triangular spot between the vitta and the apical patch being dark and shining. Body beneath and legs rusty red, sprinkled with grey tomentum. The whole body clothed with short erect hairs.

St. Paulo, Upper Amazons.

This insect, from its colour and form, bears a most deceptive resemblance to many species of *Heilipus*, a genus of Curculionidæ.

Genus Hastatis, Buquet.

Buquet, in Thoms. Archives Entom. i. p. 338.

In this genus the body is oblong, slightly convex, and beset with short bristles. The head is moderately short, depressed between the antenniferous tubercles; the eyes are rather small. The antennæ are about the length of the body, and clothed above and beneath with short, stiff hairs. The lateral tubercles of the thorax are acute and spiniform. The elytra are rounded at the apex, and depressed in the middle. The mesosternum is prominent in front. The thighs are clavate, the tarsi short and broad, with a broad tooth at the base of each claw.

Hastatis galerucoides, n. sp.

H. oblonga, breviter setosa, fulvo-brunnea, vertice thoracisque lateribus cinereis; elytris marginibus lateralibus lineaque longitudinali discoidali pallide testaceis; antennis nigris, articulis 3^{o}–6^{m} apice dilatatis, angulis productis. Long. 5 lin. ♀.

Head brown, partly clothed with yellowish-ashy pubescence, which forms two divergent stripes on the vertex. Antennæ a little shorter than the body (♀), black, clothed with short bristles; third to sixth joints gradually dilated at the apex, with the apical angles produced. Thorax clothed with dense tawny-brown pubescence, sides each with a broad ashy vitta, lateral tubercles large and acute. Elytra oblong, obtuse at the apex;

surface clothed with short bristles, finely punctate-striate, depressed along the suture, tawny brown, with the lateral and apical margins and a line from base to apex terminating at the sutural angle pale testaceous. Body beneath dusky castaneous; mesosternum with two tubercles in front. Legs pale-reddish testaceous, with a large black spot on the outer side of the middle and posterior femora.

Santarem.

Genus Callia, Serville.

Serville, Ann. Soc. Ent. Fr. iv. (1835) p. 60.

The species composing this well-known genus are all of small size and of the most diversified colours—some being metallic, and others resembling species of various other families of Coleoptera. The antennæ are filiform, with the joints from the third (inclusive) gradually and proportionally decreasing in length. The tarsal claws have a broad and acute tooth at their base.

1. *Callia fulvocincta*, n. sp.

C. oblonga, setosa, chalybea, nitida; elytris violaceis, cano tomentosis, basi fascia lata fulvo-aurantiaca. Long. 3 lin. ♀.

Head glossy steel-blue, thinly clothed with hoary tomentum; front with a deeply impressed longitudinal line. Antennæ dark metallic blue, setose. Thorax short (much shorter than in the allied *C. axillaris*), glossy steel-blue, smooth, convex. Scutellum steel-blue. Elytra oblong, setose, punctured, violaceous, obscured with fine hoary tomentum; base with a broad tawny-orange fascia, broadest a little before the lateral margin. Body beneath and legs steel-blue.

Santarem, flying over masses of dried branches.

2. *Callia chrysomelina*, Pascoe.

Callia chrysomelina, Pascoe, Trans. Ent. Soc. n. s. v. p. 34.

C. oblonga, postice paulo dilatata, setosa, nigra; capite, thorace, antennarum articulo basali (apice excepto) femoribusque anticis et intermediis (geniculis exceptis) læte ferrugineis; elytris crebre punctatis azureis; corpore subtus chalybeo. Long. $3\frac{1}{2}$ lin. ♀.

Ega, dry twigs.

3. *Callia criocerina*, n. sp.

C. oblongo-elongata, setosa, nigra nitida; capite, thorace, antennarum articulo basali (apice excepto) femoribusque anticis et intermediis (geniculis exceptis) flavis; elytris elongatis, crebre punctatis, violaceis. Long. 3 lin. ♂.

Head and mouth, except the tips of the palpi, yellow. Antennæ a little longer than the body, bluish black; basal joint of the antennæ, except the extreme base and the apex, yellow.

Thorax glossy yellow; lateral tubercles large, obtuse at their apex. Scutellum yellow. Elytra elongate-oblong, parallel-sided, setose, thickly punctured, violet. Body beneath and legs black; anterior and middle femora, except their apices, yellow.

S. Paulo, Upper Amazons.

4. *Callia halticoïdes*, n. sp.

C. elongata, setosa, nigra; thorace (margine postico excepto) ferrugineo; antennis articulis tribus terminalibus albo-testaceis; femoribus anticis (geniculis exceptis) abdominisque lateribus flavo-testaceis. Long. $2\frac{1}{2}$ lin. ♂.

Head small, deeply impressed down the middle, shining black, except the margin of the epistome, which is pale testaceous. Antennæ scarcely longer than the body, black, extreme bases of the joints and the whole of the three terminal joints whitish testaceous. Thorax very short, transverse; lateral tubercles very acute, red, hind margin black. Scutellum black. Elytra elongate, linear, setose, thickly punctured, partly in rows, black. Body beneath and legs black; anterior femora in the middle, and intermediate femora on one side, pale testaceous; sides of abdomen testaceous.

Ega, Upper Amazons.

5. *Callia lycoïdes*, n. sp.

C. elongata, setosa; capite thoraceque flavis, lateribus nigro vittatis; elytris fulvo-flavis, plaga quadrata communi basali lineola prope basin marginali et plaga magna apicali nigris; antennis nigris, articulis tribus terminalibus flavis; femoribus (apice exceptis) et tibiis basi pallide testaceis. Long. $2\frac{1}{2}$ lin. ♂.

Head small, tawny yellow, with fine golden pubescence, sides behind the eyes each with a dusky stripe. Antennæ not longer than the body, black; three terminal joints pale yellow. Thorax somewhat elongated, rusty yellow, shining, and clothed with fine golden pubescence; lateral tubercles broad, but acute; disk obtusely tubercular, with a dusky stripe on each side. Scutellum tawny yellow. Elytra elongate, regularly punctate-striate (punctures large), tawny yellow; a quadrate patch over the scutellar region, a basal marginal streak, and a broad fascia at the apex black. Body beneath black; legs black; thighs, except their apices and the bases of the tibiæ, yellow testaceous.

S. Paulo, Upper Amazons.

6. *Callia cleroïdes*, n. sp.

C. sublinearis, postice paulo ampliata, setosa, nigra; capitis lineolis, thoracis vitta laterali antennarumque annulo magno mediano fulvo-flavis. Long. $3\frac{1}{2}$ lin. ♂.

Head small, deeply impressed in the middle, black, a line down the centre of the crown and one on each side, and the lower part of the face, tawny. Antennæ as long as the body, black, apex obscurely rufescent; apical half of the fourth and nearly the whole of the fifth joint clear tawny yellow. Thorax elongated, lateral tubercle small, conical; surface coarsely punctured and tubercular, black; sides each with a broad golden-fulvous vitta. Scutellum black. Elytra elongated, a little dilated at the apex; surface setose, closely punctured, partly in rows, black; lateral edges near the base obscurely rufescent, and an indistinct streak from the shoulder down each side dull tawny. Body beneath clothed with silvery-grey tomentum. Legs black; femora at the base rufescent.

Ega.

The preceding series of species, mimicking respectively various types of Coleoptera, do not exhaust the variety of dress which the *Calliæ* put on. I have a small species in my collection, from Rio Janeiro, which presents the style of coloration of certain species of Lampyridæ*.

Genus Pretilia, nov. gen.

Closely allied to *Callia*, but differs in the thorax being unarmed on the sides. This part of the body is short, convex, and rounded, the sides being tumid instead of having the distinct conical tubercle. The eyes are short and convex, their reniform undivided shape distinguishing the species from the Tetraopinæ, to which they are allied by the form of the thorax. The body is linear and setose. The antennæ are filiform and longer than the body in both sexes; the third joint is much elongated, and half as long again as the fourth, the remainder being filiform and slender to the apex. The pro- and meso-sterna are both very narrow. The legs are moderately elongated, and the tarsal claws have a large tooth at the base.

I am indebted to Mr. Alexander Fry for pointing out the chief distinguishing characters of this genus.

Pretilia telephoroïdes, n. sp.

P. linearis, setosa; capite flavo-ferrugineo, occipite nigro nitido; thorace rufo, pube aurea tecto; elytris nigris vel fulvo-brunneis,

* *Callia lampyroïdes.* Elongato-oblonga, depressa, setosa, fusco-nigra, testaceo marginata. Caput breve, nigrum, læve, ore testaceo marginato. Antennæ corpore multo breviores, parce ciliatæ, nigræ, articulis basi pallide testaceis. Thorax subquadratus, supra tuberosus interstitiis grossissime punctatis; niger, lateribus litura rufo-testacea, breviter tuberculatis. Elytra elongato-oblonga, apice rotundata, setosa, supra punctata, fusco-nigra, lateribus late testaceo marginatis. Corpus subtus nigrum. Pedes nigri; coxæ et femora pallide-testacea, his nigro maculatis. Long. 3¼ lin. ♀. *Hab.* in Rio Janeiro (Squires).

apice nigris, pube fulvescente vestitis, punctato-striatis, apice obtusis; pedibus testaceis, tarsis fuscis; pectore abdomineque nigris, griseo tomentosis, hoc lateribus fulvo-testaceis; antennis nigris, basi ferrugineis, articulis 5° et 6° flavis. Long. 3–4½ lin. ♂ ♀.

Head depressed between the antenniferous tubercles; face, cheeks, and palpi reddish yellow; crown and occiput shining black. Antennæ black; basal joint, except the apex, reddish yellow; fifth and sixth joints (sometimes also the apex of the fourth) pale yellow. Thorax short, rounded, convex; sides tumid, reddish yellow, clothed with golden pubescence. Scutellum black. Elytra linear, obtuse at the apex, punctate-striate, setose, purplish black or tawny brown, gradually becoming black towards the apex, clothed with a changing tawny pubescence. Breast and abdomen dusky, clothed with griseous pile; abdomen brownish testaceous on the sides. Legs reddish yellow; tarsi dusky.

Pará and Lower Amazons.

[To be continued.]

XXXIV.—*Additional Observations on* Ziphiorrhynchus. By Dr. H. Burmeister.

[*In a Letter, from Buenos Ayres, to Dr. J. E. Gray.*]

[Plate VI.]

My dear Friend,—I received your letter some days ago, and set to work as soon as possible to send you further notes on *Ziphiorrhynchus* (the outer form of which was described in the 'Annals & Mag. Nat. Hist.' for February 1866, vol. xvii. p. 94, Pl. III.). There is no doubt that the animal is a species of *Epiodon*, the whole of the characters being the same as those given by you in your 'Synopsis.' My name *Ziphiorrhynchus* must therefore fall, there being no reason for retaining it; but the species appears to me to be different, as far as I can judge from the drawing you have sent me. You must now study my figure, and compare it with the others, to find out the specific characters. I can do nothing here without a work concerning the species of *Epiodon*.

The figures which I send you show the skull from the side, rather less than one-fourth of the natural size, the whole skull, from the apex of the lower jaw to the end of the occipital condyle, being 75 centim. long, and each branch of the lower jaw 59 centim. The lower jaw is somewhat longer than the upper, with two round apertures (Pl. VI. fig. 3), in which are contained two large teeth. Fig. 4 shows one of these teeth, of the natural size, and fig. 5 one of the smaller teeth, which are situated in the narrow channel running backward from the alveoli of the larger teeth, as shown in fig. 3. The upper jaw has a similar but smaller channel, which is indicated, in fig. 1, at the side of the upper jaw near *b*, as a dotted line (......). In this figure, *b* indicates the maxillary bone, and *a* the intermaxillary.

In the whole longitudinal line between the two intermaxillary bones there is a deep channel, beginning at the top of the upper jaw, as shown in fig. 3. The vomer is situated in the bottom of this channel; and behind the vomer there is a strong cylindrical cartilage, which goes from the top of the jaw to the nasal opening, where it unites with the high septum of the vomer between the two apertures, as shown in fig. 2.

The intermaxillary bones are enlarged behind, and somewhat excavated, rising into a high protuberance on the forehead, the right maxillary bone being much larger than the left, as you may see in my drawing (fig. 2). In the middle of this protuberance are situated the nasal bones (fig. 2 *o o*), which are also unequal, the right being stronger than the left, and forming a large and thick *promontorium* between the intermaxillary bones.

On the outside of the maxillary bone (*b*) is situated the frontal (*d*), forming an arch over the eye on each side, and ascending like a small narrow band at the hinder margin of the maxillary bone to the top of the protuberance in the highest part of the skull. Behind these comes the large parietal bone (*c*) in the middle of the cranium, and on the sides the temporal bones (*f*), having on the underside the ear-bone or *os petrosum* (*g*). The posterior margin of the temporal is united with the occipital bone (*h*). The zygomatic bone is very curious; it forms a thin cylindrical arch, united in front of the eye with the frontal, but not reaching the temporal bone behind.

The skull is 34 centim. in breadth at the broadest part, in the middle of the superciliary arch; and the protuberance is elevated 20 centim. above the horizontal part of the upper jaw in the same region of the skull. I hope you will understand all thoroughly by examining my drawings. (Plate VI.)

The other parts of the skeleton closely resemble the figures given by Vrolik in his account of *Hyperoodon* (in the Transactions of the Academy of Haarlem, 1848, vol. v. p. 1). I have this very valuable description of the *Hyperoodon*, the only scientific work on whales in my library, except yours in the 'Voyage of the Erebus and Terror.' The neck has the same construction, and has also seven vertebræ, the first four being united into one piece, and the other three separate. The arches of these three vertebræ are open above, as is also the arch of the first dorsal, which is very small and united on the left side with the arch of the second. This is the first vertebra with a spinous process, but it is also somewhat open on the right side of the arch. The third dorsal vertebra has the arch entirely closed, and is much larger than the second. From this the vertebræ increase to the end of the lumbar part of the column, where the vertebræ are largest, each of them being 12 centim. long. The number of the dorsal vertebræ is ten, and that of the lumbar twelve. Of the ten pairs of ribs, six are united with the sternum, and four free. The sternum has precisely the same form as that of *Hyperoodon* figured by Vrolik, and this is the case also with the hyoid bone. The forms of the arm-bones are also exactly the same, except that the upper margin of the scapula is somewhat larger, and the carpal bones are not cartilaginous, but ossified.

The twelve lumbar vertebræ are followed by twenty caudals, the first eleven having spinous processes on the underside. The same region of the tail has also the smallest spinous processes of the dorsal side. The last three vertebræ are very small, forming merely round osseous corpuscles; and the two preceding these last three are each perforated perpendicularly by two foramina on each side of the central line of the body.

This is all that I can tell you of the general construction of the skeleton, and I hope you will find enough to make out the characters of the species.

[The skull shows that this species is distinct from *Epiodon Desmarestii* of the Mediterranean; and it should be called *Epiodon cryptodon*, Burmeister.—J. E. Gray.]

I am very curious to see your work on the Edentata, as you know that I had the good fortune to be the first describer of some new species of this family, such as *Dasypus hispidus* and *Praopus hirsutus*, from Guayaquil, and the new *Chlamyphorus*. I hope you know my descriptions in the 'Abhandl. der Hallisch. Naturf. Gesellsch.' I have had for some time a living *Dasypus conurus*, and have observed his curious habits: he walks, as you say, with only the tips of his claws touching the ground. His skeleton is most allied to that of the gigantic *Glyptodon*, which he also resembles in his general figure. We have many specimens in the collection here.

EXPLANATION OF PLATE VI.

Fig. 1 shows the skull from the right side.
Fig. 2, the nasal region, with the protuberance from the front.
Fig. 3, the apex of the upper and lower jaws.
Fig. 4, a large tooth, natural size.
Fig. 5, a small tooth, natural size.

In figs. 1 & 2, *a* marks the intermaxilla; *b*, the maxilla; *c*, the parietal; *d*, the frontal; *f*, the temporal; *g*, the os petrosum; *h*, the occipital bone, and *o*, the nasal bones.

XXXV.—*On* Rhynchonella Geinitziana.

By W. B. Carpenter, M.D., F.R.S., F.L.S., F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen, University of London, Burlington House, W.

If Prof. King had contented himself, in his last communication, with stating the facts which had come under his observation in regard to the structure of *Rhynchonella Geinitziana*, I should have left it to your readers to judge whether that statement (to which I take no exception) at all invalidates the facts adduced by myself. For it must be obvious to any one accustomed to estimate the relative value of positive and negative evidence, that the existence of a single specimen of that shell possessing an outer layer *not* perforated by canals is of more weight than that of a dozen specimens in which the canals pass through *what seems* to be the whole thickness of the shell; since every palæontologist knows that the superficial layers of shells, especially Brachiopods, have been so frequently removed by abrasion previously to their fossilization, that in many formations a perfect shell is a rarity.

But Prof. King, *without having seen my preparations*, persistently refuses to admit the existence of such a specimen, and disposes of the facts which I have stated in regard to it by imputing to me incapacity as a microscopic observer. I am unable, according to him, to distinguish, in a vertical section, between canals which really stop short and canals which pass out of the plane of section; and, in a tangential section, I have mistaken canals filled by transparent infiltration for the proper substance of the shell, which *I* affirm to be *really* continuous where *he* says that it *ought* to show perforations. As a microscopist of thirty years' experience, as the original discoverer of the canalicular structure in Brachiopods, and as the maker of several hundred preparations illustrative of that structure, I venture to ask whether it is more likely that I am deceived by such *transparent* fallacies, or that Prof. King's observations have been made upon abraded shells. And I believe that such of your readers as may have followed this discussion will agree with me that, so far from the "clear evidence" adduced in Prof. King's paper being entitled to acceptance "as entirely removing all doubts on the matter," it leaves this matter precisely where it was before.

The course which Prof. King has thought proper to follow in his revival of this discussion is in perfect accordance with that which he has adopted in recently controverting my statement of the existence of finely tubular Nummuline shell-structure in

Eozoon Canadense, not only (as I have the best authority for stating) without having seen a section of that fossil thin enough to show it, but even (I have good reason to believe) without having examined the like structure in any Nummuline shell, so as to be able to recognize it when seen. I trust, therefore, that the scientific public will now hold me absolved from the necessity of taking any further notice of his pertinacious attempts to throw discredit upon my observations.

I remain, Gentlemen,
Your obedient Servant,
WILLIAM B. CARPENTER.

March 21, 1866.

XXXVI.—*Notes on some Peculiarities in the Eye of the Mackerel.* By ROBERT DYCE, M.D., F.R.S. Edin., Professor of Midwifery, University of Aberdeen.

[Plate VII.]

IN the following observations it is not my intention to enter into any minute detail of the anatomical structure of the eye, but merely to notice some very striking and interesting peculiarities, different from the eye of any other fish which I have met with.

The eye of a fish, like the eye of all vertebrate animals, is constructed upon principles essentially similar, and presents the same coats and lenses as are met with in the human eye, and, generally speaking, arranged similarly. It, however, differs in many points of structure from that of terrestrial Vertebrata, its organization being, of course, adapted to the denser medium in which the fish resides, and so adapted as to bring the rays of light to converge at a shorter focus upon the retina. It is hence more globular or spherical, has always a very flattened form of bulb and a shorter axis, and is always covered by an investing fibrous membrane called the sclerotic coat. This is more or less thick and elastic; it is not, however, uniformly thick, being more so at the back of the eye than in front towards the cornea, in order, it is believed, to preserve the flatness of the cornea—an arrangement rendered necessary in all swimming animals, as well as fish, who reside constantly in water, and who receive the rays of light through so dense a refractive medium. The sclerotic also varies in thickness in different fish; in the larger fish it is very thick, while in the generality of ordinary-sized fish it is very thin, soft, elastic, and flexible. In the Mackerel, however, instead of being soft, it is *uniformly firm, nay, entirely cartilaginous*, and would be inflexible but for its peculiar construction,—so much so that it retains its ordinary form, and with scarcely any diminution in size, if left unheeded to dry; whereas, in most other fish, the eye shrivels up, unless some distending medium (as cotton) is used to keep it in shape.

Again, in every fish which I have examined, the optic nerve penetrates the sclerotic coat by a round aperture, the coat *closely* encircling the nerve (see Pl. VII.: eye of Haddock, Whiting, and Cod); but in the Mackerel there is in this unyielding sclerotic coat a portion, as it were, cut out from the back of the eye, extending from near the opposite edges of the cornea, thus leaving, when in its quiescent state, an *elliptical* space, like two narrow cones joined at their bases (<>); but if the sides of the eye are pressed close, as they must be by the muscles when the focal distance is to be changed, it then becomes a mere line or slit.

There is a still further peculiarity in the Mackerel, viz. a small *semicircular notch* on the nasal side of this linear slit, in which the optic nerve lies secure from pressure in its passage through it. (See Plate.) It is, I believe, admitted that the adjusting power in the eye, in order to obtain distinct vision at different distances, is mainly dependent upon the flexibility of the sclerotic coat, which allows of its being compressed by the muscles, and thus, by the pressure of the humours, increasing the convexity of the cornea, while it also brings the retina closer to the posterior surface of the lens. Hence, in the greater number of fish, the sclerotic is soft and flexible, yet sufficiently firm to maintain its spherical shape. In a very few fish it is as hard as bone—in the sword-fish (*Xiphius gladius*), for example—and nearly inflexible; yet all of them possess the same adjusting-power. Amongst these the Mackerel has this peculiar formation: in this fish the eye would be nearly inflexible, from its hard cartilaginous nature; but by the very simple, yet beautiful, arrangement which I have described (of the elliptical slit), compression may be effected to any useful extent—thus accommodating the form of the eye to distances. The provision made to prevent pressure upon the optic nerve by this *notch* in the hard unyielding sclerotic will also be noticed. This notch clearly demonstrates not merely that, in this fish at least, the sclerotic is an investing membrane to preserve the form of the eye, but that compression is produced to suit the focal distance; and if the compression were so great as to close the gap left in the sclerotic, it would, but for this notch, destroy, for a time at least, the optic nerve.

This singular and beautiful arrangement appears remarkably adapted to the habits of this fish. It is well known to be a very strong and rapid fish; it must therefore greatly facilitate it, in its rapid motions, in seizing its food, which it is believed it does by "striking across the course of what it supposes to be its flying prey,"—thus almost proving that its pursuit is more under the influence of sight than of taste or smell.

Couch, in his recent beautiful work, says that it will never attempt to seize that which seems without life; hence the object of the fishers is to cause the boat to be influenced by an amount of motion which shall resemble a living object. The boat must therefore be always under sail, and in a sufficient breeze to ensure any amount of success.

MISCELLANEOUS.

Note on the Genera Amphipeplea *and* Assiminea. By J. Gwyn Jeffreys, Esq., F.R.S.

Dr. E. von Martens, in his interesting "Conchological Gleanings" (Ann. & Mag. Nat. Hist. ser. 3. vol. xvii. p. 211), has referred to the description, in my work on British Conchology, of the shell of *Limnæa involuta*, in comparison with *L. glutinosa* and *L. auricularia*; but he seems to have overlooked the sectional character which I there gave of the first two species, viz. "extremely thin and fragile." Nor has he quoted exactly the words which I used in describing *L. glutinosa*. He would also have found that Lapland was recorded by Nylander as a station for *L. glutinosa*, Pau by Mermet, and the south-west of France by Des Moulins and many other writers. I thank him for having called my attention to the two localities in the Mediterranean province. The genus *Amphipeplea* cannot be separated from *Limnæa*, if *Aplexa* remains united with *Physa*.

Assiminea is undoubtedly marine and pulmonobranch, as I shall be prepared to show in the course of my work. The dentition of *A. Grayana* and *A. litorea* is delineated in the 'Annals and Magazine' for February 1859, pl. 3. figs. 12 & 13.

March 24, 1866.

On the Existence of a Third Membrane in the Anther. By. A. Chatin.

Botanists generally believe that the anther consists only of two membranes, named, since the time of Purkinje, the *exothecium* and *endothecium*. But Meyen and Schleiden observed in certain young anthers the tissue which corresponds with the third membrane; they seem, however, to have regarded it as part of the *endothecium* of Purkinje. The author states that there is no doubt of the existence of a third membrane interior to the endothecium or membrane with fibrous cells; it forms a sort of interior epidermis, and should be called the *endothecium*, the membrane which received that name from Purkinje being the *mesothecium*.

Evolution.—The third membrane *always* exists at a certain stage of development of the anthers. The cells of the inner membrane, which are at first confused with the tissues which form the outer membranes and other parts of the anther, begin to detach themselves from the contiguous tissues at the period when the pollinic utricles themselves acquire their peculiar appearance. The development of the cells of the third membrane, and that of the pollinic utricles, then proceed side by side until the pollen is nearly mature. But as this period approaches, and when the mother cells of the pollen have disappeared and the threads are produced in the fibrous cells, the third membrane shrivels, becomes lacerated, and is usually absorbed without leaving any traces, except a granular matter adhering to the second membrane.

As a provisional production intimately connected with the development of the pollen and the special organization of the fibrous cells, the third membrane seems to be of great biological importance. Its disappearance as the dehiscence of the anthers approaches, however, is subject to some exceptions. Thus it persists in various degrees in *Hyoscyamus, Pedicularis, Convolvulus, Forsythia, Erythronium, Fuchsia, Paratropia, Crassula, Echeveria, Megazea, Æsculus, Citrus, Dictamnus, Helleborus, Linum, Reseda, Sparmannia, Thea, Tropæolum, Arum, Dianella, Hæmodorum, Loranthus.*

In anthers with apicilar dehiscence the third membrane is regularly persistent, as if in these anthers, which are found to be without fibrous cells, the non-destruction of the third membrane was connected with the non-production of fibrous cells in the second.

Colour.—The third membrane is most frequently coloured, whilst the second is generally colourless. Its colour is also generally independent of that of the epidermic membrane; but the second membrane sometimes partakes of that of the third, as in *Aponogeton, Gonolobus,* and *Salvia splendens.* The colour of the third membrane, on the contrary, is directly related to that of the pollen, so that the colour of the destroyed membrane may be known from that of the pollen; and, on the other hand, the colour of the pollen may be foretold from that of the membrane.

Structure.—The cells of the third membrane are sometimes papilliform, sometimes flattened, but always possess very delicate walls. Some exceptions are presented in *Pyrola, Cassia, Vaccinium,* and *Rhododendron,* in which the anthers have no fibrous cells, and the internal membrane is strikingly thickened as if in compensation. The membrane is usually composed of a single layer of cells; but there are two in *Sparmannia,* and from two to six in *Viola, Crassula orbicularis,* and some species of *Cassia* and *Canna.* The layers are most numerous towards the junction of the valves. The membrane does not only extend over the valves of the anther, but lines the whole cavity of the cells.

Contents.—The chief contents of the cells of the third membrane are various colouring-matters, fatty bodies often united into drops charged with colouring-matters, nitrogenous substances, mucilage, sugar, and aleurone.

Functions.—All its characters indicate that the third membrane is the nurse of the pollen; and it may also be the reservoir from which the cells of the second membrane derive the nutriment necessary for their rapid transformation.—*Comptes Rendus,* January 15, 1866, pp. 126–130.

New Fishes from the Iberian Peninsula. By Dr. Steindachner.

Barbus Graelsii, Steind.

Form elongate, subcylindrical; length of head contained $4\frac{3}{5}$–$5\frac{1}{2}$ times in the total length; dorsal fin without a serrated bony ray; anal and caudal fins long-rayed; both pairs of barbels long, the posterior reaching or passing the posterior margin of the præoperculum.

$$\text{D. }4/8;\ \text{A. }3/5\text{–}6;\ \text{V. }2/8;\ \text{L. lat. }\begin{array}{c}8\text{–}9\\ \hline 48\text{–}50\\ \hline 5\end{array}.$$

From the Ebro and the rivers about Bilbao.

Leucos Arcassii, Steind.

Body elongated; head rounded off in front, small; depth about one-fifth of the total length.

$$\text{D. }3/7;\ \text{A. }3/7;\ \text{L. lat. }\begin{array}{c}7\text{–}8\\ \hline 42\text{–}46\\ \hline 4\end{array}.$$

In the Ebro, near Logroño, and the Cailes near Tudela.

Chondrostoma Miegii, Steind.

Nose short, obtuse; orifice of mouth semicircular; pharyngeal teeth six on the right and seven on the left side, rarely six on both sides; a bluish-grey longitudinal band above the lateral line.

$$\text{D. }3/8;\ \text{A. }3/9;\ \text{V. }1/8;\ \text{L. lat. }\begin{array}{c}9\text{–}10\\ \hline 50\text{–}53\\ \hline 4\frac{1}{2}\text{–}5\frac{1}{2}\end{array}.$$

In the Ebro and the rivers about Bilbao.—*Bericht der Akad. der Wiss. in Wien,* 1866, pp. 14 & 15.

New Fishes from South America. By Dr. Steindachner

Pentaceros Knerii, Steind.

Dorsal with fourteen spines; forehead not crested; body spotted with blackish brown.

Ancylodon altipinnis, Steind.

Depth contained $4\frac{1}{3}$ times in the total length; dorsals united by a narrow membrane; first dorsal with ten spines.

Clinus Philippii, Steind.

Depth contained $4\frac{1}{2}$ times in the total length; dorsal with nineteen spines; fringed tentacles over the eyes and nasal apertures and on the nape; large, irregular, pale spots on the base of the dorsal fin and on the back.

Brycon lineatus, Steind.

A blackish spot above the foremost scales of the lateral line; a black longitudinal band on the middle rays of the caudal fin; brown longitudinal lines on the posterior half of the body.—L. lat. 56–57.

Platycephalus angustus, Steind.

Length of head contained $3\frac{1}{2}$ times in the total length, and breadth of head once and five-sixths in its length; two small præopercular spines, of nearly equal length; dorsal with nine spines; caudal with three deep-black longitudinal bands upon a milk-white ground; body pale brown, with small, roundish, faintly marked spots and two transverse bands on its posterior half.—*Bericht der Akad. der Wiss. in Wien*, 1866, pp. 19 & 20.

The White-beaked Bottlenose.

A specimen of *Lagenorhynchus albirostris*, Gray (Cat. of Seals and Whales in the British Museum, p. 272), has been shot on the coast of Cromer by Mr. H. M. Upcher, of Sherringham Hall, who has kindly presented the skull to the British Museum. This is only the second time that the animal has been observed on the British coast. It was first described by Mr. Brightwell in the 'Annals & Mag. of Nat. Hist.' for 1846, vol. xvii. p. 21, t. 1.—J. E. G.

Domesticated Whales.

The Whitefish, or White Whale, was kept for some time alive in a tank in America. "He was sufficiently well trained during the time he was in confinement to allow himself to be harnessed to a car, in which he drew a young lady around the tank; he learned to recognize his keeper, and would allow himself to be handled by him, and at the proper time would come and put his head out of the water to receive the harness or take his food." "He was less docile than a specimen of *Delphinus Tursio* which was for a time with him in the same tank." (Wyman, Boston Journ. Nat. Hist. 1863, p. 603.)

Capture of a Ribbonfish.

A very fine specimen of a Ribbonfish (*Gymnetrus Banksii*), with the crest in a very good state, has been caught at West Hartlepool, on the coast of Northumberland. It is 14 feet long, and, like the other specimens which have been taken on the north-east coast of England, was found in shallow water, in a wounded condition. It has been shown by the fishermen at Stockton-on-Tees.

Note on the Genus Chevreulius *of Lacaze-Duthiers.*

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

Gentlemen,—Mr. Alder, in the 'Annals' for February last, has stated that the genus *Chevreulius* of Lacaze-Duthiers has been described twice before, by Messrs. Stimpson and Macdonald.

I believe that the same genus is distinctly indicated by Ehrenberg (1828) in the introduction to his 'Symbolæ Physicæ' (Mammalia, p. 3), thus: ". . . . quod formam animalium novam attulimus (*Rhodosoma verecundum*) Ascidias bivalvibus Molluscis externa etiam forma adnectentem, Ascidiam scilicet tunica cartilaginea bivalvi indutam." These words seem to prove that the genus is found in the Red Sea.

I take this occasion to call to mind a curious body described by Linnæus as an *Asterias*, but which perhaps may prove to be founded on a dried specimen belonging to *Rhodosoma*.

Asterias (*lunata*) *semiorbiculata.*

Corpus depressum, referens lunam dimidiatam, cum suis cornibus, adspersum undique punctis obsoletis, absque oris aut ani vestigio. (Linn. in "Chinensia Lagerströmiana," 'Amœnitates Academicæ,' iv. p. 256, n. 44. fig. 14.)

The figure represents a crescent-shaped body, about 2 inches long, with some dispersed granulations on the surface.

Perhaps, however, it is only an object of art, like the *Corallium chinense* on the same plate, which represents a piece of jade formed into a man on horseback.

I am Gentlemen,
Yours obediently,
O. A. L. Mörch.

Copenhagen, Feb. 27, 1866.

On the Functions of the Air-cells, and the Mechanism of Respiration, in Birds. By Dr. Drosier.

After brief mention of the additions made to our knowledge of these matters by numerous distinguished physiologists, the author remarked that still more remained to be done—a proof of the difficulty of the subject. Several of the commonly received views are quite untenable,—such as that the air-cells are intended to assist in supporting the bird in flight, by rendering it lighter, in consequence of the rarefaction of the air in the air-cells, and the hollow bones; and again, that the air-cells are a sort of second respiratory apparatus, so that birds may be described, as they were by Cuvier, as animals having a double respiration. In disproof of these views, it was shown that a pigeon weighing 10 ounces, or 4375 grains, would have its weight in air diminished by less than one grain in consequence of the rarefaction of the air in its air-sacs and hollow bones; so that the floating-power resulting from such rarefaction would be almost inappreciable. Again, the air-cells are bounded by delicate membranes, in which the blood-vessels are very minute and sparsely scattered. Hence very little blood is offered for oxidation in them.

Some of the earlier observers, as Harvey and Perrault, in the middle of the seventeenth century had correctly described the air-cells of birds as sacs that enclose and confine the air received from the openings, on the inferior surface of the lungs, in which the bronchi terminate. Later observers, however, have generally fallen into the error that the air passes from the air-sacs into the cavities of the peritoneum and the pericardium, and even extends itself between the muscles, and beneath the skin in some cases; and notwithstanding that Guillot and Sappey have shown that the air does not pass out of the air-sacs, such errors are repeated even at the present day. The lungs of birds are not very elastic, are fixed to the ribs at the upper part of the thorax by close cellular tissue, and bound down by an aponeurosis formed by the tendons of the pulmonary diaphragm, so that they cannot draw in much air by expansion. They are moreover small, and are penetrated by the principal bronchi, which open upon their surfaces. Such lungs are quite incapable of acting in inspiration in the same manner as the lungs of reptiles and mammals. Capacious membranous bags are therefore provided to receive the inspired air, the volume of which is much greater in the case of birds than in the case of mammals. But the larger quantity of air inspired would be of little use if it were merely drawn into the air-sacs to be simply expelled again; for the greater part of the inspired air does not pass through the lungs, but direct through certain large bronchial tubes into the air-sacs situated within the thorax. There are another set of air-sacs situated without the thorax—namely, two very large sacs in the abdomen, and several others anterior to the thorax. When the thoracic air-sacs expand, the others contract, and *vice versâ*. The alternate expansion and contraction of the two sets of air-cells causes currents of air to play continually through the spongy tissue of the lungs peculiar to birds, and to pass between the almost naked capillaries, first described by Mr. Rainey (in 1848) as forming the only walls of the areolar spaces that answer to the air-cells of the mammalian lung. The air-spaces between the capillaries are, according to Mr. Rainey's measurements, only $\frac{1}{9600}$th of an inch, and the quantity of air in them must soon be deprived of oxygen and saturated with carbonic acid. Hence the necessity of its continual change. This change is effected by constant streams of air that fan the capillaries in passing from one set of air-sacs to the other. The intricate courses which the air takes in passing in and out of the air-cells and bronchial tubes of various orders is difficult to describe, especially without diagrams.

The respiration of birds, even when in repose, has been shown to be much more active than that of mammals. But in order that birds may be equal to the enormous exertion required of them for sustaining themselves in the air for considerable periods of time, very ample provision must be made for respiration. If therefore the lungs were constructed after the mammalian type, they would require to be very large, and powerful muscles must have been provided for the respiratory movements. But this would add unduly to the weight of the body. The lungs therefore are small, very porous, and light; yet nevertheless their efficiency is ensured by a more minute division of the capillaries, and a more complete exposure of these to the action of the air supplied so abundantly from the capacious air-sacs. In short, more perfect *localized* instruments of respiration cannot be conceived.

Our great physiologist, John Hunter, believed it impossible that the ribs and sternum of a bird could move while the powerful pectoral muscles are engaged in flight. He therefore thought that the air-sacs of birds might be intended to act as reservoirs of air to be used in respiration during flight. These sacs, however, do not hold enough air to support the respiration of a bird for two minutes ; for in that time, if the trachea of a bird be tied, it dies; yet many birds continue on the wing for hours together. Sappey has endeavoured to explain the difficulty which occurred to Hunter by pointing out that the great pectoral muscles of birds arise exclusively from the sternum, and not at all from the ribs, as they do in mammals. But this explanation only removes a part of the difficulty; for the ribs are so articulated with the sternum, that they cannot move unless the sternum moves also. Now the sternum in respiration moves at its articulations with the two coracoid bones, these bones being fixed in regard to the sternum and humerus in the movements of flight. It might seem, therefore, that when the pectoral muscles contract, the sternum would be drawn powerfully upwards as the wings are drawn downwards, and so the sternum and ribs flexed. But this is not so ; for the fibres of these muscles converge towards and pass over the coracoid bones on their way to be inserted into the ridge of the humerus, and they act in the direction of the axis of the coracoid ; so that they only draw the sternum and coracoid together more closely, and do not tend to flex these bones on one another. The common inspiratory muscles are therefore free to act, whether the pectorals are in action or not. To be more exact, the line of action of the great pectoral muscle lies a little below the coracoid bone, and parallel to its axis. Hence, in contracting, the muscle will tend to depress the sternum, and so assist the inspiratory muscles, and render inspiration deeper in flight than when the wings are closed.

The author gave a mathematical as well as an experimental proof that the external intercostal muscles raise both the ribs to which they are attached, and that the internal intercostals depress both ribs. A frame of wood, in the form of a parallelogram with hinges at the angles, represented two ribs, the spine, and the sternum. An india-rubber ring was passed over a peg in the upper rib and another in the lower rib, at different distances from the spine, to represent the intercostal muscle. Both ribs were elevated or depressed according as the upper peg was nearer to, or further from the spine than the peg in the lower rib.

The hollow bones are filled with air, not for respiratory purposes, but to remove the moisture from the interior of the bones secreted by the endosteum, which would otherwise accumulate and defeat one of the objects for which the bones are hollow, namely, to diminish their weight,—the other object being to increase their strength. The author proposes to publish his views in a separate form so soon as he shall have leisure to complete certain experimental investigations that he has devised.—*Cambridge Phil. Soc.* Feb. 12, 1866.

On the Organs of Parturition in the Kangaroos. By EDMOND ALIX.

I have lately, by the kindness of M. E. Verreaux, had the opportunity of examining the organs of parturition in a female *Halmaturus Bennettii*. This investigation has enabled me to solve a question which has long been under controversy. The organs of generation, in the female Kangaroo, consist of two ovaries, two Fallopian tubes, two uteri, and two lateral vaginæ (which, after bending round in the form of loops, terminate in the urethro-genital vestibule), and a median pouch or vagina. This median vagina, to which our attention must be particularly directed, is in the form of an elongated cone. The base of the cone, turned towards the uteri, has a wide communication on each side with the lateral vaginæ; its apex advances between these two passages and reaches the bottom of the urethro-genital vestibule. Home asserted (Phil. Trans. 1795) that there was a direct communication between the cavity of the median vagina and that of the urethro-genital vestibule, that the orifice enlarged gradually as the period of parturition approached, and that it then became capable of sufficient dilatation to allow the escape of the fœtus. Cuvier did not accept this opinion, his dissections not having shown him the orifice indicated by Home. He assumes, in consequence, that the fœtus gets into one of the lateral vaginæ and passes slowly along until it is expelled. Owen (Cycl. of Anat. and Phys.) has confirmed Cuvier's assertions; and this opinion has been generally adopted. The object of this arrangement of the organs would be the multiplication of obstacles destined to prevent the too rapid expulsion of so delicate an embryo.

Nevertheless, if we consider the narrowness of the lateral vaginæ, and especially the extreme fineness which they present at about 2 centimetres from the urethro-genital vestibule, we may be alarmed at the slowness of the passage and the violence of the pressures to which this delicate embryo would be subjected. There is no more argument in favour of the second than of the first opinion; and the observation of facts can alone teach us what is the truth.

In a preparation which I have submitted to the examination of my colleagues of the Société Philomathique, it is easy to see, upon the pubic face of the urethro-genital vestibule, immediately above the urinary meatus, a circular orifice, larger than that meatus, and folded in the manner of the anal sphincter. A sound introduced through this aperture, passes immediately into the cavity of the median vagina. This preparation furnishes incontestable evidence of the existence of the aperture denied by Cuvier and Owen, and affirmed by Home. The difference of opinion between these authors may perhaps be due to their not having examined the same species.

The lateral vaginæ present no trace of distention, and there is nothing to indicate that they have served for the passage of the fœtus. They do not appear to have been of any other use than to receive the semen at the moment of copulation and to convey it to the neck of the uterus. They would thus merit the name of *spermatophorous vaginæ,* whilst the median vagina would be an *embryophorous vagina.* This opinion is confirmed by an interesting fact—namely, that the median vagina is covered with a pavement-epithelium, while the lateral vaginæ are clothed with a cylinder-epithelium.

From these facts it follows that the issue of the embryo does not in this case present that slowness which was ascribed to it by the opponents of Sir Everard Home; but it must not be supposed that the prevision of nature can be at fault; it has made up for this by the instinct of the mother. M. Jules Verreaux, during his residence in Australia, possessed a considerable number of Kangaroos, which he kept in confinement. By attentively watching them day and night, he succeeded in ascertaining the secret of their parturition. When the female feels that she is about to expel an embryo, she applies her two fore feet to each side of the vulva in such a manner as to separate its labia; she then introduces her muzzle into the vestibule and receives the embryo in her mouth. The fore feet are then at once removed to the margins of the marsupium in such a manner as to dilate its aperture; the head is passed into the pouch and deposits the embryo there. In a few moments it is attached to the teat. Messrs. Owen and Bennett had a suspicion of these facts; but the honour of the discovery is due to M. Jules Verreaux.—*Comptes Rendus,* January 15, 1866, pp. 146–148.

Descriptions of Twenty-one new Fishes from Port Jackson, and One from Port Natal. By Dr. F. Steindachner.

Dr. Steindachner has communicated to the Vienna Academy a paper on the Fishes of Port Jackson, in which he refers to sixty-six species. He describes the following as new:—

1. *Plectropoma myriaster.*—Body and fins densely covered with small round spots; length of head contained $2\frac{7}{10}$–$2\frac{4}{5}$ times, and depth of body 3 times, in the total length; caudal fin slightly rounded off.
D. 13/14–15; A. 3/8; L. lat. c. 100.

2. *Dules novemaculeatus.*—Dorsal with nine spines.
D. 9/10; A. 3/7–8; L. lat. 49–50.

3. *Scorpis Richardsonii.*—Profile of head concave; diameter of eye = $\frac{1}{4}$ length of head.

4. *Scorpæna Jacksoniensis.*—A milk-white spot upon and below

the last rays of the dorsal; body reddish brown, with black spots on the belly and ventrals.

D. 11–1/9; A. 3/5; L. lat. 50–52.

Parapistus, g. n.—Form of body Scorpænoid, without occipital pit; head not scaly, armed with spines; pectoral fins with divided rays; trunk covered with ctenoid scales; branchiostegal rays seven; supplementary gills large; a cleft behind the fourth branchial arch.

5. *Parapistus marmoratus.*—Length of head contained 3 times, and depth of body $3\frac{1}{2}$ times, in the total length. Body light brown, with darker marblings.

D. 15/9; A. 3/5; P. 11; L. lat. 56–63.

6. *Sciæna Novæ Hollandiæ.*—All the fins, except the first dorsal, almost entirely covered with scales; depth of body = length of head; caudal rhombic.

D. 10–1/25–7; A. 2/7; L. lat. 50.

7. *Sphyræna grandisquamis.*—Length of head contained $3\frac{4}{5}$ times, and depth of body $8\frac{2}{5}$ times, in the total length; operculum rounded off; maxillary bone terminating in front of eye; dorsal commencing behind the apex of the pectorals.

D. 5–1/10; A. 1/9; L. lat. c. 82.

8. *Gobius Krefftii.*—Body with three rows of round spots; length of head contained four times, depth of body $6\frac{1}{2}$ times, in the total length; pectorals with several hair-like free rays.

D. 6–1/9; A. 1/9; L. lat. 36.

9. *Eleotris striata.*—Scales rather large; head much pointed in front, forehead very narrow; head, except operculum, scaleless; obsolete spots on the sides of the body.

D. 7–1/10; A. 1/10–11; L. lat. 35.

10. *Eleotris gymnocephalus.*—Head and nape without scales; forehead broad, flat; eye small; body yellowish, with the margins of the scales brownish; a large blackish spot before the caudal fin and upon the axillæ of the pectorals.

D. 7–1/9; A. 1/9; P. 19–20; L. lat. 39–40.

11. *Eleotris Richardsonii.*—All the fins intensely yellow; dorsals and caudal spotted or banded with brown; caudal short, rounded, a brown longitudinal band on each side of the body; cheeks and opercula scaled; head contained $4\frac{5}{8}$ times in the total length, and eye 5 times in that of the head.

D. 7–1/9; A. 1/9; L. lat. 37.

12. *Mugil breviceps.*—Eye without adipose membrane; head contained $5\frac{2}{5}$ times in the total length.

D. 4|1/8; A. 3/9; V. 1/5; P. 2/13; L. lat. 48.

Heterochœrops, g. nov.—Maxillary teeth as in *Chœrops*, for the most part amalgamated into a lamella; four free canine teeth in the intermaxillary and lower jaw in front of the lamella; sides of the head and ventral fins scaled; præoperculum toothed; cheeks not elevated; dorsal spines 11; lateral line not interrupted.

13. *Heterochœrops viridis.* Sides of body green; scaleless portion of fins dark greenish blue; fourth dorsal spine higher than any of the rest.

D. 11/11; A. 3/11; L. lat. 42.

14. *Odax Hyrtlii.*—Præoperculum toothed on the hinder margin; a very large indigo-blue spot between the last dorsal spine and the sixth soft ray of the same fin; caudal yellowish, with a violet margin; muzzle and cheeks with azure longitudinal streaks; first dorsal spine not elongated.

D. 18/12; A. 3/10; L. lat. 58.

15. *Lotella Schuettei.*—Length of muzzle equal to that of the eye; first dorsal rather higher than second; vertical fins with black borders; points of the rays in the same fins white.

D. 5/60–62; A. 55–56; V. 7; P. 25.

Richardsonia, g. nov.—Upper margin of mouth formed by the intermaxillary and maxillary bones; all the bones of the jaws, the tongue, vomer, palatal and pharyngeal bones armed with teeth. Ventrals of half the length of the body; dorsal at the commencement of the last third of the length; anal placed in front of the small adipose fin; eye of moderate size; supplementary branchiæ distinctly developed. Sp. *Richardsonia retropinna*, Rich. sp.

16. *Hemiramphus trilineatus.*—Intermaxillaries twice as long as broad; dorsal and anal of equal depth and length; ventrals short, without any elongated ray, situated nearer to the caudal than to the branchial aperture; three dark-blue longitudinal lines between the occiput and the dorsal.

D. 2/12; A. 2/10; P. 1/10.

17. *Atopomycterus Bocagei.*—Form of body roundish; head quadrangular; spines of various lengths, longest on the anterior frontal band, with two roots; head with small, belly with larger black spots.

D. 13; A. 12; P. 22; C. 1/7/1.

18. *Trygonoptera Mülleri.*—Disk elongate rotundate; snout blunt; breadth of disk equal to length of body; tail somewhat longer than body; dorsal at some distance in front of the caudal spine.

19. *Trygonoptera Henlei.*—Snout blunt; disk considerably broader than long; lengths of tail and body equal; dorsal fin placed immediately in front of caudal spine.

20. *Trygonoptera australis.*—Disk broader than long; tail rather longer than body. Posterior angle of disk obtusely rounded off; ventrals considerably smaller than in *T. testacea*; anterior margin of disk convex.

SCHUETTEA, g. nov. (Fam. Psettoidei).—Body oblong, strongly compressed; dorsal and ventral lines also strongly compressed. Eye very large; muzzle short; cleft of mouth directed upward; lower jaw projecting; jaws, vomer, and palatal bones with small pointed teeth of equal length; præoperculum finely toothed; ventrals completely developed; dorsal and anal fins very long, opposite, with the spines densely pressed together; accessory branchiæ large; branchiostegal rays seven.

21. *Schuettea scalaripinnis.*—Depth of body contained $2\frac{4}{5}$ times in the total length, and eye $2\frac{1}{3}$ times in that of the head; operculum spinosely notched at its hinder margin; upper surface of the head with a moderately elevated crest.

D. 5/31; A. 3/28; P. 16; L. lat. c. 50.

(22.) *Mustelus natalensis.*—Teeth quadrangular, much broader than high, drawn out into thin rounded processes on the free margin; pectorals longer than broad; first dorsal commencing in front of the hinder margin of the pectorals, and reaching with its posterior point to the commencement of the ventrals.

From Port Natal.

Bericht Akad. Wiss. in Wien, March 8, 1866, pp. 50–54.

On the probable Existence of Accessory Eyes in a Fish. By Prof. R. LEUCKART.

It has long been known that the bodies of certain *Scopelinidæ* are covered with very brilliant pigment-spots, grouped more or less regularly. Hitherto these spots had not been carefully examined; but Professor Leuckart, having investigated them anatomically in one species (*Chauliodus Sloani*), endeavours to interpret them as accessory visual organs. This would certainly be a very unexpected discovery in a Vertebrate animal, especially as the number of these eyes amounts to more than a thousand, disseminated partly upon the hyoid and its dependencies, and partly on the head and belly, where they form two parallel longitudinal rows. Professor Leuckart's opinion is founded upon the anatomical structure of the organs in question. They are in the form of small cylinders, the anterior half of which is occupied by a spherical body very like a crystalline lens. Behind this there is a sort of vitreous body. The layer of pigment which envelopes this supposed ocular bulb presents a silvery lustre and a structure identical with that which lines the eyes of the *Plagiostomi.* It has, however, been impossible to detect on the nerve of the organ any membranous expansion acting the part of a retina; but it must not be forgotten that the observations were made upon an animal preserved in spirits. The genus *Stomias* presents exactly similar organs. This genus has hitherto been placed among the *Esocidæ,* but erroneously, according to Leuckart: it must be united with the *Scopelinidæ.*—*Bericht Versamml. deutsch. Naturf. und Aerzte,* 1865, p. 153; *Bibl. Univ.* January 1866, *Bull. Sci.* p. 94.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 101. MAY 1866.

XXXVII.—*An Epitome of the Evidence that Pterodactyles are not Reptiles, but a new Subclass of Vertebrate Animals allied to Birds* (Saurornia). By Harry Seeley, Esq.*

Baron Cuvier assumed that Pterodactyles were Reptiles, and as reptiles they have since been described. It was by no rigorous determination such as modern science would give that the great master assigned to the tribe of Saurians this extinct group of animals. Other authors have referred them to mammals, to reptiles, and to birds; but Cuvier, regarding the latter hypothesis as scarcely worth notice, devoted much of his demonstration to proving that they were not mammals, and much of it to assuming that therefore their structure was reptilian. Of course there is some truth in this, as there is sure to be in every conviction of Cuvier's; and facts were then more favourable to such a view than they are in the eyes of modern discovery. But the evidence on which Cuvier relied was furnished chiefly by two individuals, neither of which showed the details of structure seen in Cambridge specimens; hence it will not be surprising if the facts which suggested the reptilian hypothesis prove, on examination, to point to another conclusion.

Quoting from the new edition of the 'Ossemens Fossiles' (that of 1824), in Cuvier's own words, we shall endeavour to illustrate the results at which he arrives.

First, then, he says—"Ayant encore porté mon attention sur le petit os cylindrique marqué *g* [*i. e.* os quadratum] qui va du crâne à l'articulation des mâchoires, je me crus muni de tout ce qui étoit nécessaire pour classer ostéologiquement notre animal parmi les reptiles." The exact relations of the quadrate bone are not seen in either Cuvier's or Von Meyer's figures of *Ptero-*

* The substance of this paper was communicated to the Cambridge Philosophical Society, as part of a monograph of Pterodactyles, read March 7 and May 2 & 16, 1864.

dactylus longirostris; but in the figures of *P. crassirostris, P. longicollum*, and *P. Kochi* it appears to be a free bone articulated to the squamosal and petrosal region of the skull and with the lower jaw. This is the case neither with Chelonians nor Crocodiles, and is only in a certain sense found in lizards and serpents; while, on the contrary, it is characteristic of the whole class of birds. The form of the bone is certainly not more Lacertian than Avian, while its direct attachment to the bone of the brain-case finds no parallel among lizards, but is exactly paralleled in all birds.

Cuvier then goes on to say, "Ce n'étoit pas non plus un oiseau, quoiqu'il eût été rapporté aux oiseaux palmipèdes par un grand naturaliste." Which position he supports as follows:—

(1) "Un oiseau auroit des côtes plus larges, et munies chacune d'une apophyse réeurrente*; son métatarse n'auroit formé qu'un seul os, et n'auroit pas été composé d'autant d'os qu'il a de doigts."

These, though they may not be characters which are those of birds, are certainly not eminently reptilian. The elongated form of the tarsals in birds is peculiar, but quite functional, as may be seen among the penguins, where, when the so-called tarso-metatarsal bone is no longer erect, it becomes much shorter, and is nearly separated into three distinct bones. And it would be premature to assert that this tarsus has no analogue in the Cretaceous Pterodactyles.

(2) "Son aile n'auroit eu que trois divisions après l'avant-bras, et non pas cinq comme celle-ci."

This is a difference of detail only. The creatures have wings, and they are formed on the same general plan as those of birds. Most birds have two phalanges in the long finger, though some have three. One Pterodactyle is described as having only two phalanges in the wing-finger, while most of them appear to have four phalanges, and others but three. But in birds the longest finger appears to be the middle one, whereas in Pterodactyles it is the outermost one. This adds nothing to its supposed reptilian characters.

(3) "Son bassin auroit eu une toute autre étendue, et sa queue osseuse un toute autre forme; elle seroit élargie, et non pas grêle et conique."

I am not aware of any evidence tending to show that the pelvis of Pterodactyles was materially different from that of some birds. And the discovery of a long-tailed bird like the

* This is shown in other specimens figured since, and in the specimen from Stonesfield, in the Oxford Museum.

Archæopteryx shows that the tail is like that of old birds, even if it presents some analogy in form to that of certain reptiles.

(4) "Il n'y auroit pas eu de dents au bec; les dents des *harles* ne tiennent qu'à l'enveloppe cornée, et non à la charpente osseuse."

This is not a reptilian character. Among reptiles some tribes have teeth, others want them; and among mammals some animals are without teeth, though they are so characteristic of the class. And therefore it seems an anomaly that birds should all be toothless. And so, without citing the supposed teeth of *Archæopteryx*, it may be affirmed that it would be no more remarkable for some birds to have teeth than it is for some mammals and reptiles to be without them.

(5) "Les vertèbres du cou auroient été plus nombreuses. Aucun oiseau n'en a moins de neuf; les palmipèdes, en particulier, en ont depuis douze jusqu'à vingt-trois, et l'on n'en voit ici que six ou tout au plus sept."

This, again, is a variation of detail such as, had it occurred among ordinary birds, would not have occasioned remark. When the variation of the neck-vertebræ ranges from twenty-three to nine, the further reduction of the number to seven becomes insignificant, and is certainly far from going to show that the animal was a reptile.

(6) "Au contraire, les vertèbres du dos l'auroient été beaucoup moins. Il semble qu'il y en ait plus de vingt, et les oiseaux en ont de sept à dix, ou tout au plus onze."

This modification is so obviously the result of small development of the pelvic bones, and hence of the small number of vertebræ in the sacrum, that it cannot be held to bear against the avian relations of Pterodactyles any more than it supports their reference to the class of reptiles.

These are Cuvier's arguments; and in them is found nothing against the ornithic affinities of the tribe, except the tarsus, and absolutely nothing to support the hypothesis that Pterodactyles are reptiles.

Further on (tome v. part 2. p. 363), speaking of the teeth, it is said—"Elles sont toutes simples, coniques, et à peu près sembables entre elles comme dans les crocodiles, les monitors, et d'autres lézards." Now the teeth of Pterodactyles are (in the skull) all, or nearly all, in the premaxillary bones, in which it is so characteristic for the teeth of animals to be merely conical and simple. Therefore it would have been difficult to imagine the teeth to have been anything but what they are, whatever the affinities of the Pterodactyle might be.

At p. 367 it is remarked—"La longueur du cou est proportionnée à celle de la tête. On y voit cinq vertèbres grandes et prismatiques comme celles des oiseaux à long cou, et une plus petite se montre à chaque extrémité." This adds nothing to the evidence for its assumed reptilian character.

"Ce qui est le plus fait pour etonner, c'est que cette longue tête et ce long cou soient portés sur un si petit corps; les oiseaux seuls offrent de semblable proportions, et sans doute c'est, avec la longueur du grand doigt, ce qui avoit determiné quelques naturalistes à rapporter notre animal à cette classe." Nor can this be taken as evidence that the animal was a reptile. And in many other minor matters Cuvier is careful to show how their modifications resemble those of birds; and when this is not so, birds are the only animals from which he finds them varying. And the few suggestions which are thrown out respecting affinities to lizards are upon points which are also common to birds. Thus what Cuvier did was to distinguish these animals from birds, and incidentally to show that their organization was only a modification of that of the avian class. And the legitimate inference from this would have been that their systematic place was that of a new group of birds, and not that they were reptiles.

None of the long list of writers reviewed or cited by the learned author of the 'Fauna der Vorwelt' appear to have adduced anything of importance in favour of the presumed reptilian relations of Pterodactyles. And what Professor Owen has incidentally stated in his descriptions would go far towards demonstrating them to be bird-allies, while he, no more than preceding or succeeding writers, has pointed out any characters which would justify the position that has been assigned to them in the reptilian class. In a case like this it may be remembered to Prof. Owen's honour that he described certain fragments of bones of Pterodactyle as those of birds, and never allowed that the determination was erroneous, as many maintained.

Seeing, then, that Pterodactyles have hitherto been placed with reptiles, on Cuvier's dictum, and on the trivial data which I have quoted that their nature might be apparent, I believe it will be readily conceded that the proofs that Pterodactyles are reptiles have yet to be found.

In determining and arranging the osteological remains which adorn the collections of the Woodwardian Museum, I was struck with the almost invariably ornithic characters of the bones of Pterodactyles, and was led to the conclusion that, as the principle of organization was avian, and the bones were nearly all avian in their modifications, the animal must have been avian. And comparative diagrams of the corresponding parts of Pterodactyles and birds were exhibited to prove it when, in 1864, I read a paper on the Pterodactyle as evidence of a new subclass of birds, at the meeting of the British Association in Bath. And now Prof. Owen, in his 'Comparative Anatomy,' elevates the Pterodactyles to the rank of the highest group of reptiles —thus placing them between the recognized Reptilia and Aves, as I had done.

Under these circumstances I venture to submit an epitome of the evidence which led to the conclusion that Pterodactyles are a subclass of bird-allies, and have nothing whatever to unite them with the Reptilia—a result which has been chiefly worked out from Cambridge specimens, which have been almost invariably determined by comparing the articular surfaces of the bones. And thus the osteology of the group has been made out independently of comparison with the bones of other animals.

In a former paper attention was drawn to the equality in size between the fore and hind limbs of Pterodactyles; and anyone who examines the figures of the species *longirostris, brevirostris, crassirostris, scolopaciceps, longicollum, Meyeri, micronyx,* &c., will observe that the clawed phalanges of the hand are spread out like those of the foot, while the wing-finger is bent back in front, often against the metacarpal bones. The small bones of the hand are often not dissimilar to those of the foot. From these facts, and from a consideration of the joints, I find that the Pterodactyle was quadruped, and, when not flying, carried its wings folded up in front of the fore limbs. For if it were true, as the restorations and figures of Pterodactyles flying would lead us to believe, that the large wing-metacarpal was only used to support the wing, and the small metacarpals only used to support the claws by which the creature is imagined to have suspended itself like a bat, it would be impossible to believe that the force of flying so exactly corresponded to the force of suspension as to cause the large and the small metacarpals invariably to attain the same length. A correspondence of this kind in structure, as it seems to me, can only indicate a correspondence in function; and as the animal did not fly by means of its claws, the only other inference is that it walked by means of its metacarpal bones. There are plenty of instances of inequality in thickness of metacarpal and metatarsal bones where the major part of the work of running or jumping is thrown on some special bone, but there are probably no instances of inequality in length where the function is exactly the same; and hence it may be shown that it would be contrary to all considerations, both theoretical and empirical, to suppose the growth would be the same though the functions were so different as those supposed. But in birds, where the functions of the different metacarpals are not very dissimilar, one metacarpal is exceedingly short; very much less, then, could they all be expected to correspond in length in an animal where one was used for flying and the others for clinging. But they do correspond; and therefore I conclude that they were not used in dissimilar, but in the same function. And hence, as the only way in which they could have been equally used was in walking, it follows that the Pterodactyle was quadruped. This, as we shall see, is a consideration of theoretical value, as bearing on their position in the animal kingdom, and will help to show their affinity to birds in a direction which removes them far from reptiles.

It is well known that many bones of most birds are filled with air, and that, as a principle, the more the motion of the animal, the greater is the number of bones filled with air. This air is received from the air sacs, which receive it from the lungs and return it through the lungs again. Thus there is in birds a sort of supplemental lung-system, which circulates air through the body. Nothing of this sort is observed in reptiles, even the lungs with them being generally in a very rudimentary condition, while in birds the respiratory system is more perfect and complex than in any of the other Vertebrata, and, as a result, the temperature of the blood is hotter.

Now in Pterodactyles the bone-walls are all very thin, the bones being hollow and showing pneumatic apertures, which are large, precisely as in birds of great flight. The fact that the bones are supplied with air necessitates an elaborate system of air-sacs to furnish the supply; and the existence of these air-sacs speaks incontestably to bronchial tubes opening on the surface of the lungs to supply them, and to the existence of lungs essentially like those of birds. But the circulation of this air through the body was seen in birds to have relation to rapid motion through the air, which necessarily would produce more rapid respiration. But rapid respiration only means more rapid oxidation of the blood, and conversion of the purple cruorine into scarlet cruorine—that is, the conversion of venous blood into arterial blood. And if venous blood is rapidly converted into arterial blood, there must be rapid circulation. Now rapid circulation cannot take place without a heart with two auricles and two ventricles; therefore I conclude that Pterodactyles had the heart like that of birds and mammals: and hence it follows that they must have had hot blood. But it has been seen that the Pterodactyles were quadrupedal; and hence it may fairly be concluded that they could not have moved so much through the air as birds, and therefore the stimulus to active respiration could not have been so great; and yet they possess to perfection the elaborate respiratory system of the most active birds; and so it follows that their circulatory and respiratory organs were not less developed than in birds, but rather more developed.

This alone is ample evidence, were there no other, that our animals were near allies of the birds; but it will be seen that the correspondence is not limited to the general principle of organization, but extends to many of its details.

I have been able to examine fragments of several skulls from the Cambridge Greensand, one of which is of great size, and shows the interior of the front part of the skull, exhibiting the form, size, and characters of the front part of the brain. The brains of birds and reptiles are both so characteristic that there can be no doubt about the conclusion to be drawn from this evidence. In Pterodactyles the large hemispheres are extremely high, and terminate in front in well-rounded convexities, between which there is a little depression. This is most characteristically avian, and would be quite sufficient to show that the Pterodactyles ought not to be expected to have any resemblance to reptiles. I have also been able to examine three skulls of which the occipital and parietal regions are well preserved, and can confidently assert that the brain is not less developed than in birds; indeed it is only by some minor modifications of the basal region that any one could distinguish the skulls from those of ordinary birds. There is nothing in the brain to show that the Pterodactyles were not more highly organized than birds.

Although Pterodactyles were quadrupeds, they were flying quadrupeds; and it has been generally assumed that they flew by means of membranous wings, like the mammalian bats. But their wings have little in common with the mammalian wing, not being formed by prolongations of all the fingers; and *no reptile known, from recent or fossil specimens, has wings.* Therefore there only remains the birds with which the Pterodactyle wing can be compared; and with them, as will be seen, the correspondence of plan is perfect. In ordinary birds it is singularly close, but in the *Archæopteryx* it is closer. Each of these groups of animals has a well-developed humerus, and ulna and radius not very dissimilar, as was to be expected. In both, the carpals are short, small bones; in both, the metacarpals are long, slender bones: there are three in ordinary birds (one short), four in the *Archæopteryx,* and four in most known Pterodactyles. In ordinary birds, one of the fingers which these support sometimes terminates in a claw; in *Archæopteryx* two of the fingers appear to terminate in claws, while in Pterodactyles three of the fingers have claws. In birds two of the metacarpals, more or less anchylosed together (and therefore functionally one), with their phalanges, terminate the wing; but in Pterodactyles there is one large metacarpal which supports a number of long phalanges, varying to as many as four, while in birds the number is usually limited to two. Thus, however dissimilar they may look at a glance, the wings of birds and Pterodactyles do not differ in kind, but only in degree. The plan is the same, but the modifications of it are different. And these divergences seem chiefly to have reference to the fact that Pterodactyles were quadrupeds; whence it comes that while in birds the whole limb is modified for flight, the whole limb in Pterodactyles, excepting one finger, is also modified for standing. And thus it happens that in birds the bones of the arm and forearm are enormously long, while in Pterodactyles they are comparatively short, and that, while in Pterodactyles the phalanges of one finger are enormously elongated to form a wing, in birds, where they have no such function, they are short.

Therefore I affirm that the fore limb of Pterodactyles has nothing reptilian in its mode of construction, but is essentially avian in type; and even if it should be found that the wing-finger supported a membranous wing, which there are no sufficient reasons for assuming as certain, that would rather show an approximation towards mammals than the faintest affinity with the Reptilia.

Then the form of body and proportions of its parts are worth remark in Pterodactyles; for they find no parallel among the Reptilia, but are very bird-like. The large, long head, tapering in front, is essentially the head of the bird in form, and probably, but for the teeth, would have been always so regarded. Although Plesiosaurs and turtles both have long necks, the proportions of the neck in Pterodactyles are decidedly those of a bird. The length of the limbs finds its parallel in no group of reptiles, but is characteristic of birds; and the proportions and form of the breast-bone are only to be matched among birds. Neither the length of the tail in some tribes nor its shortness in others is opposed to our knowledge of the structure in birds. Therefore it is not astonishing to find that Blumenbach considered the Pterodactyles to be birds, that Sömmering named the genus *Ornithocephalus*, or that Prof. Hermann placed it between the birds and mammals.

I will now briefly give some of the results of a consideration of the several bones. And here, no more than in the organization, do I find any characteristics of reptiles, or anything to make me doubt that the Pterodactyles were, even in the details of structure, formed essentially on the ornithic plan.

If the reader will refer to any figure of the skull of a Pterodactyle, and compare with it any similarly formed skull of a bird (say that of the heron), it will be found that the form and size of the region for the brain is the same in both, and that all the cavities of the skull, orbits, nares, and the apertures between them, correspond exactly in the two. The eye is usually more developed in the Pterodactyle than in birds, is similarly defended with sclerotic plates, and, as a result of larger size no less than of the greater intensity of life in the animal, it is surrounded with bone. The lachrymal, similar to that of a bird, grows down from above, and meets a process of the jugal, of which there is a trace in some birds, which grows up from below. Then the eye extends down to the quadrato-jugal, which accordingly is much thickened, and appears to extend up the inner side of the quadrate bone (from which it sometimes cannot be separated) to meet the outward process of the alisphenoid and squamosal bones. This slight and evidently functional difference is almost the only important deviation from the bird-type seen in the Pterodactyle skull. As I have already remarked, the quadrate bone, both in form and in its relations to the skull, is quite the same as that of a bird; and the articulation with the lower jaw is exactly matched by the complex articulation of some birds. The relations and proportions of the premaxillary, maxillary, and nasal bones are those of birds; and, as far as can be judged from figures, the other bones of the skull are not less avian. As regards Cambridge specimens, I can confidently say that, if seen separately, and their history were unknown, no anatomist would ever dream of their being anything but a new tribe of birds.

The vertebral column of true birds is very peculiar, and, with some few exceptions, is readily distinguished from that of all other animals by the concavo-convex articular surfaces. No Pterodactyle is at present known to show this character, though both kinds of articulation exist in the class. The *Dimorphodon* has vertebræ which are *convex* in front, while the Pterodactyloid animals from the Cretaceous beds have the vertebræ *concave* in front; hence, seeing that the development is entirely functional, it would not be surprising to find Pterodactyles with vertebræ like birds; for the bird's vertebra might be easily modified into the concave or the convex type. But it would seem to be by no means necessary that a bird should have this concavo-convex articulation to the vertebræ; for, as Prof. Owen has stated, "in the third to the eighth dorsal vertebræ of *Aptenodytes*, the fore part is simply convex, while the hind part is concave." Thus the Pterodactyle may be regarded as a case in which all the vertebræ have a like simplicity of articulation; for in all their other features, from the atlas and axis downwards, they present characters which have been recognized by Cuvier, Owen, and other observers as only comparable to those of birds. In the pectoral apparatus every bone might have been that of a true bird, nor can any characters be given sufficient to distinguish them well.

Prof. Owen remarks that "the scapular arch is remarkably similar to that of a bird of flight." And, again, the same able authority remarks, "In the main, the Pterosaurian breast-bone, like the scapular arch, is formed on the ornithic type; but the postcoracoid lateral emarginations are distinctive Pterosaurian characters." And, going into details, Prof. Owen observes, "Only in birds are distinct synovial articulations provided for the coracoids, which, in the main, are situated and shaped as in the Pterodactyle." After so clear an exposition, I cannot draw the conclusion that, because the Pterodactyle has the characters of a bird, therefore it must be a reptile.

The compact pelvic bones are distinctive. The femur, tibia, fibula, and humerus are in the main avian. Nor will any of the remaining bones be found to show reptilian characters. From facts such as these it seems to me no hard task to determine whether the Pterodactyle has the organization of a reptile or of a bird. I find it in every essential principle to be formed on the avian plan. Yet it differs more from existing birds than they do among themselves, and therefore cannot be included as an order of Aves; for the points of structure in which it differs from birds are those in which all existing birds agree. I therefore regard it as forming a group of equal value with Aves, each as a subclass, forming together a great class of birds. Its distinctive characters are—in having teeth, in the simple convex or concave articulation of the vertebræ, in the separate condition of the tarsal and metatarsal bones, in having three bones in the forearm instead of two, in a peculiar carpal bone, in the sacrum formed of few vertebræ, and in the modification of the wing by the enormous development of the phalanges of one finger. The subclass so characterized forms a parallel group with the true birds. Whether it may not in some points of organization rise above birds, is a question on which I offer no opinion, further than to state that in none of the typical mammalian characters does it approach the mammals. Reptiles, as may naturally be expected, resemble the Pterodactyles, because the gap between reptiles and birds is smaller, and the osteological correspondences between them are many. Hence those parts in which the Pterodactyle falls short of the specialized characteristics of true birds may rightly be regarded as those in which it is more Saurian. Such are the quadruped motion, the lizard-like hand, the simple articulation of the vertebræ, the smaller sacrum and less-developed pelvic bones, the divided condition of the tarsals and metatarsals, the succession of the teeth, and the often long tail. But, while making it more Saurian, they do not necessarily imply that the animal was more reptilian in the sense of being of lower organization, but only that it diverged less from the Saurian type on which the osteology of the bird seems founded. Therefore the

Pterodactyle's place in nature appears to be side by side with the birds, between the reptiles and mammals, thus:—

Mammalia

Saurornia . . . . Aves

Reptilia.

XXXVIII.—*On the Developmental History of the Nematode Worms.* By Rudolph Leuckart*.

The investigations and discoveries of the last few years have in many respects modified our notions on the particulars of parasitic life, and enriched our knowledge with a great number of important details. Of many parasites, even of man, we have now the entire life-history clearly before us. But there still remain many gaps in our observations; and these are nowhere so great and so serious as in the group of the Nematoda, or Roundworms.

Our present knowledge of the life-history of these parasites (with the exception of the *Gordiacei*, which are parasitic only in the lower animals) is pretty nearly limited to what has been ascertained by Virchow, Zenker, and myself with regard to the *Trichinæ*. At any rate the *Trichinæ* are the only (true) Nematoda whose natural history is known in all phases, and through all migrations.

In the same way as the other known Entozoa, the *Trichinæ* live under different conditions and in different animals in their young and adult states. In order to arrive at sexual maturity, they must pass from the muscle of one bearer into the intestine of another; from rats and mice they migrate into cats and pigs, and from the latter find their way again into their former hosts. That man and other mammals occasionally come within the developmental cycle of the *Trichinæ* is to be regarded, in a helminthological point of view, as merely accidental, notwithstanding its fatal significance. The intercalation of these organisms represents to a certain extent a collateral course, which is just as unimportant for the circulation of the *Trichinæ* as the occurrence of *Cysticerci* in the muscles of rats or dogs in the life-history of the Tapeworms of man, which primarily requires only the interchange with the pig or the ox.

* Translated by W. S. Dallas, F.L.S. &c., from a copy of the paper in the 'Archiv für Heilkunde,' Band ii. pp. 195–235, communicated by the author.

Notwithstanding all analogies with the other Entozoa, and especially with the Tapeworms just mentioned, the *Trichinæ* diverge in their comportment in this respect: the muscle-*Trichinæ,* which may be compared to the *Cysticerci* of muscles, regularly originate by self-infection in the bearer of the sexually mature intestinal *Trichinæ,* whilst the development of the *Cysticerci* usually requires infection from without. In other words, the embryos from which the muscle-*Trichinæ* are produced migrate in the host of their parents; while the germs of the *Cysticerci* quit their original host and pass into another species of animal. In the complete development of the *Tæniæ,* therefore, three different bearers usually co-operate, while that of the *Trichinæ* in general only require two.

But the difference here indicated is by no means of primary importance. So little is it such, indeed, that not unfrequently the two forms of worms completely change their parts. Just as we know that embryos of *Trichina* introduced from without become further developed, under certain circumstances, in the muscles even of other animals, so also is it sufficiently well known that the bearer of a *Tænia solium* not unfrequently acquires *Cysticerci* by self-infection. That this does not more commonly take place, notwithstanding the development of the embryos while still in the body of the parent, is explained by the presence of a firm egg-capsule, which requires the action of the juices of the stomach to set free its vagrant inmate. For their further development the germs of *Tænia* must pass the stomach (which, of course, can only occur exceptionally in man), whilst the embryos of *Trichina,* which are produced without egg-shells, start upon their migration immediately from the intestine.

According to my observations, however, there are numerous Nematoda in which the emigration of the embryos from the original host not only occurs regularly (which is by no means the case with the *Trichinæ*), but even constitutes a necessary preliminary to further development.

In the mucous membrane of the stomach of the cat there lives a viviparous Strongylide worm hitherto overlooked (*Ollulanus tricuspis,* mihi *), which measures scarcely more than 1 millim.

* I append the following diagnosis to characterize this worm, which is by no means rare:—

Ollulanus tricuspis, n. gen. et n. sp.—Small, rather thick worms, with a beaker-shaped or poculiform chitinous coating of the mouth-cavity. Pharynx slightly muscular, of granular appearance. In the males two short and stout, nearly straight spicula, and a bilobed caudal hood, each of the lateral wings of which contains six ribs. Female with three caudal points. Vulva at some distance before the anus; uterus simple.

in length, and produces young of comparatively quite colossal size (0·3 millim.). The worms are usually found in considerable numbers together, both embryos and fully-developed organisms, so that the mucous membrane usually appears reddened and is often covered with small ecchymoses. The embryos, however, remain only for a short time in the dwelling-place of their parents. They quit the stomach, part of them passing directly out with the excrements, whilst part migrate, in the manner of the embryos of *Trichina*, into the body of their host. The coat of the pleura, the diaphragm, liver, and lungs of the infected cats are sprinkled with a greater or less number of small cysts, each of which encloses one or more embryos. The wall of the capsule has the texture of connective tissue, and is so thick as not unfrequently to measure three or four times the diameter of the internal space. If several worms are present in the same capsule, each of them has its own cavity, which, however, it does not in general completely fill with its convolutions. These capsules are most frequent in the lungs, where they sometimes produce the appearance of a regular miliary tuberculosis, and give rise to a more or less widely diffused inflammation. (On one occasion I examined a cat which had evidently died in consequence of this inflammation.) The bloody bronchial mucus usually contains considerable numbers of mobile embryos, whilst the muscles and other organs (as also the blood) are free from them.

The organization of the embryos is very characteristic; indeed the earliest states of the Nematoda in general are by no means so uniform and concordant in structure as is generally supposed. Their bodies measure about 0·3 millim. and are of the same thickness throughout (0·015 millim. with a length of 0·32 millim.). The tail (reckoned from the anal orifice) is short and furnished with an S-shaped point, which is distinctly marked and projects towards the ventral surface over the end of the strong chitinous band running along the sides of the body (on the future so-called lateral line). The œsophagus constitutes nearly half of the entire intestinal tract, and contains a number of clear vesicles in its clavate posterior extremity. The commencement of the genital organs is small and placed on the ventral side, behind the middle of the intestine.

From the analogy of the *Trichinæ*, we should now expect that these embryos would be developed in the capsules of their bearer into larval intermediate forms. But nothing of the kind takes place. Not only do we never observe any further development of them in the cats, but we speedily ascertain that sooner or later they are destroyed. The encapsuled worms gradually lose their mobility and their transparent appearance; they become granular, and finally decompose into an oval or roundish mass, which encloses an oil-drop and may readily be mistaken for an egg or yelk-mass.

Encapsulation in the interior of the first host is consequently in this case an accidental phenomenon, and by no means the introduction to a further metamorphosis as in the *Trichinæ*. This belongs, in the present parasite, rather to the embryos only which emigrate through the intestine and bronchi.

As I could not manage to keep these embryos alive for any length of time in water or moist earth, even with addition of excrement or bronchial mucus, I administered them, with bread, to a mouse. I hoped to be able in this way to cause the further development of the young worms; and in this I was not deceived. On examining my experimental animal six weeks after the commencement of the experiment, I found, in the very first fragment of muscle which I placed under the microscope, a round worm rolled up in the manner of *Trichina*, enclosed in a capsule about 0·3 millim. in diameter, which proved on closer examination to be a second developmental form of my worm. Then wherever I sought for them in the muscles of the trunk I found the same worms, but most abundantly in the regions of the neck and breast; a few also occurred in the heart and œsophagus and even in the loose connective tissue permeated by fat between the organs of the neck, although elsewhere they might be looked for in vain except in the striped muscles. The total number of the parasites in the body of my experimental animal must have been many hundreds.

On a superficial examination the capsules resembled those of *Trichinæ*, but they were all round or only a little elongated. When they were closely examined, however, many other differences were detected. In place of the structure so characteristic of the *Trichinæ*, the wall of the cyst here presented nothing but a closely interlaced, firm and tough connective tissue, which was surrounded by growing nuclear structures, and enclosed innumerable granular cells (0·025 millim.), which were constantly pushed to and fro by the movements of the convolute worm. At the poles of the cyst a yellowish pigment was deposited in the nucleate tissue which was here particularly accumulated; and this pigment sometimes extended over the whole capsule. Here and there single fat-masses were also seen at this point.

Except in its dimensions (length 0·8, breadth 0·04 millim.) the enclosed worm showed an unmistakeable similarity to the embryos above described. This applies especially to the form of the body and the structure of the intestinal canal; only the pharynx has already a muscular texture (even to the posterior extremity), and the intestine is of a brownish colour. The walls of the body are of considerable thickness, and contain numerous clear nuclei in their deeper layers, whilst the cuticle is distinctly annulated. The truncated extremity of the head exhibits the most singular comportment; it bears a roundish chitinous disk, usually somewhat drawn in, from the middle of which the funnel-shaped mouth originates; at a short distance behind the lip-like projecting margin of the head there stand some small papilliform prominences. The commencement of the genital organs measures 0·017 millim.

From the want of sufficient material, I have been unable as yet to trace the conversion of this larval form step by step into the sexually mature animal. I have, hitherto, been able to make only a single experiment, and this has scarcely done more than prove the fact that my worms fall out of their capsules in the alimentary canal of the cat, and remain alive for a long time. When I examined my experimental animal eight days after it had been fed with the flesh of the infected mouse, I found the young worms, not indeed in the stomach, but in the cæcum and colon. They were not numerous, and presented no perceptible change—a circumstance that almost leads me to suppose that they were not yet sufficiently mature for conversion into the sexual animal.

Our *Ollulanus*, however, is by no means the only Strongylide worm with a change of hosts. To all appearance there are a great number of forms which behave exactly in the same way, except that in them the migration of the embryos in the interior of the first bearer disappears, and the intermediate host is also different. This I suppose to be the case especially with *Strongylus commutatus* from the lungs of rabbits and hares, as also with *S. rufescens*, a species hitherto unknown, which I have discovered, together with *S. filaria*, in the lungs of the sheep*, and, indeed, because their embryos agree almost completely with those of *Ollulanus*. The only difference existing in them consists in the caudal point (projecting over the lateral chitinous bands) being straight. In both cases † the embryos are developed in multitudes together in the finer branches of the bronchi and their terminal dilatations, where they cause a more or less widely diffused inflammation, with phenomena of hepa-

* The characters of this species, the name of which is derived from the shimmering through of the brown intestine, are as follows:—Head unarmed, with three small lips and a short œsophagus. Thin; the female almost span-long, the male shorter. The vulva immediately in front of the anus; in the uterus only a few ova in segmentation. The caudal hood of the male short, with thick ribs and two long and rather strongly curved spicula.

† Here also evidently belong the "Anguillulidæ" of the lungs of the hare, observed by Sollmann (Beilage No. 11 of the Coburger Zeitung, 1865), which, from his statements, must have been very abundant in Thuringia during the last two years.

tization, not unfrequently making portions of half an inch in diameter perfectly impermeable.

The ova are deposited in segmentation and possess their shells, which are perforated by the embryos when their development is complete. There is no doubt that these embryos emigrate, as they are not only met with in the bronchial mucus (often tinged with blood), but may also be traced up into the trachea.

Unfortunately I can say nothing as to the subsequent destiny of the embryos. My leading experiments with them have all failed. I should, however, suppose that after emigration the young worms penetrate into mollusca or insects*, are developed in them for a certain period, and then, when their bearer is accidentally taken up with food, find their way from the mouth into the lungs.

At present I also think we may assume the same to be the case with the *Strongylus filaria* of our sheep †, which in many seasons is so abundant as considerably to thin our flocks. This worm inhabits especially the bronchial ramifications of medium diameter, in which, according to its numbers, it sometimes produces merely a catarrhal affection, and sometimes a state of inflammation, which not unfrequently diffuses itself over a great part of the lung and causes death. In the frothy mucus which fills the bronchi and trachea innumerable embryos are found, some of them still enveloped in the capsules in which they were born. They are distinguished from the previously described forms by the obtuseness of their caudal extremity (the absence of the above mentioned point), the shortness of the œsophagus, and the presence of a small knot which projects outwardly in the vicinity of the mouth. The size is also rather larger (0·54 millim.).

In moist earth the embryos remain alive for some time, some of them even for several weeks. They take no nourishment, and do not grow, but nevertheless undergo a change of skin in from eight to fourteen days; by this, however, they are scarcely perceptibly altered, except that the caudal extremity becomes somewhat sharper, and the buccal knot is reduced in size. Most of the embryos die during the change of skin; and even those few which survive it appear to close their lives soon afterwards. An attempt to infect a lamb with the moulting worms failed, as also did the transference of the bronchial mucus abundantly thronged with embryos, which was effected at different times upon four sheep. The widely diffused supposition of the contagiousness of

* In many insects, especially dung-beetles, we meet with asexual Nematode worms, which might easily belong to the developmental cycle of some Strongylide.

† Not only of the sheep, but also occasionally, as I have observed, of the roebuck and fallow deer.

verminous pneumonia (proceeding from *Strongylus filaria*) must therefore be without foundation*.

The immigration of the young worms into their definitive host appears to take place only when they have grown to at least twice their original length; at least I conclude so from the analogy of *Ollulanus*. The smallest specimens observed by me measured 3–5 millims. They were found several times in the trachea of healthy sheep, and were not yet sexually developed. When their length has increased to 9–12 millims. the worm is found in the interior of the lung. Sometimes they appear to die even in this stage; at least I once found in the lung of a sheep a number of small, tubercle-like knots, each surrounded by a space of hepatized tissue, and enclosing a dead and coiled up *Strongylus* of the above-mentioned size.

With regard to the development of the last-mentioned Strongylide worms, I have been compelled to confine myself to mere suppositions; in other cases I have again been fortunate in my experiments.

Thus, especially, I have succeeded in tracing experimentally the entire developmental history of the so-called Hooded Worm (*Cucullanus elegans*). The worm, which in the developed state measures about 20 millims. in length, lives in the intestine and pyloric appendages of the perch, and is so abundant as to be found in nearly every specimen of the fish. Among its most important distinctive characters is, as is well known, its possession of a horny buccal funnel equally remarkable for its size and the elegance of its markings—an organ which is also certainly met with elsewhere in the family *Strongylidæ*, but in a different form.

The female *Cucullani* produce living young, which escape from the egg-capsules whilst still within the body of the parent, and, in large specimens, may be found in many thousands in the sexual passages. Unlike the embryos of the other *Strongylidæ*, they are furnished with a long subulate caudal extremity, which measures nearly one-third of the total length of the body (0·4 millim.), and possesses an extraordinary mobility. In a state of repose the animals are usually bowed or rolled up spirally; several of them may also not unfrequently be seen adhering together by their tails and making powerful jerking movements. The cuticle is uncommonly firm, and distinctly ringed, and characterized by a hump-like thickening on each side at the level of the anus. A similar thickening is observed on the dorsal mar-

* It is also opposed to the fact that the young embryos (as also in *S. commutatus* and *S. rufescens*) never undergo any further metamorphosis in their birthplace.

gin of the buccal orifice; but the latter projects far more distinctly, and is also larger. The œsophagus is still free from the subsequent division into the muscular and glandular portions. The beaker-shaped armature of the mouth is also wanting; in its place there is only a short and narrow chitinous tube leading into the interior.

The further development of the embryos takes place in the little *Cyclopes* which inhabit our waters in such quantities (more rarely in the larvæ of the dragonflies). Within a few hours of the transference of these animals into the aquaria stocked with the young worms, a few immigrants may be found in their interior. The number increases in course of time up to several dozens; indeed I once found thirty-four young *Cucullani* together in a *Cyclops* of only moderate size. The worms, owing to the toughness of their cuticle, can resist the action of the water for a long time (for single embryos may be seen moving about briskly in the mud a fortnight after their introduction); hence their immigration may take place with tolerable certainty even in freedom.

From the presence of the boring-tooth on the upper lip, it might be supposed that the immigration takes place directly through the external integuments, as in the case of the *Cercariæ*; but, as far as I have been able to observe, this is not the case. The embryos are rather taken up through the mouth of the *Cyclops*. They are first seen in the intestine, and only subsequently in the body-cavity, where they twist about briskly for a time between the muscular cords and the intestines.

Gradually, however, this movement becomes slower. The worm increases in length (to 0·6 millim.) and diameter, and after a certain period (in summer within three days; in winter later) undergoes a change of skin, after which it exchanges its previous slender form at once for a plump one. On closer examination, moreover, many differences from its previous structure are detected. Thus the boring-tooth disappears with the old skin, and the tail is reduced nearly to one-half of its previous length. The œsophagus has become divided, by a stronger development of its posterior half, into two sections differing from each other even histologically, and which constitute almost one-third of the whole intestinal canal (elsewhere of a deep brown colour). The outer walls of the body have also increased considerably in thickness, although the cuticle is perhaps thinner than before.

After the worms have remained in this state for some time, a new change takes place in them. This is the preparation for the formation of the buccal cup. The rounded anterior extremity of the œsophagus which issues outward through a short, funnel-shaped chitinous tube, separates at the circumference of the latter from the adherent parenchyma and gradually retracts itself more and more. The cavity which is thus produced in front of the œsophagus has at first, of course, the form of a meniscus; and it retains this as long as the funnel-shaped chitinous tube which unites the œsophagus with the buccal orifice persists; but when the latter breaks up on the approach of the next change of skin and the œsophagus sinks in posteriorly, the cavity becomes deeper and more globular in its form. Its inner surface then becomes clothed with a chitinous lamella, which, on the walls of the buccal orifice, passes over continuously into the new cuticle formed beneath the old one, and, after the casting of the latter, speedily acquires a yellowish brown colour. This covering is, however, quite distinct from the future buccal cup; it is not only smaller but also furnished with a different sculpture. Even after its second change of skin our worm is certainly not yet the definitive *Cucullanus*. It is much smaller (at the utmost 0·8 millim.) and has no sexual differentiation. The sexual organs, scarcely larger than in the embryo, consist of a simple bean-shaped body, which is attached to the ventral wall immediately in front of the middle of the chyle-intestine. On the abbreviated caudal extremity the worms bear three small points, which subsequently (after the sexual differentiation) are found only in the female individuals.

In summer I have sometimes observed the stages of development here described within six days after the infection of the *Cyclopes*, while in winter three weeks not unfrequently elapse before they are completed. To all appearance, however, the parasitism of these animals is very fatal to their host; almost all the infected *Cyclopes* are observed to die soon after the completion of the developmental processes above described. At the same time it must be borne in mind that, in the small aquaria of the experimenter, the parasites penetrate into their hosts in far greater numbers than would ever be the case in the open water.

The last phase of development is only passed through in the interior of the final host. The young *Cucullani*, in the form of small asexual worms with a simply sculptured buccal cup, are taken up by the perch with its food (the *Cyclopes*), when they grow rapidly and at the next change of skin cast off their previous larval characters; at the same time the sexual differentiation takes place, carrying the animals quickly towards their perfect maturity. Within ten days or a fortnight after their transfer into the intestines of the perch, the young *Cucullani* must have already effected their copulation.

When we glance over the life-history of the *Cucullanus* as here briefly described, we again find in it essentially (and still more completely than in the *Trichinæ* and *Ollulani*) the same picture that has already been revealed to us by former observations for other groups of Entozoa. We see the brood of the *Cucullanus,* like that of the Tapeworm, quitting the bearer of their parent in the embryonic form; we see them migrate into an intermediate host, whilst here approach their later structure by transformations of various kinds, and finally attain their complete development after their transfer to their definitive host.

There can be no doubt that in a considerable number of Nematode worms the life-history is exactly as in *Cucullanus,* and that this is the case not only in the family *Strongylidæ,* as above indicated, but also in other families, especially in that of the *Ascaridæ.*

In the mesenteric covering of the stomach and intestines of the mole we not unfrequently meet with pedunculated flat capsules, 1·5–2 millims. in diameter, which enclose a thread-worm, 8–10 millims. in length, usually rolled into a flat spiral. This worm is an *Ascaris* (*A. incisa,* auctt.), but an *Ascaris* with undeveloped sexual organs, and with a boring-tooth near the three tubercular buccal papillæ. This boring-tooth was probably possessed by the worm in its embryonic state, and perhaps was employed by it in its wanderings in the interior of the mole. Its retention after the formation of the lips (which must take place very early, as I have seen them in young animals only 1 millim. in length, with a capsule 0·4 millim. in diameter) seems to indicate that it will also be subsequently required. Perhaps, after the passage of the worm into its definitive host, it may use this tooth to break through the firm capsule which at this time envelopes it. The animal which constitutes this definitive host is at present unknown; but we may easily suppose it to be some of the numerous rapacious animals which prey upon the mole. In fact, the owls, buzzards, and other predaceous birds harbour in their intestines a round worm (*A. depressa,* auctt.), which, notwithstanding the more complicated structure of its buccal organs, may readily represent the developed form of *Ascaris incisa.* The two forms agree especially in this respect—that they possess at the commencement of the chyle-intestine a cæcal diverticulum directed forward, which is usually wanting in the *Ascarides* of the Mammalia. I have, however, been unsuccessful in my attempts to develope *A. incisa* in the buzzard; but I had only a single bird at my disposal for this experiment, and moreover the buzzard may not be the animal.

Perfectly similar encapsuled and asexual Nematode worms, with lips and boring-tooth, occur in numerous marine fishes, sometimes in the liver, but also sometimes (*e. g.* in the Torsk) in the muscles. As some of these are of considerable size (some more than 1 inch), and they often occur in great numbers, they have long been known and introduced in various parts of the helminthological system under different names (*Filaria piscium, Ascaris capsularis*, &c.). They belong (as indeed is proved by the varying form and size of the boring-tooth) to several different species, and may be developed, in predaceous fishes, sea-birds, seals, and dolphins, into well-known *Ascarides* (perhaps *A. aucta, A. spiculigera, A. osculata*, &c.). At any rate, the final development, as in *Cucullanus*, only takes place after their transference to another host.

That the intermediate form of *Cucullanus* is free, and not encapsuled like the young *Ascarides* just mentioned, can hardly be regarded as an important distinction between them. This depends rather upon the nature of the host and of the organ inhabited than upon the peculiarities of the parasite, as we shall see immediately from another example.

In *Cucullanus* (and probably also in *A. incisa*, &c.) a transformation takes place in the embryos during their residence in the intermediate bearer. They do not grow, but change their structure, especially that of the mouth. But this is not always the case throughout the Nematoda.

We can hardly examine an example of the bleak (*Leuciscus alburnus*), so common in our brooks, without finding in the mesentery and liver numerous small capsules (up to 1 millim. in diameter), each of which encloses a young roundworm. It is probably the worm referred to in Diesing's 'Systema Helminthum' as a *Trichina* (*T. cyprinorum*). It varies in size from 0·6 to nearly 2 millims., but otherwise presents the same characters—a slender body, short tail, wide mouth with a strongly prominent boring-tooth on the ventral side, and a muscular pharynx with a long glandular cæcum. The only difference that I could detect between the smaller and larger specimens consisted in the last-mentioned cæcum, which is less developed, not only absolutely but relatively, in the smaller worms; so that it may readily be supposed to have been developed from the posterior end of the œsophagus only after immigration into the bleak. But that the worm undergoes no other changes is certain; the characters above indicated are found not only in the largest specimens, but also in those which have died in their capsules, the number of which is usually by no means small.

As to the course taken by the worms in their immigration there can be no doubt, when we find that they are by no means rare even in the intestine of the bleak. And we do not meet only with small worms in this situation, but also with half-grown animals of 1 millim. and more, which sufficiently proves that their stay in the intestine not unfrequently extends beyond the time necessary for passage.

But the bleak is not the only bearer of these young Nematoda. I have also found them in the pike, and that under circumstances which lead me to assume with almost perfect certainty that they are the young forms of *Ascaris acus*, which is well known to be so abundant in this fish.

Beneath the mucous membrane of the stomach of the above-mentioned animal we not unfrequently observe white spots, of larger or smaller size, produced by an aggregation of cells, and which are probably nothing but altered glandular sacs*. Each of these cell-masses contains an example of the young round-worm just described, and, according to its size, sometimes a small one (0·6 millim.), sometimes a larger one (up to 2·5 millim.). But, besides the encapsuled specimens, free ones are also found, creeping about quickly upon the mucous membrane of the stomach and in the intestine, some of which have attained to a much larger size. In the intestine I have found specimens 9 millims. in length; whilst in the stomach none were ever more than 5 millims. These larger specimens were indeed always sexually immature, but were still distinctly *Ascarides*, and could hardly be anything but the common *Ascaris* of the pike (*A. acus*). The boring-tooth and the wide buccal aperture which occur in the smaller worms had been lost, and replaced by the large lip-like projections which were formed beneath the old chitinous skin in the circumference of the former buccal cavity (as could be distinctly traced in animals of about 3 millims.).

The preceding observations sufficiently prove that our worm is the larva of an *Ascaris* which undergoes a further development in the intestinal canal of the pike. In the bleak the worm retains its original larval organs, although even here it considerably increases in size. But whether this growth be necessary for the further development of the worm in the pike seems at the first glance almost doubtful, as specimens of very different sizes occur even in the latter; but, independently of the fact that the small worms are almost always found imbedded in the mucous membrane of the stomach, and very rarely free, it seems probable that these smaller forms commence another migration after their transfer to their definitive bearer, instead of being directly and continuously converted into *Ascarides*.

That similar phenomena occur elsewhere among the Nematoda is proved by an observation which I have made upon the so-called *Trichinæ* of the mole. I premise that these so-called

* In the frog, also, numerous capsules of Nematoda are to be found in the walls of the stomach and rectum; and these are probably produced from altered glandular sacs.

Trichinæ are not only "very probably not the same that we find in the pig," but that they have nothing at all to do with the *Trichinæ*, but are rather very probably young *Ascarides*. Moreover the worms do not occur only in the muscular tissue, but, as Herbst has already correctly indicated, just as frequently in other structures, especially the lungs and liver, and indeed so universally that one can hardly examine a mole without finding more or less numerous specimens in it. In the last-mentioned organs the presence of the worms betrays itself, even to the most superficial examination, by the fact that here each of them lies in a tuberculoid knot formed by an aggregation of granular cells, and constantly surrounded in the lung by a small area of hepatized pulmonary tissue. On the other hand, I have never seen the worms of the muscles encysted thus, but always free *in the interior of altered muscular fibres*; for it is in this light that we must regard the tubes, filled with granular matter and enclosing the worms, which are imbedded between the other, normal muscular fibres. Where the worm, with its more or less tortuous body, lies, this tube usually presents a larger or smaller dilatation, or perhaps, more correctly, a series of four or five alternate small dilatations, which correspond with the curves of the body and change with every movement of the animal. And these movements are so little obstructed that the worm creeps along for a considerable distance in the tube in either direction with its (obtuse) cephalic extremity in front, and even frequently turns about and returns upon its previous path. During this process the granular contents of the tube are displaced and pushed aside. In certain places we may see in the interior of the tube a distinct impression of the body, but this, apparently, only where the worm has stayed for some time. During the ordinary movements, the granular contents flow together at once behind the advancing worm, so as to form a continuous mass. With the exception of its contents, the muscular tube is, however, entirely unaltered; we observe neither a thickening of the sarcolemma, nor even an increase of the surrounding areolar tissue, such as is observed in the vicinity of the *Trichinæ* and *Ollulani* of the muscles.

With the exception of an inconsiderable difference of size (0·38–0·43 millim.), the worms are all of the same structure. They are slender, truncated anteriorly, furnished with a tubercular boring-tooth on the lower lip, and with a short, conical tail, the end of which forms a separate short point, as in many *Strongylidæ*. The œsophagus, which is somewhat thickened posteriorly, is of considerable length, and has a granular texture, but has no trace of the so-called cellular body occurring in the *Trichinæ*.

It is clear that, notwithstanding a residence probably of years in the mole, these animals constantly retain the embryonal character, and this even more rigidly than the young *Ascaris acus*, which grows in its intermediate bearer to as much as four times its original length. In all probability they remain in the mole without any alteration at all; for the above-mentioned difference of size exists even at the time of their immigration, as may be readily ascertained from the specimens not unfrequently found in the contents of the stomach among the remains of half-digested earthworms and larvæ of insects*.

As regards the parentage of these worms, I can only add to the supposition already indicated, that they appear to have no genetic relationship with the sexually mature Nematode worms which live in the mole. It is evident that their residence in the mole is only temporary, and intended to facilitate their transference into other animals. Starting from this point of view, I fed two young buzzards, taken from the nest, with several moles every day, for three weeks, and in this way most certainly transferred many thousands of the worms into their intestines. My hope of seeing the worms further developed in their new hosts was indeed disappointed; but, on the other hand, I found the lungs and liver of both the animals (especially their peripheral portions) sprinkled with innumerable small tubercles, each of which, as in the moles fed for experiment, contained a small roundworm. As these little worms agreed in every detail (size, form, and internal structure) with the above-described young forms, I do not hesitate to refer to the experiment made for the explanation of the phenomenon, and to affirm that the parasites in question, after their transfer into the new host, recommenced their migration†, as I have already endeavoured to show is

* The stomachal mucous membrane of the mole contains another young Nematode form, of 0·73 millim., with a rounded head (without a boring-tooth) and a caudal point, from the base of which two smaller points project. The internal structure shows no essential difference from that of the form above described; but this similarity of course does not suffice for the assumption of a genetic connexion. The so-called *Trichinæ* of the earthworm, which occur in great quantities free in the contents of the stomach of the mole, have nothing to do with these worms. They are rapidly destroyed in the stomach of the mole, without any trace of further development. One earth-worm, however, harbours several species of Nematoda, and especially, besides the common so-called *Anguillula* (*Rhabdites*) *lumbrici*, which, notwithstanding its pharyngeal armature, has probably contributed most to the confusion with *Trichinæ*, two young forms with which I am unacquainted.

† With this Herbst's statement also agrees—namely, that in his experiments with "trichinous" moles' flesh, in pigeons, magpies, and weasels, he found the worms administered in the muscles and other organs. (Nachrichten von der G. A. Universität zu Göttingen, 1852, No. 12.)

probably the case also with the smaller specimens of the young *Ascaris acus*. That I have detected the same worm-capsules in buzzards with no precedent experimental feeding cannot be urged in opposition to my conclusion, as their number was constantly comparatively small, even in decidedly older animals. I have, however, never met with parasites in the muscles of my buzzards.

The tuberculoid knots consisted of a thin envelope of connective tissue and an aggregation of cells of considerable size, the elements of which were united in the immediate vicinity of the worm to form a finely coherent mass, of irregular form and opaque texture. It was remarkable that each cyst (at least in the lungs) was close to a distinct vessel, and sometimes so firmly united to it that it was difficult to separate them. Whether this peculiarity justifies us in supposing that the migration of the worms is effected through the blood-vessels I will leave undecided; but it appears to me that the circumstance that the capsules were generally appended, not to the capillaries, but to the smaller arteries, is scarcely in favour of such an assumption.

The worms of the muscles of the mole, therefore, present us with an example of a Nematode larva which retains its original embryonic structure notwithstanding its residence in an intermediate bearer, and also resembles an embryo in this respect—that it recommences its wanderings even after accidental immigration into a second intermediate bearer.

These are conditions with which we have not yet become acquainted in other groups of Helmintha; but these are not the only peculiarities in the life-history of the Nematoda. To my great astonishment, I have convinced myself, in the course of my investigations, *that there are also Nematoda which are developed without intermediate bearers**.

Among these forms is a small Strongylide which is by no means rare in the intestinal canal of the dog; it is nearly allied to *Ancylostomum duodenale* of the human subject, and is known to zoologists under the name of *Dochmius trigonocephalus*. Like *Cucullanus* (and *Ollulanus*), it possesses a horny mouth-armature, of cup-like form and complicated structure, with the help of which it nibbles at the intestinal villi of its host.

The ova of this roundworm, which are usually expelled during the first stages of segmentation, are developed in damp situations in a few days (three to four in summer, four to six in winter)

* A few months ago, I published a statement of my (first and imperfect) observations on the development of *Dochmius, Ascaris nigrovenosa,* and *Cucullanus,* in the 'Nachrichten von der K. Gesellsch. der Wiss. zu Göttingen,' 1865, No. 8.

into little worms, 0·34 millim. in length, which, on the conclusion of their embryonic development, immediately break through the outer capsule of the egg, and move about briskly in the mud. Without a knowledge of their parentage, we should refer them to the free *Anguillulidæ* or, rather, *Rhabditidæ*. Like these, they possess a simple, narrow and short, chitinous buccal tube, which is followed immediately by a long muscular pharynx, the posterior bulbous enlargement of which contains three flapping chitinous teeth, of conical form. The anterior half of the pharynx also forms a dilatation, but this possesses a more elongated cylindrical form. The body is rather compressed, somewhat diminished in front, and drawn out behind into a long and slender tail, the tip of which is separated in the form of a distinct appendage.

Moreover not only the structure, especially of the pharyngeal section, but also the mode of life, reminds one of the species of *Rhabditis*. The animals feed and grow, and change their skins, as if they had to carry on a free existence throughout their lives.

In about a week the little worms have grown to twice their original length. Their structure remains essentially the same as before (with the exception of the loss of the caudal tip, which is thrown off with the first change of skin), being only changed in this respect, that the armature of the posterior dilatation of the pharynx has been lost, and the muscular striæ which were previously distinct at this point have made room for some clear vesicles.

At this stage of development the free life of our worms is concluded. They indeed remain alive for a long time (some even for more than two months) in mud and water, but they undergo no further changes.

From the analogy of the other parasites, we might have expected that the young *Dochmii* would now immigrate into an intermediate host. But all my experiments made in this direction produced no result. Sometimes, certainly, the worms were observed in small water-snails (*Physa*) which lived in the same vessel with them; but it appears to me that this immigration was merely accidental, not only because the worms remained unaltered in the snails, but especially because I have ascertained by direct experiment that such a migration is not necessary to bring the worms to their perfect development. I have, in fact, succeeded in rearing the young worms directly to sexually mature *Dochmii* in the intestine of the dog.

In a dog which had been experimented on eight days previously, the parasites were found nearly unaltered, and, indeed, all in the stomach, mostly in the cardiac half. The only remarkable difference consisted in the posterior pharyngeal dilatation (which was previously cordate) having increased considerably in length, and acquired seemingly a granular appearance in its interior. The chitinous coat of the buccal cavity was somewhat tougher, and the commencement of the genital organ was enlarged. In front of this two clear vesicles of considerable size were to be seen—undoubtedly the nuclei of the two colossal glandular cells situated here in nearly all *Strongylidæ*, which open outwards through the *porus excretorius*. The worms were but little increased in size.

A few days later (ten days after transfer) I found a further stage of development in a dog: this was characterized by a stouter form and the possession of a chitinous buccal funnel, and had been produced, like the above-described second developmental form of *Cucullanus*, from the earlier larval form by a change of skin. As in *Cucullanus*, moreover, the structure of the buccal cup was not the final one. It was scarcely more than a simple clothing of the funnel-shaped buccal cavity; whilst the buccal armature of the mature *Dochmius* has a rather complicated structure, and is composed of a number of separate skeletal pieces. Posteriorly, however, the buccal armature was already continuous with the horny lining of the pharynx. The sexual distinctions could not yet be made out, the sexual organs, notwithstanding their increased size, still retaining their primitive organization.

The intermediate stage here described, however, is of but short duration, and passes without interruption into the mature stage (in this respect differing from *Cucullanus*, in which it is attained within the intermediate host). Twelve days after the transfer we see the young animals (now 2 millims. in length) acquire the definitive *Dochmius*-form by a change of skin. The buccal cavity is produced behind the provisional funnel, and is at first clothed only with a thin and colourless coat, which, however, soon shows that it is composed of separate pieces. In the course of two more days the young *Dochmii* measure 3–5 millims. The genital organs are more or less increased, and in the males even fully developed, although still without mature seminal corpuscles. The female organs seem to require a longer time for their development. The ovaries especially, which in the smaller animals were seated upon the so-called uterus as short and thin, horn-like diverticula, had already, in the larger specimens, grown through a considerable portion of the body-cavity, and formed many loops, without, however, anywhere attaining their full length or enclosing mature ova.

[To be continued.]

XXXIX.—*Notulæ Lichenologicæ.* No. V.

By the Rev. W. A. Leighton, B.A., F.L.S.

The following new British Lichens are described by Dr. Wm. Nylander in the 'Flora' (1864, pp. 353 & 487, and 1865, p. 601).

Verrucaria inumbrata, Nyl.

Thallus fuscescens vel sordide cinereo-fuscescens vel cervinus, sat tenuis, effusus, inæqualis, sæpe dispersus; apothecia mediocria a thallo tecta, ostiolo nudo, epithecio minutissimo sæpius impresso, perithecio integre nigro; sporæ $8^{næ}$, incolores, oblongo-ellipsoideæ vel ellipsoideæ, murali-divisæ, long. 0·033–0·050 millim., crass. 0·017–0·025 millim. Gelatina hymenea iodo vinose rubens.

Ben Lawers in Scotia, ad saxa schistosa edita. (Admiral Jones.)

Inter *V. Sendtneri* et *V. intercedentem* locum systematicum habet hæc species.

Verrucaria furvescens, Nyl.

Thallus fuscescens vel olivaceo-fuscescens, granulato-inæqualis, sat tenuis (vel crass. 0·75–fere 1 millim.), opacus, effusus, haud continuus; apothecia innata, mediocria (latit. circiter 0·4 millim.), apice conico emerso, perithecio integre nigro; sporæ $8^{næ}$, incolores, fusiformes, 5-septatæ, long. 0·031–0·033 millim., crassit. 0·006 millim.; paraphyses sat graciles, confertæ.

In Scotiæ montibus, Ben Lawers, supra muscos minutos in terra schistosa-micacea.

Ad stirpem pertinet *Verrucariæ chloroticæ*; notis datis bene distinguitur. Gonidia magna (diam. 0·026–0·032 millim.).

Verrucaria consequens, Nyl.

Thallus obsolete cinerascens, latissime effusus, non distinctus; apothecia sat parva, prominula, perithecio dimidiatim nigro; sporæ $8^{næ}$, incolores, ovoideæ, 1-septatæ (superiore parte crassiore), longit. 0·016–0·019 millim., crass. 0·007 millim.; paraphyses parvæ vel nullæ, distinctæ. Gelatina hymenea iodo haud tincta.

Supra saxa calcarea, æstibus maris submersa, prope Glenarm in Hibernia. (Admiral Jones.)

Species accedens ad *Verrucariam epidermidis* et sicut eadem saxicola.

Thelopsis melathelia, Nyl.

Thallus vix ullus proprius (chroolepoideus); apothecia nigra, tuberculoso-prominula, rugoso-irregularia (latit. circiter 0·5 millim.), epithecio haud semper distincto, perithecio ellipsoideo nigricante (vel lamina tenui rufescente) undique similari; thecæ polysporæ; sporæ ellipsoideæ vel oblongæ, sæpius indistinctæ, 3-septatæ, long. 0·014–0·017 millim., crass. 0·006–0·007 millim.; paraphyses graciles, et filamenta ostiolaria gracilia. Gelatina hymenea iodo cærulescens, dein sordide violacee tincta.

Supra muscos depressos ad terram in micaceo-schistosis alpis Ben Lawers Scotiæ. (Admiral Jones.)

Pertusaria nolens, Nyl.

Thallus cinereus, lævigatus, areolato-rimosus, determinatus (crass. circiter 0·3 millim.); apothecia innata, (nulla prominentia thalli indicata, nec nisi) ostiolis (epitheciis) nigris, planiusculis, rotundatis, oblongis aut nonnihil difformibus (latit. 0·15–0·30 millim.), sæpe 2 aut plura approximata, intus concoloria; sporæ $8^{næ}$, incolores, ellipsoideæ (pariete mediocri vel sæpe tenui), longit. 0·030–0·042 millim., crass. 0·015–0·022 millim.; thecæ cylindraceæ (iodo intense cærulescentes).

Ad saxa basaltica prope Glenarm in Hibernia. (Admiral Jones.)

Faciei est præcedentis, omnino formæ *Lecanoræ cinereæ*, pro qua sumatur, nisi microscopice (et chemice) examinetur.

Adhuc exemplum sistit nexus cum genere *Lecanora*!

Thelotrema subtile, Tuck.

Thallus macula lactea vel albida subnitidiuscula indicatus; apothecia incoloria (alba), erumpentia sat parva (latit. 0·4 millim.), margine thallodeo parum prominulo, proprio sæpe albo-pulverulento; sporæ $8^{næ}$, incolores, oblongæ, 10–13-loculares, longit. 0·040–0·056, crass. 0·009–0·010 millim. (iodo cærulescentes).

In Hibernia, Kerry, ad corticem fagi. (Isaac Carroll, Esq.)

Parum (et præsertim sporis majoribus) differt a *Thelotremate bicinctulo*, Nyl.

Pyrenopsis diffundens, Nyl.

Thallus niger, opacus, tenuis, areolato-squamulosus, squamulis subfurfureis sat parvis variis, effusus; apothecia rufescentia, innata (latit. 0·3 millim. vel minora), sæpe gyalectoidea, at variantia planiuscula, intus tota pallida; sporæ $8^{næ}$, incolores, ellipsoideæ, simplices, longit. 0·011–0·023 millim., crass. 0·007–0·011 millim.; paraphyses discretæ, gracilescentes.

Gelatina hymenea iodo vinose rubens (præcedente cærulescens).

Ad saxa arenaria ("greensand") prope Maidstone in Kent. (Admiral Jones.)

Collema psorellum, Nyl.

Thallus nigricans vel fusco-niger, tenuis, rugosus vel subgranulato-inæqualis, diffractus, determinatus; apothecia rufescentia vel fusco-rufa, parva (latit. 0·3–0·4 millim.), subbiatorina; sporæ (solitæ hujus generis, submurali-divisæ,) longit. 0·023–0·035 millim., crassit. 0·012–0·016 millim. Gelatina hymenea iodo intense cærulescens.

Ben Lawers, ad saxa micaceo-schistosa. (Admiral Jones.)

Thallus intus glomerulose compositus. Apothecia vulgo obtuse marginata, dein explanata margine excluso.

Lecidea obsoleta, Nyl.

Thallus nullus proprius visibilis; apothecia nigra, minuta (latit. circiter 0·3 millim.), opaca, margine obtuso vel non distincto, intus concoloria; sporæ $8^{næ}$, incolores, oblongæ, simplices (vel septo obsoleto), longit. 0·009–0·011 millim., crassit. 0·003 millim.; paraphyses fere mediocres, discretæ, apice subclavato, incrassato, subincolore, (vel epithecium dilute vage nigrescens,) hypothecium sordide fuscescens. Gelatina hymenea iodo vix tincta.

Sussex Downs, prope Lewes, ad cretam. (Admiral Jones.)

Locum habeat prope *L. neglectam*, Nyl.

Arthonia melaspermella, Nyl.

Thallus vix ullus vel macula diffusa pallescente indicatus; apothecia nigra (vel fusco-nigra), plana, sat parva (latit. circiter 0·5 millim.), marginata (margine subcrenulato, demum evanescente); sporæ $8^{næ}$, fusco-nigrescentes, oblongo-ovoideæ, 1-septatæ, longit. 0·011–0·015 millim., crass. 0·0045 millim. Gelatina hymenea iodo dilute cærulescens.

In Anglia, prope Londinum, ad lignum legit Currey; apothecia rotundata lecideiformia facile seriatim secus fibras ligni disposita.

Verrucaria advenula, Nyl.

Similis *Verrucariæ endococcoideæ*, sed differens sporis, quæ sunt oblongæ (demum fuscescentes), 3-septatæ (ad septa sæpius constrictiusculæ), longit. 0·015–0·020 millim., crass. 0·006–0·008 millim. (non iodo tinctæ). Gelatina hymenea iodo vinose rubens.

Supra thallum *Lecideæ excentricæ* prope Killarney in Hibernia. (Admiral Jones.)

Perithecia forte interdum subtus (exoperithecio) subincoloria, et sporæ ad faciem stirpis *Verrucariæ epidermidis* vergentes. Paraphyses nullæ rite evolutæ, nec filamenta ostiolaria ulla visibilia (D. Fuisting ea dixit "periphyses;" melius dicerentur *anaphyses,* si nomine novo egeant). Apothecium latit. circiter 0·1 millim.

XL.—*On the Morphological Structure and the Motory Phenomena of the Contractile Substance of the* Polythalamia (Gromia oviformis)*. By M. Reichert.

1. In the Polythalamia two substances are distinguishable, independently of the shell: the contractile substance of the body, and the colourless constituent which forms the central mass of the body and contains colourless and coloured corpuscles as well as vesicles.

2. Nothing has been accurately determined in regard to the morphological composition of the central substance of the body containing the vesicles, in *Gromia oviformis.* Vesicular bodies of the size and structure described by M. Schultze, 'Ueber den Organismus der Polythalamien,' &c. p. 21, and figured in pl. 1. fig. 6, pl. 7. figs. 10 and 12, were not observed. Whether the apparent vacuoles of the contractile cortical substance, which are not described by this observer, led to the idea of the existence of vesicular bodies, or whether I have not been so fortunate as to obtain animals with true vesicles situated in the central substance of the body, future observations must decide.

3. The contractile substance of the body forms the cortical layer of the soft body of the Polythalamia, which surrounds the central substance containing the vesicles. Whether this was provided at the mouth of the shell with an orifice could not be ascertained in *Gromia oviformis;* but in one instance a granular flocculent mass, probably arising from the central substance, was observed at the orifice of the shell. The contractile substance of the body in *Gromia oviformis* forms a depressed ellipsoidal hollow sac corresponding in external form to that of the entire body, and hence accommodates itself, as in other Polythalamia, to the shell, with the necessary regard to the siphons. It probably takes part in the formation of the shell, but appears subsequently to separate almost entirely from it, as the sea-water enters between the shell and the cortical substance even at its wide commencement; it is also well known that the soft body of *Gromia oviformis* partly leaves the shell. Besides contractility,

* Translated by J. W. Griffith, M.D., F.L.S., from the 'Monatsbericht' of the Berlin Academy, Aug. 1865.

the cortical substance of the soft body probably also possesses the property of producing excretions by which animals forming its food are killed. It also exhibits phenomena of sensation; for the extended processes retract on contact with foreign bodies. It is probably also a respiratory organ, and the active motion of its granules may contribute to the constant change of the sea-water. From the manner in which the many-chambered Foraminifera enlarge and grow, it can scarcely be doubted that it plays an important part in this formative process. Lastly, I have observed that segments separate from it and apparently disappear entirely; so that it must undergo a kind of regenerative process, and restoration must take place in the remaining cortical layer from regeneration by intussusception.

4. The contractile cortical substance of the body of the Polythalamia in a state of rest cannot be recognized as a distinct constituent, even with the aid of the microscope; it forms so thin a layer that its optical section, with the thickness of the body of the animal and the apparently shapeless central substance of the body containing the vesicles, appears merely as a boundary line of the latter and without a double contour. But it is distinctly visible when thickened by contraction and evolving the processes, as well as when the central mass containing the vesicles is passively pushed against it. Although it may originally have been formed from a group of cells, yet when fully developed there is not the slightest trace of any distinct components. It is perfectly hyaline and colourless in the pseudopodia, but sometimes becomes coloured at condensed spots. At these condensed spots and in the larger processes it also appears finely granular, and hence appears under the microscope as if it contained larger granules. Although in other low invertebrate animals the presence of similar true granules in the contractile substance is undoubted, this must at present be denied in the case of the contractile substance of the Polythalamia, as the granular appearance only occurs during the state of contraction, and must therefore be attributed to irregularities of the surface.

5. In regard to the motory phenomena of the body of the Polythalamia, which must be brought into connexion with the contractility of the cortical substance, I distinguish active and passive. To the passive belong the movements and the often apparently rotating motions of the central substance of the body, arising from the peristaltic constrictions of the contractile mantle and the locomotion of the entire body. All the active motory phenomena are recognizable by general or local alterations in the external form and morphological structure of the contractile cortical substance.

a. The contractile property of the cortical substance is exhibited in the simplest manner by greater or less constriction of the ellipsoidal body of the Polythalamia, which occurs slowly and slowly changes position. At the constricted spot the contractile substance is thickened, and its optic section exhibits the form of a narrow sickle with the concavity placed outwards. These constrictions are regularly accompanied by passive movements of the central substance of the body, which contains the vesicles.

b. On every part of the contractile cortical layer the contractile action gives rise to processes in the form of tubercles, warts, papillæ, also flat knob-like prominences and lamellæ, and, lastly, elongated, either regular or somewhat irregular processes. These prominences and processes are only formed, as far as the present observations extend, upon the outer surface of the contractile cortical layer. They appear either at the orifice of the shell or upon a protruded segment of the entire body of the animal; but they are also developed within the shell, at any part of the surface of the body. In the latter case they give rise to the appearance of vacuoles and alveoli, which, however, are filled with sea-water and exist upon the surface of the body, and not within the central substance containing the vesicles. The elevations commence with an aggregation of contractile substance, small at first, at some part of the boundary of the contractile membrane; they then gradually enlarge by the addition of more matter from the surrounding parts, and the contractile membrane is seen to move over the central substance of the body containing the vesicles. By increase of the contraction, new elevations of various forms are sometimes developed upon a lamellar or elongated process, so that the originally membranous contractile lamella thus assumes variously branched forms.

c. The most slender kind of the elongated processes forms the so-called pseudopodia of the Polythalamia. These are most strikingly developed outside the shell, at the orifice; but they exist also within the shell during the above-mentioned formation of vacuoles. In the sarcodic net, as it is called, formed by them, membranous plates of the contractile substance are sometimes so inserted, as shown by a described observation, that as it were a portion of the contractile substance, from which pseudopodia are developed, maintains the connexion with the other parts of the contractile cortical layer merely by a slender pseudopodiform filament. The pseudopodia may arise directly from the cortical substance; but they are usually developed from stouter processes, in consequence of an increase of the contractile action. The so-called granules observed in the granular movement must be regarded as very minute wart-like elevations of the membranous contractile substance. They occur most frequently in the pseudopodia; but their movement is observable in all the processes, even in the unthickened and elevated contractile membrane, both within and outside the shell.

d. On return to the so-called state of rest, each process retracts to exactly the same place in the contractile sac or the lamella as that from which the elevation occurred. In the branched forms the retraction commences at the terminal branches, and at the same time the movement of the granules ceases; that of the trunks follows. Hence it may be regarded as a law, that the particles of the contractile cortical layer protruded by the contraction, after return to the state of rest, lie in exactly the same order and relative position as they did when the contraction began.

e. All motory phenomena in which large masses of the contractile substance are concerned, exhibit a certain sluggishness at their commencement as well as at their recedence. A stout cylindrical process always requires a considerable time for its formation, during which new contractile matter is being added—as much as half an hour or even more; the development of the more slender pseudopodia, and especially of the granules, takes place rapidly.

f. The contractile action in the granular movement is moreover remarkable from the circumstance that in most cases, immediately after the state of rest has taken place, it causes a similar action in the adjoining contractile substance, producing a movement of waves, resulting from contraction, running in various directions. The law of these waves has not hitherto been determinable; according to appearances, the commencement, the cessation, and, in the case of the plates and membranes of the contractile substance, also the direction of the motion of the granules ensue with perfect irregularity. Moreover, although the appearance of a so-called granule of the granule-movement gives rise to a similar contractile motion in the adjacent parts, yet instances have often occurred to me in which granules have appeared and remained, without setting a contraction-wave in motion. It may be regarded as a peculiarity of the motory phenomenon of the contractile cortical layer, that every movement of contraction may remain at a certain state of intensity for several hours.

Comparison of the Contractile Substance of the Bodies of the Polythalamia *with Muscular Fibre.*

The comparison of the contractile cortical layer with muscular fibre will refer exclusively to the morphological phenomena, and what may be deduced from them to illustrate the relative law of the contractile action. What takes place within the contractile muscular fibre on its transition from the state of rest to that of action, and the reverse, is still very obscure; there is even controversy upon its minute structure. Still an attempt to compare the two different forms of contractile substance at present known with each other appears justified, so long as only recognized and undoubted facts are brought into comparison, and thus new aspects and some progress, although but slight, may be made towards the further explanation of the contracting-power of the two structures.

The following are the properties of muscular fibre which should be prominently brought into comparison :—

1. The contractile particles of the muscular fibres are arranged with special regard to the long axis of a cylinder or to some kind of longitudinal axis: every muscle consists of an aggregation of these longitudinally arranged contractile morphological elements.

2. No other means of recognizing the organism of the muscular fibres as a whole are known, except those which refer to the contractile power.

3. The contractile action is accompanied by changes in the form of the muscular fibres, which I have designated active motory phenomena. The passive motory phenomena are exhibited in the neighbourhood of the contractile substance by displacement of the substance situated there, and any so-called passive sources of motion of the organisms which may be present—by conversion of the original pressing force of the shortened muscular fibre into tractive force, &c.

4. In regard to the active phenomena of motion, the following facts are established :—

a. On the transition of the contractile substance of the muscular fibre into the so-called active or contracted state, it diminishes in longitudinal and increases in transverse section, either without or with but little change of volume. Or this may be expressed thus :—The slender elongated body is finally changed into a more or less thick plate or disk. On return to the state of rest, the original elongated form is restored.

b. The shortening and thickening on the one hand, as also the elongation and diminution of breadth on the other, may apparently occur suddenly in the entire muscular fibre; they may, however, run as a contraction-wave, distinctly perceptible under the microscope, from one end to the other.

c. The contraction may be limited to or localized in any segment of the length of the muscular fibre.

d. The contraction may stop at any intermediate state within the most extreme limits; it may then either increase or pass from the state of action to that of rest.

e. During the contraction, the particles of the contractile substance must be displaced in a manner corresponding to the form of the state of action and of rest, and therefore according to a law. It must thus be conceived that the particles of the contractile substance during each state of action and of rest must have a determinate absolute and relative position corresponding to the form in each case, that their displacement during the contraction is in this way regulated according to a law, and that the particles, after displacement, return to exactly the same absolute and relative position as that in which they were previously. Every other change in the absolute and relative position of the particles is excluded from the contractile action; hence the uniform mobility in every direction belonging to liquids is absent, as the absolute and relative position of the particles to each other in each ease would depend on accidental external circumstances, and would comprise in itself the possibility of any changes in relative position. The contraction of organized bodies is also distinguished from elasticity, quite independently of other phenomena, by the mobility of the particles only occurring in a definite direction, regulated with regard to the organized form.

By comparison of the morphological properties and active motory phenomena of the two contractile structures, the following three differences become evident:—

1. Muscular fibres are elongated contractile formations, in which the contractile particles are arranged with regard to a longitudinal axis during the state of rest. What the special form of the fibre may be, whether cylindrical or spindle-shaped, or flattened and terminating in a lancet-shaped point, as the smooth unstriped muscular fibres, it may often be difficult to decide. But, for comparison, the fact is sufficient, that the contractile particles in a muscular fibre are arranged with regard to a longitudinal axis.

Moreover muscular fibres exist as separate contractile elements, by the aggregation of which the muscles and muscular laminæ of the more highly developed animal organisms are formed.

The contractile cortical layer of the Polythalamia forms during the state of rest a very thin membranous expanded contractile structure, in which the contractile particles are arranged with respect to a body expanded in breadth, or a disk. This layer, whether originating from cells or not, forms a continuous whole, in which no distinct contractile elements can be detected, with our present resources, in fully developed animals.

2. In muscular fibres the property of contractility is, as far as our present observations extend, the principal, if not the only consideration to be taken into account, and to be estimated in

the structure as a whole. The contractile cortical layer of the Polythalamia is a principal constituent of the body as a whole, upon which its external form depends, and which exerts an action in regard to the entire body, not merely by its contractility, but also by its respiratory secretory power, &c.

3. The muscular fibre, on transition from a state of rest into the so-called active state or that of contraction, becomes changed into a flattened disk-shaped body. The contractile cortical layer of the Polythalamia, on transition into the active state, as is well known, appears in extraordinarily varying forms. When, however, it is considered that this contractile structure forms a continuous whole, in which the contraction ensues at any spot and to any extent, with the attraction of new contractile particles, which augment the mass in action, alter the form, and, lastly, may increase to any extent, the distinctive and essential relation on transition into the state of contraction may be characterized by the words "the contractile membranous plate finally changes into an elongate, under certain circumstances cylindrical body." If the contractile energy is of but little intensity and is limited to a small spot, this form of contraction will appear as a small tubercle, and under the microscope as a minute granule upon the contractile membrane. If the tubercle enlarges, a more or less elongated papillary body becomes developed from it, which appears as a tentacle or a pseudopodial process upon the contractile cortical layer continuous with it and in a state of rest. Lamellar processes and alveolar spaces will be formed by the contractile force of a segment of the contractile cortical layer corresponding to this form. Branched forms may be produced by increase of the contractile force in already existing processes, with attraction of new masses. A remarkable circumstance is, that the various forms resulting from contraction, as far as the present experiments extend, only occur upon the outer surface of the contractile layer. The circumstances which are in action here are unknown; but the law that the contractile cortical layer of the Polythalamia which in a state of rest forms a plate or disk, on passing into the active state finally assumes elongated variable forms, is not thereby altered.

Of the three above-named differences, the first two, which refer to the purely morphological question, do not at present allow of further comparison. Both contractile structures are at all events morphologically of entirely different value and of different importance. The rational morphological relation of the two contractile structures to each other can only be determined hereafter by an accurate knowledge of the history of the development of the body of the Polythalamia and of the muscular fibre, as also a comparative anatomical consideration of the entire structure of the Polythalamia and the animal organisms in which distinct muscular fibres occur. By the words, "that the contractile cortical layer of the Polythalamia is an undeveloped muscular mass, sarcode, or protoplasm," is as little or even less advance made than by the expression "that the Polythalamia are undeveloped vertebrata."

In regard to the motory phenomena, in which the contractile action is expressed, the differences are very striking at first sight. In the case of the muscular fibre (for the sake of simplifying the comparison and, by comprising the extremes, allowing the law to be surveyed with great nicety), a cylindrical contractile substance becomes converted by contractile power into a *disk with a circular outline*, possessing nearly or absolutely the same volume; in the case of the contractile cortical substance of the Polythalamia, a disk with a circular outline into a *cylinder*. Accurate examination, however, teaches us that different forms only are concerned, under which the contractile substance is applied and its contractility realized for the accomplishment of spontaneous and involuntary movements and functions in the organism. As regards the expression of the contractile action, *i. e.* of the movement of the contractile particles in a certain direction corresponding to each change of form of the contractile structure, the distinction of a so-called active or passive state is of secondary importance. The former force, which urges and transfers the contractile particles from a position arranged according to the long axis of a cylinder, into that in which the contractile particles are situated with regard to the axis of the cylindrical section and in the form of a disk, is in every respect exactly the same, by whatever cause, on transition into the state of rest, the displacement of the contractile particles from the discoidal form into that of the cylinder is produced; and so *vice versâ* in regard to the contractile action occurring in the Polythalamia.

If, however, the transition of the contractile structure into the so-called state of rest and the form of this state is also taken into account as an active motory phenomenon, the muscular fibre and the contractile cortical layer of the Polythalamia agree perfectly as regards their contractile action. In both are recognizable the same fundamental forms, which appear in the alternation of two contractile tissues in a state of action, viz. the elongated cylindrical, and the disk or plate, expanded in breadth or into the section of a cylinder—the difference referring simply to the circumstance that in the two contractile tissues, as already stated, quite independently of other morphological relations, the same fundamental forms are not conceived in the so-called active and passive states of the contractile action. Hence it results, from the comparison of the morphological properties and motory phenomena of muscular fibre and the contractile cortical layer of the Polythalamia, that the contractile substance during its action appears in two forms—the elongated (under certain circumstances cylindrical) form, in which the contractile particles are arranged with regard to a long axis, perhaps that of a cylinder; and the form of a plate or disk, in which the arrangement of the contractile particles has regard to the axis lying in the section of the cylinder. The contractile action itself is exhibited in the displacement of the contractile particles from one fundamental form to the other, and *vice versâ*. Each of the two principal or fundamental forms of the contractile substance in the animal organisms may be realized as the so-called active state, or as that of rest. In the muscular fibre the arrangement of the contractile particles with relation to the longitudinal axis of the cylinder is conceived as the state of rest, the discoidal form as the active form; while the reverse occurs in the Polythalamia.

XLI.—*On a new Species of* Astacus. By Dr. E. von Martens.

The Zoological Museum in Berlin has recently received from Dr. Richard Schomburgk a species of crayfish, almost equal in size to a lobster, from the Murray River, Australia. Dr. J. E. Gray, in a paper on the Australian Crayfishes, embodied in Eyre's 'Journal of Expeditions of Discovery in Australia,' vol. i. 1845, p. 409, mentions a large species living in the said river, weighing about two pounds, and possessing the same flavour as the European lobster. This may be the same; but, as I could not find elsewhere a zoological description of it, I venture to regard and to describe it as new.

Astacus armatus.

Rostrum of the cephalothorax as long as the peduncles of the outer antennæ, pointed, furnished on each side with four teeth, the posterior ones smaller; its lateral edges continued backwards on a short extent of the cephalothorax in the form of a raised ridge. A single spine behind the middle of the orbit, somewhat behind the orbital edge, and continued backwards in a similar very short ridge. The sides of the cephalothorax, the hepatic as well as the branchial region, furnished with scattered conical spines, each enlarged at its basis, as if placed on a cushion. The lateral lamina of the outer antennæ of the same spiniform shape as in *Homarus vulgaris*, but somewhat longer. Two strong spines on the interior edge of the carpus, the foremost much stronger.

The hands are exactly similar in size and in the shape of the teeth situated on the cutting-edges, both lateral edges of the hand serrated by blunt, short, conical spines, bent forwards and forming a double row on the external edge, and a single one on the internal. The femur of the four other thoracic feet furnished on its upper edge with two, three, or four spines. The upper face of the abdomen armed with strong conical spines disposed on each segment in a transverse row of six, the outer ones stronger; only on the second segment, the lateral part of which is enlarged forwards as well as backwards, there are two outermost spines, one behind the other, so that this segment possesses eight instead of six of them. The laminæ of the abdominal feet membranaceous, with calcareous edges. The hinder half of all the laminæ of the caudal fin soft and flexible; the lateral edges of the median one (the last abdominal segment) with a single tooth, further removed from its extremity than in the lobster, and corresponding in situation to the deep notch in this segment in the Crayfish. The two lateral pairs of caudal plates with the same transverse and denticulated suture as in the lobster.

Length from the extremity of the rostrum to that of the caudal fin 330 millims.; length of the hand 130 millims., breadth of the same 60 millims.

Astacoides nobilis, Dana, from New South Wales, comes very near to this species in several respects, but is at once distinguished by its blunt, almost toothless, rostrum; its abdominal spines are much more feeble. The formation of the rostrum and the want of a deep notch in the caudal fin bring this new species nearer to *Homarus* than any other known species; but the hands being equal, and the last thoracic segment being moveable independently of the cephalothorax, distinguish it from the lobsters. As I could examine one specimen only, which I did not wish to injure, the number of the gills could not be ascertained; and, as it is a female, there were no means of determining whether any appendages exist in the male These are the two characters on which is based the division *Astacoides*, adopted by Dana as a genus. Judging from some other characters, which are peculiar to *Astacoides Madagascariensis* and the new species, as the prickles on the sides of the thorax and the membranaceous texture of the abdominal feet, I think it probable that also in the above characters *Astacus armatus* will resemble *Astacoides*. Whoever may consider the teeth of the rostrum and the notches of the caudal fin to be generic characters will be under the necessity of establishing a new genus for our species. I prefer, however, to regard it as evidence against the generic value of those subordinate characters, the different combinations of which would not fail to require more and more new genera.

XLII.—*On the various Modes of Coloration of Feathers.* By M. Victor Fatio*.

The various plumages of birds have been studied in all times, and their difference of coloration has been in the present day the subject of many interesting works. The question of changes of plumage has presented itself in various ways. Is a new coloration always the peculiarity of a new feather? or may the coloration sometimes undergo alteration in the same tissues? Each of these notions has had its defenders; but the second gradually increasing in probability, it has become necessary to find out how and by what means these internal modifications take place.

Schlegel†, in 1852, supposed a new life in the feather at the approach of spring; and most of the naturalists who have paid attention to the subject since his time have sought rather to throw over this first hypothesis than to substitute for it a new and plausible explanation of the phenomenon.

Nevertheless some theories put forward during the last few years have still further subdivided the question. Weinland‡, supposing that a pigmented fat came from the body to colour the dead feather afresh, did not believe in the presence of what may be called a latent colouring principle beneath the apparent colour.

Severtzof§ believed in this primitive inherence of the new colouring matter, and put forward the ozone of the air as the modifying agent of the coloration in general.

As none of these methods satisfy the mind, and especially as none of them can sustain a careful observation, I have taken up the question by commencing with the study of the growth and anatomy of the feather, which must hereafter facilitate that of the ulterior developments.

I shall not enter here upon the details of these preliminary researches, but will confine myself to citing briefly the points most indispensable for the comprehension of my subject. I shall state, in the first place, that each feather consists of—

1. A central stalk, or primary axis.
2. Numerous barbs arranged on the sides of this first stem, and forming, as it were, branches or secondary axes.
3. Numerous barbules regularly implanted upon the barbs, and forming tertiary axes.

* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle,' March 25, 1866, Archives des Sciences, pp. 244–254.

† Naumannia, vol. ii. 1. p. 2.

‡ Zur Verfärbung der Vogelfeder ohne Mauserung, Cabanis, iv. 1856.

§ Mikroskopische Untersuchungen über die Verfärbung der Federn, &c.

4. Small lateral hooklets, forming, as it were, the branches of the latter, or quaternary axes.

I may then indicate that each of these parts is also composed of an exterior *epidermis* with flat and irregular cells, of a *cortical matter* formed of cells more or less elongated into fibres, of a coloured *medullary substance* in rounded or polygonal cells in the interior, and of *pigment-granules* scattered or grouped in the centre of each segment of each axis.

Lastly, I may state that the feather is formed in the interior of the corium at the expense of plastic cells which become organized in a protective sheath, and that, in growing, they push before them the down which prepared their path in the young bird.

Cuvier*, Reclam†, Engel‡, Holland§, and many others have written so much upon the development of feathers, that I may abstain from touching upon this point. When once grown, the feather has already received all the coloured principles that it can ever derive from the body; the bloodvessels which have nourished it become gradually obliterated, and its interior medulla dries up by degrees.

This being established, I commenced by studying the modifications due to actual moultings, or to changes of feathers; but I shall not enter here into any details, in order to arrive more speedily at the true purpose and actual result of my investigation—namely, the various modes of coloration in the same feather.

Every bird presents different aspects according to its age and sex and the season; but it also varies according to the localities which it inhabits, and the food which it finds there. The blood, modified by these various internal or external influences, furnishes the new feathers with diversely elaborated pigments.

A young bird, for example, at its first moult, will not receive either the same quantity or the same quality of pigment as an older individual. A male will not receive the same colouring matter as his female, or, rather, he will receive a substance which, although at first analogous, will be capable of modification in a different manner. Lastly, an old individual will always receive only the same quantity of the same pigment, so as constantly to present a similar plumage.

* F. Cuvier, Observ. sur la Structure et le Développement des Plumes (Mém. du Musée d'Hist. Nat. tome xiii.).

† C. Reclam, De Plumarum Pennarumque Evolutione. Leipzig, 1846.

‡ Jos. Engel, Ueber Stellung und Entwickelung der Feder (Wiener Sitzungsber. Bd. xxii., 1857, pp. 376–393).

§ F. Holland, Pterologische Untersuchungen (Journal für Ornithologie, 1864, vol. xi.).

A feather grown in autumn becomes modified in the spring, if it is not renewed; but at the same time it passes by degrees from a death which was only apparent to a more and more real death, until a moment will arrive when it must be expelled and replaced by another, presenting certain forms and proportions and a determinate coloration.

At the approach of cold, a new feather, longer and warmer because it has been less worn, comes to replace the old one; in the spring a more brilliant plumage decorates the bird, which is preparing for its nuptials.

When, in the spring, a bird cannot cover itself with a new clothing, it refreshes its old plumage by picking off the worn ends and retaining what still remains good. It is precisely this refreshing, and the new tint thus produced, that I have more particularly endeavoured to study in the present memoir. I have attempted, in taking up the question, always to reproduce artificially what I supposed must have taken place in nature.

A new coloration may appear in a feather, slowly, and even commencing in the autumn, or more rapidly, only in the spring; it may also consist in a simple augmentation of the intensity of the former coloration, or be in complete contrast with it.

The external or internal conditions which may act upon the feather are *the humidity of the air, temperature, light, movements, and the grease of the bird.* The modifications produced by these agents are *the various development of certain parts, the solution and diffusion of the internal pigment,* and *the rupture of the external parts.*

The humidity of the air causes the cortical substance of a feather to swell, and thus facilitates the communication between the constituent cells and fibres. A colourless liquid fat, arriving either by the interior or the exterior of the feather, dissolves the latent colouring fatty matter in the centres; the intensity of the colour is then simply augmented in certain cases, whilst in others the old colour is replaced and driven outwards by the new one, which spreads and forces it to become extravasated throughout in the form of an external powder. A slightly elevated temperature facilitates these chemical actions; winter slackens them; great cold arrests them almost entirely. Light seems, as it were, to direct the deposit towards those surfaces which are most exposed to it.

A feather thus becomes coloured more or less rapidly, but always from the periphery to the centre, as the extreme parts of the new feather are the first and the most exposed to the influences of the circumambient air.

Moisture, which in course of time injures the cortical substance which it at first inflated, weakens and deteriorates the ends of all the feathers; the latter, torn off by friction at each movement of the bird, by degrees make way for the coloration manifested in other feathers beneath them.

During this time the lowest parts of the feather are gradually decolorized, not, as might be supposed, in consequence of an ascending current of colouring matter, but simply by the fall of the greater part of the coloured downy barbules.

All this takes place without any introduction of new blood, without any resurrection of the "soul of the feather," and solely, as I have just said, under the influence of moisture externally and of the fat in the interior. I have produced and studied under the microscope both the development of the cortical substance and the internal solution of the different pigments in the barbs and barbules.

Conditions of climate and food produce varieties in nature, just as the different influences and the more or less abnormal diet to which we subject birds in captivity cause their plumage to vary. We may, for example, obtain albinism, either by an impoverishment of the blood so that it may no longer furnish colouring matters to the feathers, or by a complete extravasation of all the internal pigment. Nevertheless, although the solution takes place everywhere in the same way, the coloration is not developed in the same manner in all feathers.

Bogdanow*, who has occupied himself with the chemical solution of the pigments of feathers, has distinguished in them two groups, in accordance with differences in their pigmentation. He has given the name of *optical* feathers (*optiques*) to those which always furnished him with a brown pigment and owed their variety of colours to light alone; and that of *ordinary* feathers (*ordinaires*) to those which contained variously coloured pigments. I have retained this primitive division, which the microscope has shown to be natural; but a deeper study has forced me to establish two new subdivisions—the *mixed* feathers (*mixtes*), dependent on the ordinary feathers, and the *enamelled* feathers, dependent on the optical. The comparative distribution of the cortical substance, combined with the different pigmentation, give these feathers their principal distinctive characters.

In the *ordinary* feathers, which contain various pigments, it is the barbs that possess the thickest layer of cortical substance. These barbs, in swelling, throw off their useless barbules, and in spring form as it were clubs, of which the coloration is the same both by transmitted and reflected light. These first feathers present plenty of brilliancy of colour, but never reflections.

* Étude sur les Causes de la Coloration des Oiseaux (Revue Zoologique, 1858, vol. x. p. 183).

In the *mixed* feathers the barbules are persistent, because the cortical substance is equally distributed in the two axes. In them the latent coloration is concentrated principally in the barbs, and these possess ready communication with the barbules. These second feathers, like the ordinary feathers, contain various pigments and sometimes present much brightness of colour; but they never possess reflections, and rarely so much brilliancy as the preceding ones.

In the *optical* feathers it is the barbule alone that can develope itself. It swells enormously, and very often swallows up in its mass its lateral hooklets, when it acquires a cylindrical or prismatic form. Sometimes in spring it may actually measure three or four times as much in diameter as in the previous autumn.

These feathers always contain brown pigments, and the separative septa of the superposed segments which compose each barbule are in them much stronger than in any other feathers. These third feathers present themselves under all forms, and of all the colours of the spectrum, but always with metallic reflections.

Lastly, in the *enamelled* feathers, it is again the barb that is developed and throws off the barbule, although these are nevertheless optical feathers, invariably furnished with dark pigments. In them the cortical substance has not been developed into fibres,—on the contrary, it presents itself in the form of large polygonal cells with the nuclei strongly coloured brown. On the dorsal surface of the barbs the cells, much less strongly coloured, are elongated and vertical, and form as it were a transparent external varnish of greater or less thickness. To this fourth kind belong some green feathers, and especially all the blue feathers without metallic lustre.

The observation of these four divisions allows us to establish the following general laws:—

1. *Of two successive axes, one is always developed at the expense of the other.*

2. *In the ordinary feathers, properly so called, the secondary axis predominates over the tertiary.*

3. *In the optical feathers, properly so called, the tertiary axis, on the contrary, predominates over the secondary.*

A. *The mixed feathers present a mean condition.*

B. *The enamelled feathers are optical in their pigmentation, and ordinary in their development.*

The *mixed* character is very often met with in a feather together with a development of another kind; but no feather can be at once ordinary and optical, any more than ordinary and enamelled or enamelled and optical.

The influence of humidity and light upon the development and coloration of the parts which are most exposed to them, readily explains why the dorsal surface of a feather is usually more highly coloured than its ventral or inferior surface.

Besides the coloration seen by transmitted light and produced by various pigments, which act the same part with light as any other coloured bodies, I explain the brilliancy of ordinary feathers, the coloration of enamelled feathers, and the varying metallic lustre of optical feathers by the following phenomena of interference.

The development of the cortical substance increases the brilliancy by multiplying the reflecting surfaces, and at the same time increasing their distance. The meeting of these rays, reflected at various distances, produces an effect nearly similar to that described by Dove * in some bodies. I should even be tempted to ascribe the production of the blue colour by the enamelled feathers to a phenomenon analogous to that by which the above learned physicist endeavours to explain the brilliancy and lustre of some bodies,—namely, to the superposition of a transparent reflecting layer (in my case slightly coloured) upon a base covered with dark-coloured designs. In fact, if I scrape away this external varnish at some point, the blue feather appears black or brown at this part.

In the lustrous optical feathers a new complication is added to these first effects. It indeed recalls the designs and streaks of Dove, but seems nevertheless to approach more nearly to the phenomenon of the coloured rings. This is a series of transverse lines, sometimes brilliant, sometimes obscure, corresponding with the strongly marked segmentation of the barbules, as may be easily ascertained by examining an opticalfeather with a low power under direct light. The effect of each barbule is added to that of the following one, and we always find a much more regular arrangement of the barbules in the feathers which have the strongest metallic lustre.

We must not confound the coloration extravasated in powder, of which I have spoken above, with another coloration deposited in the same form, but from the outside, upon the feathers of some birds. In the latter case, it is by rubbing against foreign bodies, vegetable or mineral, that some species cover certain parts of their bodies with a truly external and more or less solid coloration.

Nor must we confound the decolorization which takes place upon a living individual with that which occurs slowly in our museums. The decolorization in collections arises most frequently from a saponification of the coloured fatty matters, produced in course of time by air and light, as also from a disintegration

* Abhandlungen der Akad. der Wiss. zu Berlin, 1855.

of the epidermis and cortical substance, produced either by too great dryness or, especially, by too much moisture.

A closer investigation of feathers would perhaps explain the geographical distribution of colours modified by climatic influences, the formation of local varieties, or the parallel effects, often so curious, of captivity upon coloration.

XLIII.—*Contributions to an Insect Fauna of the Amazons Valley.* Coleoptera : Longicornes. By H. W. Bates, Esq.

[Continued from p. 303.]

Group *Astatheinæ.*

Genus Phæa, Newman.

Newman, Entomologist, p. 13.

Syn. *Lamprocleptes,* Thomson, Arch. Entom. i. 377.

The chief character which distinguishes this genus from *Tetraopes* (the chief American representative of the group Astatheinæ) is the form of the tooth of the claws. The tooth in *Tetraopes* is long and acute, running parallel to the claw itself, but much shorter; in *Phæa* it is very broad and short, adhering only to the base of the claw, as in the Callianæ. The eyes, as in the rest of the Astatheinæ, are completely divided. The body is more or less elongate and linear.

Phæa coccinea, n. sp.

P. linearis, brevis, coccinea, pube pallida sericea vestita; femoribus apice, tibiis, tarsis et antennis (basi exceptis) nigris. Long. $3\frac{1}{2}$ lin.

Head as broad as the middle part of the thorax, bright red; eyes moderately prominent, black. Antennæ about as long as the body, filiform, hirsute, black, basal half of the first joint red. Thorax constricted near the front and hind margins, surface strongly elevated and smooth in the middle, clothed with long erect hairs; bright red. Elytra linear, bright red, clothed with fine pale silky pubescence (visible only in certain lights), and with erect hairs, strongly punctate-striate, the punctures fainter and more confused towards the apex. Body beneath and thighs yellowish red; apex of thighs, tibiæ, and tarsi black.

Santarem.

Group *Amphionychinæ.*

[The Amphionychinæ are distinguished from the Phytœciinæ (both having bifid claws) by the sides of the elytra having a longitudinal carina extending from the shoulders.]

Genus Lycidola, Thomson.

Thomson, Systema Cerambyc. p. 125.

The proposer of this genus has omitted to state the essential characters which distinguish it from *Spathoptera* and *Hemilophus*. These are furnished by the peculiar width of the sterna, especially of the prosternum, which is as broad as, or a little broader than, the mesosternum. The prosternum in *Spathoptera* is much narrower than the metasternum, and in *Hemilophus* it is reduced to a mere thread, almost concealed by the large coxæ. *Lycidola* is moreover distinguished from *Spathoptera* by the dilatation of the elytra commencing almost from the shoulders, by the breadth and shortness of the head, and the transverse thorax. The genus is founded on *Saperda palliata*, Klug (Entom. Bras. Specimen alterum, pl. 42. f. 11).

Lycidola simulatrix, n. sp.

L. nigra, breviter setosa; capite et thorace vitta laterali communi fulva; elytris apud medium fascia alba diaphana, apice singulatim rotundatis; femoribus basi flavo-testaceis. Long. 5–6 lin.

Head short and broad, the face extending a short distance below the eyes, and not dilated; black, face reddish; occiput on each side with an oblique fulvous stripe. Antennæ black; third joint one-fourth longer than the fourth, cylindrical; the fourth a little dilated; both densely hairy; the remaining joints shorter than the third and fourth taken together, and sparingly setose. Thorax considerably broader than long, coarsely punctured, except on the disk, which is smooth, deep black; sides each with a fulvous stripe. Scutellum black. Elytra dilated almost from the shoulders, and quite abruptly, at the apex singly rounded; disk punctured, and having on each three longitudinal carinæ, the two outer of which are united before the apex, and the inner one abbreviated; expanded sides shagreened and traversed by a flexuous carina; colour wholly deep black with a violet tinge, except a white diaphanous belt across the middle, interrupted at the suture. Body beneath and legs black; basal part of thighs testaceous yellow.

Var. Base of each elytron with a small fulvous spot in continuation of the thoracic stripe; lateral edge of the elytron also fulvous near the base (approaching *L. palliata*, Klug). Tapajos.

The typical form not uncommon at Ega, on leaves. The var. found only on the banks of the Tapajos.

Genus Spathoptera, Serville.

Serville, Ann. Soc. Ent. Fr. 1835, p. 50.

Body elongated, dilated behind; facies of the genus *Lycus*.

Head somewhat prolonged on the vertex; face elongated and dilated below the eyes. Thorax short, a little narrower than the head. Elytra dilated from beyond the middle, apex briefly emarginated. Legs short; claws bifid. Prosternum narrower than the mesosternum. Antennæ about the length of the body, or a little shorter; basal joint greatly elongated, gradually and slightly thickened from base to apex, ciliated; third and fourth joints greatly elongated, hairy and ciliated beneath, sometimes very thickly ciliated; following joints short and sparingly setose. The lateral carina of the elytra is thick and prominent, and extends from the shoulder to the apex.

1. *Spathoptera capillacea*, n. sp.

S. elongata, postice dilatata, nigra; capite thoraceque vitta laterali fulva, fronte rufescente; elytris macula angulari humerali fasciaque lata pone medium fulvis; antennis articulis tertio et quarto haud dilatatis, infra pilis longis densissimis nigris vestitis. Long. 6 lin.

Head coarsely punctured; vertex elongated, shining black, with a fulvous vitta on each side behind the eye; face dull reddish, clothed with scant tawny pile. Antennæ a little shorter than the body, black; fifth and sixth joints reddish; third and fourth joints greatly elongated, neither of them thickened, but furnished on their under surface with a dense fringe of long thick hairs. Thorax coarsely punctured, shining black, with a fulvous stripe on each side. Elytra with their dilatation commencing a little before the middle, at first very gradual, at about two-thirds their length abruptly dilated; apex of each rounded, and offering a small triangular emargination; surface finely setose; disk closely punctured, and with two very fine raised lines, united before the apex (where alone they are distinct); dilated margins (outside the strong lateral carina) shagreened and traversed, to the apex, by a nearly straight carina; colour black, with a basal spot on each shoulder bent towards the suture, and a broad fascia beyond the middle, fulvous; the edges both of the humeral mark and the fascia irregular. Body beneath and legs black; coxæ and thighs beneath pale testaceous.

Ega.

2. *Spathoptera mimica*, n. sp.

S. elongata, postice dilatata, fulva, capite vitta laterali nigra, thorace lateribus maculaque triangulari dorsali nigris; elytris nigris, macula humerali angulata fasciaque lata pone medium fulvis; antennis breviter hirsutis, nigris, articulis quinto et sexto testaceis, quarto incrassato. Long. 6–7½ lin.

Head fulvo-testaceous, punctured; sides behind the eyes with a black stripe; vertex elongated, convex. Antennæ wholly clothed with shortish hairs, black; fifth and sixth joints pale testaceous; fourth joint dilated. Thorax with a few large punctures and an elevated dorsal line fulvous; deflexed sides, and a triangular dorsal spot with the apex scarcely reaching the anterior margin, black. Elytra elongated, the dilatation commencing very gradually before the middle, and at two-thirds the length more abrupt; at the apex singly rounded and faintly emarginated; surface finely setose, closely punctured, and with two indistinct raised lines united before the apex; dilated margins (outside the lateral carina) shagreened, and traversed by a raised line from base to apex; colour black, with a basal spot on each shoulder (bending towards the suture), and a broad fascia beyond the middle, fulvous; the edges both of the humeral spot and the fascia jagged. Body beneath fulvo-testaceous; sides of breast black, and abdomen with two rows of brown spots. Legs black; coxæ and inside of femora testaceous.

Ega; found only on leaves of trees in the deep forest.

Genus Hemilophus, Serville.

Serville, Ann. Soc. Ent. Fr. 1835, p. 50.

The chief difference existing between this genus and *Amphionycha* resides in the antennæ, which in *Hemilophus* are formed almost the same as in *Spathoptera* and *Lycidola*: that is to say, the third and fourth joints are disproportionately elongated, occupying together, in some species, nearly one-half the total length of these organs; they are, besides, thickened and densely hirsute, sometimes ciliated. Both genera have a strongly elevated lateral carina, bifid claws, and very narrow prosternum. The elytra in *Hemilophus* are sometimes a little dilated before the apex, but in *Amphionycha* never show any trace of dilatation.

Hemilophus fasciatus, n. sp.

H. elongatus, sublinearis, ante apicem paulo ampliatus; capite fulvo, vitta laterali maculaque triangulari occipitali nigris; thorace nigro, vitta utrinque laterali fulva; elytris nigris, macula cuneiformi humerali fasciaque recta mediana fulvis; antennis nigris, articulo quinto basi rufo, articulis quarto et quinto paulo incrassatis, dense breviter setosis. Long. 5 lin. ♂.

Head tawny yellow, with a triangular spot on the occiput and a stripe behind each eye black; forehead convex and marked with a deeply impressed line. Antennæ a little longer than the body (♂); black, with the base of the fifth joint reddish; basal joint clothed with longish hairs; third and fourth joints together longer than the whole of the following joints, thickened, linear, densely clothed with short hairs; remaining joints clothed sparingly with very short hairs. Thorax coarsely punctured, leaving smooth spaces on the disk, and having a deep transverse impression behind; black, with a fulvous vitta on each side of the upper surface. Elytra nearly linear, being very slightly dilated a little before the apex, the latter, on each elytron, presenting a very shallow emargination with a short spine at its outer side; surface densely punctured, partly in lines, and with several interstices slightly raised, black; a straight humeral spot, pointed behind, the basal part of the lateral edges, and a straight fascia about the middle fulvous. Body beneath tawny yellow; sides of thorax and breast and middle of the abdominal segments black. Legs black, base of thighs yellow.

Ega.

Genus Tyrinthia, nov. gen.

This genus includes a number of species which agree with *Hemilophus* in the great length and dense clothing of the third and fourth (or, at least, the third) antennal joints, but differ in the absence of a distinct continuous lateral carina from the elytra. The vertically deflexed sides of the elytra form with the disk, in section, a distinct angle; but the carina is not apparent, except for a short distance from the shoulders.

I have adopted the name that the group bears in the rich collection of Mr. Alexander Fry.

1. *Tyrinthia capillata*, n. sp.

T. elongata, setosa, nigra; capite fulvo-flavo, supra nigro, vitta laterali fulvo-flava, inter antennas profunde indentato; thorace utrinque vitta laterali fulva; elytris elongatis, juxta apicem angustatis, apice singulatim rotundatis et brevissime emarginatis, supra punctato-striatis, macula humerali cuneiformi vittaque lata mediana fulvis; antennis nigris, ultra medium annulo lato flavo, articulo tertio longissimo, ciliato. Long. 5 lin. ♂.

Head coarsely punctured, forehead convex, mouth projecting, vertex deeply depressed between the bases of the antennæ, tawny yellow, the crown and occiput and a stripe behind each eye black. Antennæ as long as the body, black, with the apical half of the fourth, the whole of the fifth, and the base of the sixth joints yellow; basal joint elongate, gradually thickened and fringed with very long, fine hairs; third joint nearly as long as the whole of the succeeding joints taken together, not thickened, but furnished beneath with a continuous fringe of very long hairs; fourth joint not much longer than the fifth, and destitute of fringe. Thorax coarsely punctured, leaving smooth spaces on the disk, behind deeply impressed; fulvous, with a broad central and lateral vittæ black. Elytra linear, except very near the apex, where they are narrowed, the apex itself being narrow and apparently entire, but showing, on close examination, a very shallow emargination and minute tooth; disk regularly and rather deeply punctate-striate, black, a wedge-shaped basal spot and a broad median vitta fulvous. Body beneath black; sterna and centre of the breast bright testaceous yellow. Legs black, base of thighs testaceous yellow.

S. Paulo, Upper Amazons.

2. *Tyrinthia scissifrons*, n. sp.

T. elongata, linearis, setosa, fuliginoso-nigra; fronte, vitta laterali thoracis lineolaque laterali elytrorum fulvo-testaceis; femoribus basi articuloque quinto antennarum rufo-testaceis; antennis articulis tertio et quarto biciliatis; fronte (maris) tumida, conica, apice fissa. Long. 4 lin. ♂.

Head testaceous yellow, vertex and occiput black; upper part of the forehead (♂) conically produced and cleft at the apex, and antenniferous tubercles armed on the inner side with a conical prominence. Antennæ as long as the body, black, with the fifth joint reddish; basal joint on its upper side abruptly thickened, hairy; third and fourth joints together longer than the whole of the remaining joints, slightly thickened and furnished beneath with two fringes of long and fine hairs. Thorax coarsely punctured, and with a smooth dorsal line, black, a narrow stripe on each side pale testaceous. Elytra linear, singly rounded and entire at the apex; surface very closely punctured and furnished with three obtuse costæ, dull black; lateral edge and carina near the base dull testaceous. Body beneath dull black; base of thighs reddish testaceous.

Banks of the Tapajos and Ega, Upper Amazons. Mr. Fry informs me that the peculiar bilobed prominence of the head is found in the males of some Rio Janeiro species. *Hemilophus frontalis* of Guérin-Méneville (Ins. rec. par Osculati, n. 265) belongs to this genus.

Genus Isomerida, nov. gen.

This new genus is distinguished from *Hemilophus* by the antennal joints decreasing in length in regular proportion from the third joint to the apex, and by the fringe of hairs on their under surface existing in uniform density on all the joints. The only difference between *Isomerida* and *Amphionycha* lies in the shortness of the antennæ, which are not longer than the body, even in the males, and decrease greatly in thickness from the third joint to the apex.

I have adopted the name under which the genus stands in the collection of Mr. Alexander Fry.

1. *Isomerida albicollis*, Castelnau.

Hemilophus albicollis, Laporte de Castelnau, Animaux articulés, ii. p. 488.

I. elongata, linearis, postice paulo angustata, tenuiter setosa; capite thoraceque rufo-testaceis, cano interdum dense tomentosis; elytris punctatis, interstitiis duobus elevatis, apice truncatis, rufo-testaceis plus minusve fuliginosis, vel totis nigris; abdomine nigro, segmentis tertio et quarto dense cano tomentosis; antennis nigris, articulis basi testaceis. Long. $4\frac{1}{2}$–$5\frac{1}{2}$ lin. ♂ ♀.

This common species is very variable in its coloration, and there is only a small proportion of examples which exhibit the white hue of the thorax, and these only in the dried state; in life, the thorax is always red. The truncature of the elytra is straight and offers a short tooth at the exterior angles.

It is found on the leaves of trees, and is a common and generally distributed insect throughout the Amazonian forests.

2. *Isomerida ruficornis*, n. sp.

I. robustior, elongata, linearis, postice haud angustata, tenuiter setosa, nigra; capite, thorace, antennis (apice exceptis) et pedibus (femoribus supra exceptis) rufis; elytris apice truncatis, angulis externis dentatis; abdomine segmentis tertio et quarto dense cano tomentosis. Long. 6 lin. ♂.

Head entirely red, depressed between the eyes. Antennæ stout, as long as the body, finely fringed beneath; third joint one-third longer than the fourth, the following becoming very gradually shorter; red, with the three apical joints tinged in the middle with dusky. Thorax thinly clothed with pale silky tomentum, visible only in certain lights; red, prosternum and circuit of the acetabula blackish. Scutellum black. Elytra slightly dilated a little before the apex, the latter straightly truncated, with the outer angles slightly produced; surface punctured and marked with one faintly raised line besides the lateral carina; deep black, shining. Breast and abdomen black; third and fourth ventral segments densely clothed with pale silky tomentum. Legs red, upper side of femora black.

Fonte Boa, Upper Amazons.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Our Reptiles: a plain and easy Account of the Lizards, Snakes, Newts, Toads, Frogs, and Tortoises indigenous to Great Britain. By M. C. Cooke. 12mo. London: Hardwicke, 1865.

Although the number of our British reptiles, even if we include the Batrachia among them, is very small, there is perhaps no other class of animals so generally misunderstood by the public at large.

The undoubtedly venomous qualities of some snakes, coupled perhaps with the peculiarly insidious, gliding movements of all the Ophidians, have given the whole of those remarkable reptiles a bad name, which, as in the case of the proverbial dog, is very nearly equivalent to hanging; and this has been extended by popular prejudice to all reptiles, which accordingly lie under a sort of ban in the imaginations of the ignorant, and not unfrequently suffer persecution in consequence.

In the little volume now before us, Mr. Cooke has manfully done battle in behalf of this much maligned class of animals, showing, what indeed is well enough known to naturalists, that of all our British reptiles the common viper is the only one that has the slightest claim to the possession of those redoubtable poisoned weapons which render many of the exotic species so formidable; whilst of the others the toad alone can be charged, with some show of reason, with producing injurious effects by means of the acrid secretion of the surface of its body, when this is applied to wounds in the skin. All the rest are harmless, and, as Mr. Cooke well shows, often highly interesting in their habits and mode of life; and he has certainly done good service in the popularizing of natural history, by producing so pleasant and instructive an account of our native members of a class so generally regarded with unmixed aversion.

After a short account of the general characteristics of reptiles, and of the singular superstitions connected with what are called snake-stones, Mr. Cooke describes the British species of the class in systematic order, commencing, however, with the Lizards, and placing the Chelonians in a supplementary chapter, as being only occasional visitors to our coasts. Among the true reptiles we find two additions to our list,—one the Smooth Snake (*Coronella lævis*), the claim of which to be regarded as a British reptile may now be considered settled; the other the Green or Guernsey Lizard (*Lacerta viridis*), the introduction of which does not appear to rest on such good evidence. The Edible Frog also makes its appearance in the list, but evidently, even in the author's opinion, as a very doubtful native; and the additions to the limited series of British reptiles are concluded by Dr. Gray's Banded Newt (*Ommatotriton vittatus*, Gray), the distinctness of which from the other British Newts is shown by means of woodcut outlines of the skulls of all the four species, copied from the memoir of Dugès. After all, the total number of species cited, including the two Chelonians, is only seventeen.

These are all well described, and respectably figured on the eleven plates with which the book is illustrated; woodcuts are also given of the heads of the various snakes and lizards, and of the tadpoles, and some details of the Batrachians. The accounts of the habits of the different species are given in a pleasing style, not disfigured by that affectation of slang which some writers appear to consider indispensably necessary in a popular work on natural history. An appendix contains a synonymic list of the species, and the whole work forms a most convenient handbook of the subject on which it treats.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

March 9, 1866.—Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., President, in the Chair.

On the Metamorphoses of Insects. By Sir JOHN LUBBOCK, Bart., F.R.S., M.R.I., Pres. Ent. Soc., V.P. Lin. Soc., V.P. Ethn. Soc., F.S.A.

THE subkingdom Annulosa, to which insects belong, is divided into five classes, namely, Annelida, Crustacea, Arachnida, Myriopoda, Insecta.

The Annelida, or worms, have a body consisting of more or less numerous segments, but without any jointed appendages.

The Crustacea, or crabs and lobsters, have a jointed body, and each segment usually bears a pair of appendages. They are aquatic in their habits.

The Arachnida, or spiders, possess four pairs of legs; the body is divided into two parts, the cephalothorax and abdomen. The segments composing the abdomen bear no appendages. Spiders are aërial in their habits.

The Myriopoda, or centipedes, have a long body consisting of numerous segments, each of which bears a pair of legs.

The Insecta, or insects, have three pairs of legs. They are aërial in habits, and breathe by means of tracheæ or air-tubes, which ramify throughout the internal organs. The body is divided into three parts, the head, thorax, and abdomen.

In addition to the three pairs of legs, the thorax bears generally either two or four wings. The older naturalists collected the wingless forms into a special order—the Aptera; but more extended observations have shown that each of the large orders or groups into which insects are divided contains some apterous forms. The female glow-worm and the working ants are familiar examples of this.

But though the presence of wings is the rule, and the division of insects into orders is founded in great measure on the characters afforded by these important organs, still they are present only in the mature state of the animal, and no known insect is born with wings.

Not only in the absence of wings, but also generally in many other important points, the young insect differs from the mature form, and the changes which it goes through are known as metamorphoses. Entomologists have generally considered the life of all insects to be divisible into four well-marked periods—that of the egg, the larva or caterpillar, the pupa or chrysalis, and, finally, the imago or perfect insect. It is true that in some orders, as, for instance, the Coleoptera (beetles), Hymenoptera (bees), Lepidoptera (butterflies), and Diptera (flies), the larvæ differ much more from the perfect insects than is the case in others, as, for instance, the Orthoptera (grasshoppers) or Heteroptera (bugs); but even in these latter the stages were still supposed to be well marked,—that of the larva, by the entire absence of wings; that of the pupa, by the possession of rudimentary wings; finally, the perfect insect, by having perfect wings.

The lecturer then pointed out that, when the habits were alike, similar larvæ might be met with in very different families of insects.

Thus, among beetles, the *Melolontha* (cockchafer), *Anobium* (death-watch), and *Chlamys* are very similar in their larva state, although they belong to perfectly distinct families of beetles—namely, the *Melolonthidæ*, *Ptinidæ*, and *Chrysomelidæ*.

The same fact holds good even in larvæ belonging to different orders of insects. Those larvæ which, in the words of Mr. Herbert Spencer, are "symmetrically related to the environment," and which either are surrounded by their food, or have it brought to them, are fat, legless, fleshy grubs or maggots. Such are almost all the larvæ of flies. So, again, the Hymenopterous larvæ are generally of this character: whether they inhabit other insects, like those of the ichneumons, or live inside galls, like those of the *Cynipidæ*, or are enclosed in cells and fed by the perfect insects, like those of the bees, practically any great deviation from that which may be looked upon as the normal type is unnecessary. The larvæ of beetles, on the contrary, are generally of a very different character. But there is one group, that of the weevils, which are internal feeders. The grub of a nut-weevil feeding inside a nut is under very similar conditions to those of a *Cynips*-larva in a gall, or an *Anthrax*-larva living parasitically in a bees' cell; and we accordingly find that these larvæ, though belonging to three different orders of insects, very closely resemble one another.

To this type belong most Hymenopterous larvæ; but there are two exceptional groups, the *Tenthredinidæ*, or sawflies, and the *Siricidæ*. The larvæ of the *Tenthredinidæ* feed, like those of butterflies, on leaves, and in the general form of the body, in the possession of three pairs of legs and several pairs of abdominal prolegs, they very closely resemble ordinary caterpillars, and differ extremely from the ordinary type of Hymenopterous larvæ. In the same manner the larvæ of the *Siricidæ*, which are wood-borers, possess thoracic legs, and closely resemble the larvæ of some wood-boring beetles.

From these facts it may be concluded that the form of a larva depends more on the conditions in which it lives than on the form which it will ultimately assume. But this is shown still more clearly in the case of *Sitaris*, a small beetle which is parasitic on a species of solitary bee (*Anthophora*), and the habits of which have been carefully observed and excellently described by a French naturalist, M. Fabre. The female *Sitaris*, which comes to maturity in August, never wanders far away from the sandy banks in which the *Anthophora* loves to burrow. At that time no Anthophoras are abroad, their period of maturity is not in autumn, but in spring; and consequently, though the bee is so necessary to the beetle, we are at once met with the remarkable fact that no perfect *Sitaris* ever saw one of the bees, and it is probable that no *Anthophora* has ever yet seen a *Sitaris*. The latter lays her eggs, which are about 2500 in number, in the burrow leading to the cell of the *Anthophora*. These eggs are hatched in September, and produce small, black, active larvæ, about $\frac{1}{25}$th of an inch in length, with four eyes, two rather long antennæ, and six well-formed legs. But though evidently adapted for an active life, the young larvæ remain quiet among their empty egg-shells until the spring. Then the *Anthophora* comes to maturity, and as it passes out along the burrow the young larvæ spring upon it. The male bees, however, leave their cells about a month before the females; consequently the larva first finds itself on the male bee, from which, however, at the first opportunity it passes to the female. She, poor thing, unconscious of her misfortune, proceeds to excavate her burrow in the usual manner, constructs the usual cell, and fills it with honey. On the honey she lays her egg, but at this moment the larva of *Sitaris* springs on to the egg and floats on it, as on a raft. It then tears open the egg and devours it, thus at once destroying a rival, and making its first meal. As it has by this time been seven months without food, this its first food must be very welcome. But it is necessary on another account. The larva in its first form, though beautifully fitted for its mode of life, is quite unsuited to live on honey in a bees' cell. Hence a change of form is necessary. The increase of size produced by devouring the egg enables the larva to change its skin, and it now emerges in a form very different indeed from the last. The eyes have disappeared; the legs and antennæ are rudimentary. The mouth is so placed that when the larva floats on the honey it is just below the surface, while the spiracles are arranged along the back so as to be just above it. Lastly, the belly is very protuberant, and thus prevents the larva from rolling, in which case the spiracles might be choked by the honey, and the insect suffocated. After living from thirty-five to forty days in this condition, during which it increases very considerably in size, the larva ceases to feed, and contracts into an ovoid body, resembling in many respects the so-called pupa of a fly. Within this, as in a case, it forms a new skin, and takes on a fourth form not very unlike the second. After four or five weeks it changes again into a chrysalis, from which finally the perfect beetle emerges.

Here, then, we find, first, a remarkable change of form accompanying a change of habits, and, secondly, a case in which the life is divided into more than three well-marked stages. This phenomenon received from M. Fabre the name of hypermetamorphosis. For some time the cases of *Sitaris* and *Meloe* were looked on as exceptional; but in 1862 the attention of the lecturer was called to the question by observing a somewhat similar case in *Lonchoptera*, a genus of small flies. Moreover he found that in many species belonging to the Orthoptera and Hemiptera the stages were much less definite and more gradual than had hitherto been supposed.

In illustration of this he described the transformations of *Chloëon* (*Ephemeridæ*), and showed that the perfect form was attained through more than twenty changes of skin, each attended by a slight change of form. In its preparatory stages this insect lives in the water, but in the last two it becomes aërial. Sir John Lubbock had been so fortunate as to see more than once the passage from the aquatic to the aërial condition: the larva floated helplessly on the surface of the water; suddenly the skin burst, the insect sprang out of the back of its own head, and fluttered away. The whole process occupied less than ten seconds.

The speaker in this case wished particularly to impress on his hearers, first, the gradual nature of the changes, and, secondly, that some of them have no reference to the form of the perfect insect, but are entirely of an adaptational character. Thus the young larva is born without branchiæ, and with two caudal appendages. It gradually acquires a thin tail and seven pairs of branchiæ ; but the perfect insect has only two tails and no branchiæ. Thus, then, the changes which an insect undergoes are of two kinds, developmental and adaptational.

External forces act upon the larvæ as much as on the perfect insects. And we can thus understand the remarkable fact that some animals, which differ much when young, are very similar at maturity.

The speaker then entered into some theoretical considerations as to the nature and causes of metamorphoses, dividing the subject into three questions.

1st. How these changes of form might have originated.

2ndly. Why they are, in insects, so abrupt in their character ; and

3rdly. Why the pupa condition, a period of approximate immobility, should intervene between the active larva and the still more active imago.

1. The changes of form depend on the early condition at which some insects quit the egg. There is reason to believe that all insects pass through the stage of fat, fleshy grubs, and subsequently acquire legs*. Some, however, are hatched in the first state, while others remain in the egg until they attain the second. In the former case additional changes are produced by the fact that external forces do not affect the larva in the same manner as the perfect insect; and thus there is a tendency to still greater differentiation.

2. The abruptness of the change is more apparent than real. The actual change itself is merely the withdrawal of the curtain, the casting of the old skin, by which the alterations which have perhaps been in preparation for days, or even weeks, are rendered visible. In fact there can be no great change in insects without a moult. Insects have no bones, and the muscles are attached to the skin, which therefore is necessarily hardened to afford them a solid and sufficient fulcrum. But it follows from this that no change of form can take place without a change of skin.

In *Chloëon* we have seen that each moult is accompanied by a slight change.

In caterpillars, on the contrary, there is little alteration during growth, and the changes are concentrated, so to say, on the last two moults. The advantage of this is obvious ; the mouth, digestive, and other organs of the larva are very different from those of the perfect insect ; and if the change from the one type to the other were gradual and slow, the insect would be liable to perish of starvation in the midst of plenty.

* See, for instance, Professor Huxley's admirable memoir on *Aphis*, in the 'Linnean Transactions.'

3. Similar considerations throw much light on the immobility of the pupa. The organs are altering so rapidly that they are unable to perform their functions. When the changes are gradual, as in Orthoptera, &c., there is no period of quiescence.

The speaker then pointed out the analogy between metamorphoses and the alternation of generations.

Many species of the lower animals are represented by two totally dissimilar forms ; but, so far as the speaker knew, no explanation of this remarkable phenomenon had yet been given.

Through the metamorphoses of insects, however, we get a clue. When an animal is born in a state so early that external forces act on it in one way, and on the perfect form in another, they tend to produce greater and greater differences between the two. As long as the external organs arrive at their mature form before the generative organs are fully developed, we have cases of metamorphosis; but if the reverse is the case, then alternation of generations is the result.

The same considerations explain why in alternation of generations the reproduction is almost invariably agamic in the one form. This is because impregnation requires the perfection both of external and internal organs ; and if the phenomenon arises, as has just been suggested, from the fact that the internal organs arrive at maturity before the external ones, impregnation cannot take place, and reproduction will only result in those species which have the power of agamic multiplication.

However this may be, insects offer every gradation between simple growth and that phenomenon which is known as alternation of generations.

In the wingless Orthoptera, the young so closely resemble the perfect insects, that there is nothing which in ordinary language would be called even a metamorphosis.

In those Orthoptera which eventually acquire wings, there is of course a well-marked difference.

In *Chloëon,* though the changes are gradual, the difference between the larva and the imago is very considerable, and we have seen that the action of external forces produces changes which have no reference to the form of the perfect insect.

In caterpillars we have a typical class of metamorphoses.

Until recently, however, we knew of no case in which a larva produced more than one perfect insect*. Insects never multiply by buds, and almost always the external form is acquired before the organs of reproduction are mature. Recently, however, Professor Wagner of Kasan has discovered that the larvæ of certain Cecidomyias have the faculty of producing other larvæ, so that they present a true case of alternation of generations. Thus, then, we see that insects present every gradation, from growth to alternation of gen-

* The instances in which certain insects breed while their wings are but imperfect, might here have been cited. But as there is much difference of opinion among entomologists as to these cases, I have thought it better to take one about which no question is likely to arise.

erations; we see, from a single fact, how metamorphoses and alternate generations may have originated, and we find reason to suppose that in the course of time the latter phenomenon may become more frequent than it is at present.

It is, moreover, evident that there are in the animal and vegetable kingdoms two kinds of dimorphism. The term has generally been applied to those cases in which—as in the ant and bee in animals, and the Primulas among plants—the perfect individuals are divided into two forms. In fact the sexes themselves constitute a kind of dimorphism. In these cases the forms are not alternate. When, however, external forces act on the young in one manner, and on the mature form in another, they tend to produce different forms, which do not complement, but succeed, one another. I have elsewhere proposed to distinguish this form of dimorphism, under the name of dicidism or polyeidism. In polymorphism the chain of being divides at the extremity; in polyeidism it consists of dissimilar links.

Finally, the speaker said, "The principal conclusions which I would impress on you this evening are—

"1. That the presence of metamorphoses in insects depends, in great measure at least, upon the early state in which they quit the egg.

"2. That metamorphoses are of two kinds—developmental and adaptational.

"3. That the apparent abruptness of the changes which they undergo arises in great measure from the hardness of their skin, which permits no gradual alteration of form, and which is itself rendered necessary in order to afford sufficient support to the muscles.

"4. That the immobility of the pupa or chrysalis depends on the rapidity of the changes going on in it.

"5. That although the majority of insects go through three well-marked stages after leaving the egg, still a large number arrive at maturity through a somewhat indefinite number of slight changes.

"6. That the form of the larva of each species depends in great measure on the conditions in which it lives.

"When an animal is hatched from the egg in an immature form, the external forces acting upon it are different from those which affect the mature form; and thus changes are produced in the young, bearing reference to its present wants rather than to its ultimate form.

"7. When the external organs arrive at this final form before the organs of reproduction are matured, these changes are known as metamorphoses; when, on the contrary, the organs of reproduction are functionally perfect before the external organs, or when the creature has the power of budding, then the phenomenon is known as alternation of generations.

"Insects present every gradation, from simple growth to alternation of generations.

"8. Thus, then, it appears probable that this remarkable phenomenon may have arisen from the simple circumstance that certain animals leave the egg at a very early stage of development, and that the external forces acting on the young are different from those which affect the mature form.

"9. The dimorphism thus produced differs in many important respects from the dimorphism of the mature form which we find, for instance, in the ants and bees; and it would therefore be convenient to distinguish it by a different name.

"But there is still another aspect under which, if time had permitted, the metamorphoses of insects might have been regarded. In one or two cases, indeed, I have sketched very briefly and imperfectly the habits and mode of life of particular insects. A whole course of lectures might be filled with such life-histories. The various manners in which different insects provide for the wants of their young are most remarkable, and all the more so because their wants are so different from those of the perfect insects themselves.

"Thus the butterfly, which lives on honey, and did live on leaves, lays her eggs on a twig. She seems to feel that honey will not suit her young, and that the leaves will wither and fall before another spring comes round.

"The gnat, which lives in the air and feeds on blood, lays her eggs on the surface of water; and the sugar-loving housefly knows that very different food is necessary for her young.

"The nut-weevil chooses the embryo of the nut; the goat-moth the bark of the willow; the *Rhipiphora* braves the dangers of the wasps' nest; the *Œstrus* lays on cattle; the *Ichneumon* in caterpillars; the gall-fly in the still almost imperceptible bud; and some insects even in the eggs of others.

"Generally the larvæ forage for themselves; but in some cases the mother supplies her young with food. Thus the solitary wasp builds a cell and fills it with other insects. If, however, she imprisoned them while alive, their struggles would infallibly destroy her egg; if she killed them, they would soon decay, and the young larva, when hatched, would find, instead of a store of wholesome food, a mere mass of corruption. To avoid these two evils, the wasp stings her victim in such a manner as to pierce the centre of the nervous system, and the poison has the quality of paralyzing the victim without killing it. Thus deprived of all power of movement, but still alive, it remains some weeks motionless and yet fresh.

"But, perhaps, the ants are the most remarkable of all. They tend their young, they build houses, they make wars, they keep slaves, they have domestic animals; and it is even said that in some cases they cultivate the ground.

"Nor must it be supposed that even now the habits of insects are anything like thoroughly known to us. In spite of Réaumur and De Geer, the two Hubers, and many other excellent observers, there is in this subject still a wide field for patient and conscientious labour; the observations already made have been far from exhausting the mine, though amply sufficient to prove the richness of the ore."

MISCELLANEOUS.

On the Parturition of the Marsupials. By Professor R. Owen.

Professor Owen has communicated to the Academy of Sciences in Paris the following observations on the memoir of M. E. Alix on the above subject, a notice of which appeared in this Journal for April 1865, p. 316.

Having observed an aperture of communication between the median vagina and the urethro-genital vestibule in *Halmaturus Bennettii*, M. Alix draws from this an argument against the passage of the fœtus, in the parturition of the Marsupials, through the lateral vaginæ, which are certainly of extreme narrowness. And, indeed, if we admit this physiology of these complex organs, it would follow that the anatomists who have denied this direct communication in other Marsupials were in error.

But the function of the "lateral loops" (Cuv.) as spermatophorous canals, and that of the "fundus" of the third uterus (Cuv.) as an *embryophorous canal*, is far from being proved by the observation, in a certain species of Kangaroo, that the fundus *en cul-de-sac* becomes converted into a canal in direct communication with the urethro-genital vestibule. Such a physiological view is contrary to the law of the structure of the internal reproductive organs of the marsupial animals.

The order Marsupialia presents a series of modifications of the vagina for the greater part of which the exclusively spermatophorous function of the lateral canals is inadmissible. In the small Opossums (e. g. *Didelphys dorsigera*, the Philanders, &c.) each true uterus terminates in a vagina, reduced to form a lateral loop, which is comparatively longer, narrower, and more twisted than in *Macropus* or *Halmaturus*, and there is no median vagina*. Here, therefore, the fœtus must find its way out by the same extremely fine canals which give access to the semen.

In the larger Opossums (e. g. *Didelphys virginiana*) each uterus terminates in a vagina, the commencement of which is widened out cæcally; but these vaginæ do not communicate with each other, nor does either of them extend to the urethro-genital vestibule†.

In *Macropus* the vaginal diverticula intercommunicate, and the common cavity extends to the urethro-genital vestibule, but without opening into it. This I have ascertained in females of *Macropus major*, which had produced young at least twice.

In *Halmaturus* the diverticulum not only attains the fundus of the urethro-genital vestibule, but opens into it, as has long since been demonstrated‡.

* See Phil. Trans. 1834, p. 133, pls. 6 and 7.

† Catalogue of the Physiological Series, Hunterian Museum, 4to, vol. v. p. 154 (1838).

‡ By myself, in Proc. Zool. Soc. 1852, and Annals Nat. Hist. 2nd ser., vol. xiv. p. 450; also by Dr. Poelman in Bull. Acad. Roy. Belg. tome xviii. p. 599.

Other modifications of the complex female organs of the Marsupials, which have been described* and figured† elsewhere, are equally opposed to the hypothesis of the passage of the fœtus by a median vagina, and prove that, if it ever takes place, it must be by a rare exception, the rule in marsupial parturition being the passage of the fœtus through the lateral loops.

Whilst thus submitting to the Academy the dates and notices of the discovery of an exceptional modification of the median vagina in *Halmaturus Bennettii*, I must remark that the purpose of the anatomical section of my Memoir in the 'Philosophical Transactions' for 1834 was not to confirm a description of Cuvier's, or to refute one of Home's, with regard to an anatomical fact observed in a single species, but to show, by a general review of the entire order Marsupialia, that the parts of generation which both these eminent anatomists had described as *uterine* were really *vaginal*, and that the passage which they called the *vagina* corresponded to the urethro-genital canal of other animals.

To determine the homologies of the complex female organs of the Marsupials was the chief object of my anatomical investigations in 1834. They enabled me to prove that the parts described as Fallopian tubes (Home‡), or as a "small portion of a triple or quadruple uterus" (Cuvier§), were in reality nothing but the homologues of the two distinct uteri, in their totality, of the Rodents; and that the succeeding portions, to which the function of gestation had erroneously been ascribed, were solely efferent, and answered to the vagina of other mammalia.

It is by the aid of these homologies, expounded in 1834 (and at the same time a proof that they have been accepted), that M. Alix is now enabled to speak of *lateral vaginæ* and of a *median vagina*, although, indeed, the latter is absent in many Marsupials and occurs in the form of a *cul-de-sac* in most of those which possess it.

The mode of transit of the fœtus from the vulva to the pouch is of so remarkable a character that I cannot accept the merit, which M. Alix is so kind as to attribute to me, of having foreseen it. It would have been impossible for me to divine the facts *à priori*; and even had I been endowed with so lively an imagination, I should hardly have ventured to present this hypothesis to the Royal Society without the experiments which gave support to it. I never had any suspicion of these facts; they were the pure and simple results of observation.

Having isolated a fecundated female of *Macropus major*, I subjected her to a daily examination until I determined the precise period of gestation. It is true that I did not see the embryo *in transitu*. He must have eyes differently constituted from mine to discern a

* In *Dendrolagus inustus*, Proc. Zool. Soc. 1852, p. 106.

† In *Hypsiprymnus Whitei*, Phil. Trans. 1834, pl. 6. fig. 6.

‡ Phil. Trans. 1795, p. 228.

§ Leçons d'Anat. Comp. tome v. p. 146 (1805).

vermiform body, of 15 millims. in length and 5 millims. in thickness, through the walls of the muzzle of a large Kangaroo, buried at one time in the vestibule, and at another in the bottom of the marsupial pouch. But the transportation of the fœtus and its attachment to the teat being the result of similar operations, I determined to apply to them a new test, by means of an experiment which I proposed to the authorities of the Zoological Society, and for which I obtained their sanction.

A few hours after parturition I removed the young animal from the teat and witnessed the following phenomena :—

The mother immediately showed symptoms of uneasiness, stooping down to lick the orifice of the vagina and bury her muzzle in the vestibule. At length she grasped the sides of the pouch with her fore paws, and drawing them apart, she thrust her head into the cavity as far as the eyes, and could be seen moving it about in various directions in the act of replacing the fœtus*.

I do not know whether a Mr. Bennett has really suspected these facts. It is possible; but M. Alix cites neither work nor memoir. Mr. E. J. Bennett was Assistant Secretary of the Zoological Society in 1834, Mr. N. A. Vigors was Secretary, Messrs. Yarrell and W. S. Macleay were Members of Council; they were all present at my experiments, and accepted the consequences which I drew from them. But not one of these friends (now, alas! no more) flattered himself with having foreseen the results; not one of them pretended to any other part than that of a spectator.

Dr. George Bennett, of Sydney, has furnished me with valuable materials for my investigations, and we are indebted to him for an article on the habits of the *Ornithorhynchus* †; but I am not aware that he has published any notice or memoir upon the parturition of the Kangaroos.

In point of fact, M. Alix only cites an article of an Encyclopædia. If he had consulted original memoirs, from which articles of this nature are usually only abridged compilations, he would have saved me the trouble which I am now taking. If he will permit me to refer him to the first observation on Marsupial parturition published after the Memoir of 1834 in the 'Proceedings of the Zoological Society,' part xii. p. 163 (1844), he will there find the details of an observation of this operation in a Potoroo (*Bettongia*), reported by the late Earl of Derby, then President of the Zoological Society.

I hope that M. Alix will not allow himself to be discouraged by the fact that his supposed anatomical discovery has been anticipated by at least two observers. The field of nature is so vast and so varied, that by persevering in direct cultivation of it, he cannot fail to raise for himself a title to our gratitude by gathering in fruits at once new and solid. But it is very rarely that, by means of an isolated anatomical fact, we can rectify or determine the physiology of a complex organ.—*Comptes Rendus*, April 1866, pp. 592–596.

* See Phil. Trans. 1834, p. 345.

† Trans. Zool. Soc. vol. i. 1834.

New Fluid for Preserving Natural-History Specimens. By A. E. Verrill.

In consequence of the high price of alcohol, a series of experiments was undertaken by me last year, with the view of finding a substitute for it in preserving the soft parts of animals. Among the various solutions and liquids tested were nearly all that have ever been recommended, besides many new ones. Chloride of zinc, carbolic acid, glycerine, chloride of calcium, acetate of alumina, arsenious acid, Goadby's solutions, and various combinations of these and other preparations were carefully tried, and the results made comparative by placing the same kind of objects in each, at the same time. Although each of these, under certain circumstances, have more or less preservative qualities, none of them were found satisfactory, especially when the *colour* and *form* of the specimen are required to be preserved as well as its structure.

As a test for the preservation of colour, the larvæ of the tomato-worm (*Sphinx quadrimaculata*) were used. These larvæ are difficult of preservation with the natural form and colour, nearly always turning dark brown and contracting badly in alcohol and most other preparations.

As a result of these experiments the following solutions were found highly satisfactory in all respects when properly used. By their use the larvæ and recent pupæ of the tomato-worm were preserved and still retain their delicate green colours, together with their natural form and translucent appearance, while the internal organs are fully preserved. Fishes, mollusks, various insects, worms, and leaves of plants have also been preserved with perfect success and far better than can be done with alcohol. In the case of mollusks, especially, the preparations are very beautiful, retaining the delicate semitransparent appearance of the membranes nearly as in life, with but little contraction. Another great advantage is the extreme simplicity and cheapness of the solution.

To use this fluid I prepare first the following stock solution, which may be kept in wooden barrels, or casks, and labelled:—

Solution A. 1.

Rock-salt	40 oz.
Nitre (nitrate of potassa)	4 oz.
Soft water	1 gallon.

This is the final solution in which all invertebrate animals must be preserved. A solution with double the amount of water may be kept if desirable, and called A. 2. Another with three gallons of water will be A. 3.

In the preliminary treatment of specimens the following solution is *temporarily* employed, and is designed to preserve the object while becoming gradually saturated with the saline matter; for in no case should the specimen be put into the full strength of solution A. 1, for it would rapidly harden and contract the external parts and thus prevent access to the interior. Even with alcohol it is far better to place the object for a time in weak spirits and then transfer successively to stronger, and for some objects, as Medusæ, no other treatment will succeed.

Solution B. 1.

Soft water	....	1 gallon.
Solution A. 1	....	1 qt.
Arseniate of potassa	....	1 oz.

Another solution with double the amount of water may be made, if desired, and called solution B. 2.

To preserve animals with these solutions they are, if insects or marine invertebrates, ordinarily placed first in solution B. 1; but if the weather be cool it would be better in many cases to employ first B. 2; and in the case of all marine animals, washing first in fresh water is desirable, though not essential. If the specimens rise to the surface they should be kept under by mechanical means. After remaining for several hours, or a day, varying according to its size and the weather, in the B. 1 solution, it may be transferred to A. 3, and then successively to A. 2 and A. 1; and when thus fully preserved it may be transferred to a fresh portion of the last solution, which has been filtered clear and bright, and put up in a cabinet, when no further change will be necessary if the bottle or other vessel be properly secured, to prevent the escape of the fluid by crystallization around the opening. To prevent this, the stoppers, whether of cork or glass, together with the neck of the bottle or jar, may be covered with a solution of paraffine or wax in turpentine or benzole, which should be applied only when the surfaces are quite dry and clean. The length of time that any specimen should remain in each of the solutions is usually indicated by their sinking to the bottom when saturated by it. In general the more gradually this saturation with the saline matter takes place, the less the tissues contract or change in appearance. In many cases, however, fewer changes than indicated above will be effectual. I have in some cases succeeded well with but two solutions below A. 1. For vertebrates, except fishes, the solution A. 2 will usually be found strong enough for permanent preservation, especially when the object is small or dissected. If the entire animal be preserved, when larger than two pounds in weight, it should be injected with the fluids, especially B. 1 and the final A. 1 or 2, or an incision may be made in one side of the abdomen in vertebrates, or under the carapace of crabs, &c., to admit the fluids more freely. In preserving the animals of large univalve shells, an opening should be made through the shell, at or near the tip of the spire. Mammals, birds, and reptiles should be placed first in solution B. 2 to obtain the best results. In cases where the use of the B. fluids would be objectionable, on account of their highly poisonous nature, a fourth dilution of solution A. 1, corresponding in strength with B. 1, but without the arseniate of potassa, may be substituted, and in many cases will do nearly as well, if the weather be not very hot; but the specimens in this case should be carefully watched and transferred to the stronger solutions as soon as possible, so as to avoid incipient decomposition while in the first fluids.—Silliman's *American Journal*, March 1866.

On the Urticating Capsules of some Polypes and Acalephs. By Karl Möbius.

The urticating capsules are elastic vesicles, which may be compared with simple glands. They have a long efferent duct, which is produced within their cavity, and is appended directly to the outer wall as an inversion of it. As the commencement of this duct bends at first inwards, then upwards and then again inwards, a threefold tube is produced—the *axial body*, the innermost division of which passes over into the filamentous piece, the convolutions of which either surround the axial body or run down beside and below it.

The capsular wall everts the duct suddenly by its contracting elasticity, whenever, being assisted by external pressure, it can overcome the extending resistance of the duct.

The pressure of the capsular wall propagates itself over the whole of the duct through the fluid contents; but its first everting action is exerted in front, at the angle where the middle tube of the axial body bends into the inner one.

The duct is beset with spiral rows of hairs. As long as it remains within the capsule these are turned inwards and present a resistance to the pressure of the capsule, but when it is everted, they stand out and then increase its adhesive power. The everted ducts remain attached to surfaces with which they come in contact, and moisten these with their fluid contents. This produces an urticating pain on sensitive parts of the skin.

Each capsule can only act once. As it remains connected with its everted duct, it is torn out of the skin as soon as the movements of the Polype retract its place of insertion. The lost capsules are replaced by new ones, which are formed below them. They are developed in cells with granular contents and with one or more nuclei.

The long cylindrical urticating capsules are at first bent in their formative cells, and only afterwards become extended. Large axial bodies appear earlier than the filiform end of the duct, which in immature capsules lies regularly twisted on the wall; in mature capsules irregular bendings frequently interrupt the course of the ordinary spiral.

Most of the capsules made use of by Polypes and Acalephs, pass with their food into their own stomachs. Perhaps, when there, they assist digestion. Some Sea-anemones form an envelope for themselves of discharged capsules interlaced together. Many Polypes (*Lucernariæ, Actiniæ, Hydræ*) which change their places, employ urticating capsules during their progression, to enable their tentacles to adhere. As all rough contact induces the Cœlenterata to contract themselves, they discharge urticating capsules whenever they are subjected to an unfriendly attack; and thus these may serve them for defence.

(These statements form the concluding summary of the results detailed in the author's paper in the fifth volume of the 'Abhandl. des naturwissenschaftlichen Vereins zu Hamburg,' 1866, of which he has kindly sent us a copy.)

On the Swimming-Bladder and Sexual Organs of the Muraenoid Fishes. By Prof. Kner.

Professor Kner communicates the results of his investigation of the swimming-bladders and sexual organs of thirty-six species of eel-like fishes. The species examined belong to nineteen of Bleeker's genera, distributed through six families.

The swimming-bladder occurs, more or less developed, in all the examined species and genera of three families—namely the *Anguilloidei*, *Congroidei*, and *Ophisuridi*; whilst it is wanting in the other three families, viz. *Gymnothoracoidei*, *Ptyobranchoidei*, and *Symbranchii*.

The sexual organs are sometimes symmetrical, and sometimes the reverse; in the former case they sometimes show the same structure, resembling that of our common eel, in all the specimens examined, and therefore, as in that species, leave the determination of the sex uncertain, but sometimes exhibit differences of structure in different individuals; so that many species decidedly have the sexes separate. The latter result was also obtained by the examination of several species with unsymmetrical sexual organs, whilst others left doubts upon this point. In a species of the family *Symbranchii* (*Ophisternon bengalense*=*Symbranchus bengalensis*, Bleek.), however, there was on one side a closed ovary filled with ova 1 line in diameter, and on the other side a lobate glandular organ, longer than the ovary, and exactly resembling the testes of *Petromyzon* in appearance. As, however, no spermatozoids could be detected, even under the microscope, the occurrence of hermaphroditism in this case is not strictly proved, although it certainly seems very probable.—*Bericht der Akad. der Wiss. in Wien*, December 14, 1865, p. 207.

Annelida and Turbellaria of Guernsey. By E. Ray Lankester.

The following is a list of the species of Annelida and Turbellaria obtained by the Dredging-Committee of the British Association last summer, off Guernsey and the neighbouring islands. Some of the species obtained have yet to be identified.

Turbellaria.

1. Leptoplana subauriculata, *Johnston.* Firman Bay.
2. —— flexilis, *Johnston.* Firman Bay.
3. Eurylepta cornuta, *Müller.* Herm.
4. Convoluta paradoxa, *Œrsted.* Passim.
5. Astemma rufifrons, *Œrsted.* Guernsey.
6. A. filiformis, *Johnston.* Guernsey.
7. Cephalothrix lineatus, *Œrsted.* Guernsey.
8. Tetrastemma varicolor, *Dalyell.* Guernsey.
9. —— variegatum, *Dalyell.* Guernsey.
10. Borlasia olivacea, *Johnston.* Guernsey.
11. —— octoculata, *Johnston.* Guernsey.
12. Ommatoplea rosea, *Müller.* Guernsey.
13. —— alba, *Thompson.* Guernsey.
14. —— melanocephala, *Johnston.* Guernsey.
15. —— pulchra, *Johnston.* Guernsey.

16. Lineus longissimus, *Simmons*. Herm.
17. —— gracilis, *Goodsir*. Belgrave Bay.
18. —— lineatus, *Johnston*. Belgrave Bay.
19. Meckelia annulata, *Montagu*. Passim.
20. —— tænia, *Dalyell*. Firman Bay.
21. Serpentaria fusca, *Dalyell*. Herm.

ANNELIDA.

Chætopteridæ.

22. Chætopterus pergamentaceus, *Cuvier*. Herm.

Aphroditaceæ.

23. Aphrodite aculeata, *Linnæus*. Guernsey, *d*.
24. Hermione hystrix, *Savigny*. Guernsey, *d*.
25. Lepidonotus squamatus, *Linnæus*. Passim.
26. Harmothoë Sarmiensis, *Lankester*. Passim.
27. —— Malmgreni, *Lankester*. Herm.
28. Antinoë nobilis, *Lankester*. Herm.
29. Halosydna Jeffreysii, *Lankester*. Herm.
30. Polynoë scolopendrina, *Savigny*. Herm.
31. Sigalion Matildæ, *Audouin & Edw*. Herm.

Amphinomaceæ.

32. Euphrosyne foliosa, *Aud. & Edw*. Herm.

Euniceæ.

33. Eunice Norvegica, *Linnæus*. Belgrave Bay.
34. —— Harassii, *Aud. & Edw*. Guernsey, *d*.
35. —— (sp. inc.). Herm.
36. —— sanguinea, *Montagu*. Belgrave Bay.
*37. —— Bellii, *Aud. & Edw*. Guernsey, *d*.
38. Lycidice Ninetta, *Aud. & Edw*. Guernsey, *d*.
39. Lumbrinereis tricolor, *Leach*. Passim.
*40. —— Latreillii, *Aud. & Edw*. Guernsey, *d*.

Nereidæ.

41. Nereis brevimana, *Johnston*. Herm.
42. —— pelagica, *Linnæus*. Passim.
43. —— cærulea, *Linnæus*. Belgrave Bay.

Nephthyaceæ.

44. Nephthys cæca, *Fabric*. Passim.
45. —— longisetosa, *Œrsted*. Guernsey, *d*.

Phyllodocidæ.

46. Phyllodoce lamelligera, *Turton*. Herm.
47. —— bilineata, *Johnston*. Guernsey, *d*.
48. Eulallia viridis, *Linnæus*. Belgrave Bay.
49. —— ellipsis, *Dalyell*. Herm.
*50. —— Parretti, *Blainville*. Herm.

Glyceraceæ.

51. Glycera dubia, *Blainville*. Herm.
52. —— capitata, *Œrsted*. Herm.

Ariciadæ.

53. Nerine vulgaris, *Johnston*. Belgrave Bay.
54. Cirratulus borealis, *Lamarck*. Belgrave Bay.
55. —— tentaculatus, *Montagu*. Belgrave Bay.
56. Leucodore ciliatus, *Johnston*. Belgrave Bay.
*57. Aricia Cuvieri, *Blainville*. Belgrave Bay.
58. Ammotrypane limacina, *Rathke*. Guernsey, *d*.
59. Travisia Forbesii, *Johnston*. Guernsey, *d*.

Siphonostomaceæ.

60. Siphonostoma uncinata, *Aud. & Edw.* Herm.
61. —— (sp. incert.). Herm.

Telethusidæ.

62. Arenicola piscatorum, *Lamarck*. Passim.
63. —— ecaudata, *Johnston*. Herm.

Maldaniadæ.

64. Clymene lumbricalis, *Aud. & Edw.* Belgrave Bay.
*65. —— amphistoma, *Savigny*. Perrelle Bay.

Terebellidæ.

66. Terebella conchilega, *Pallas*. Herm.
67. —— cirrata, *Montagu*. Bordeaux Harbour.
68. —— nebulosa, *Montagu*. Bordeaux and Herm.

Sabellariadæ.

69. Sabellaria anglica, *Ellis*. Guernsey, *d*.

Serpulidæ.

70. Sabella penicillus, *Linnæus*. Guernsey.
71. —— vesiculosa, *Montagu*. Perrelle Bay.
72. Protula protensa, *Grube*. Perrelle Bay.
73. Serpula vermicularis, *Ellis*. Passim.
74. —— (sp. incert.) Herm, *d*.

There are several tubicolar forms which I have not yet satisfactorily identified. Those species in the list to which an asterisk is prefixed are new to Britain, though previously described as occurring in French localities. The *Phyllodoce Parretti* of Blainville has hitherto been obtained only from the Gulf of Genoa, and is therefore peculiarly interesting. The letter *d* indicates that the specimens were obtained by the dredge.

On the "Capture of a Ribbonfish."

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

Gentlemen,—I trust you will allow me to correct the short notice of the "Capture of a *Ribbonfish*," which was given in the April Number of the 'Ann. & Mag. Nat. Hist.' p. 312. It was not taken at West Hartlepool, which is not on the coast of Northumberland, although it is on that of the ancient Northumbria. It was observed about March 1st by a pilot near to Seaton Snook, in the county of Durham, in shallow water on a sand-bank, nearly (if not) dead, and he conveyed it to the neighbouring village of Seaton Carew, where it was shown to many persons.

It was, at first, considered to be the Vaagmër (*Gymnetrus arcticus*); but from its greater size, being 14 feet 7 inches long, it was shown to be a *larger* species.

Mr. Tristram, F.L.S., saw it, and made it out to be *G. Banksii.*

I do not know *that* species, which may probably be synonymous with *G. Grillii*, found in Iceland, or with an intermediate species known to Scandinavian zoologists.

The fish, I was informed, was sent to Leeds to be sold and exhibited; but it never was shown (as far as I can learn, and I was anxious to see it) at Stockton-on-Tees. When taken, it was in good condition, and its colours very bright.

The *Gymnetri* are too rare on our coasts to permit a revision of the species, which is much required.

Yours faithfully,
John Hogg.

Norton House, Stockton-on-Tees,
April 11, 1866.

Notes on the Dactylethræ.

To Dr. J. E. Gray, F.R.S.

Dear Sir,—I saw in the 'Annals of Natural History' an account by you of the *Dactylethræ.*

It is difficult here to tell how much is known on any subject, and therefore your notices of South African animals from time to time have proved of great service to me.

I think, however, that your impressions as to the *Dactylethræ* are not quite correct. I am inclined to think that the beardless, spurless specimens are females; and you can judge from my notes.

Description of Specimen caught in the Koonup River, near the Mancazana Old Post, Fort Beaufort District, S.A.

From extremity of mouth to anus $5\frac{1}{8}$ inches; from second inner toe, without claw, to anus, 5 inches; across the chest at armpit $4\frac{7}{8}$ inches; round the thigh $3\frac{1}{2}$ inches; length of forearm $2\frac{1}{8}$ inches; greatest width across the belly $6\frac{1}{8}$ inches; distance between eyes $\frac{7}{8}$ inch.

Colour.—Ochraceous green on head; olive-green on back, with darker leopard-like spots in rings of heterogeneous shape. Fore legs ochraceous olive-green; hind legs the same, but with a reddish-brown tinge, terminating towards the toes in a rich sienna-brown. Three inner toes armed with black nails; web of feet ochraceous. *No spurs; where the spurs would be, there was a slightly prominent projection.* Anus orange-pink. Belly white, with a pale creamy tinge. Fore legs reddish ochraceous towards their extremities. Lower extremity and hind legs of a dirty salmon-colour, the last joint of the leg and the foot being on the inner side spotted with minute yellow dots. Towards the anus on the under surface there was a silvery line, with pale bluish-grey spots.

No beard under the eyes. The general form of the glands resembles little quilts in the skin: those towards the anus were roundish and tuberculous, and form a little triangular row immediately above the vent; on the belly they were entirely linear. The inner row on the dorsal surface bifurcates into two at the throat, the outer row approaching nearer the eye, and the two inner receding towards the centre. On the dorsal line between the three lateral rows are two minute semituberculate linear glands. In other respects the description accords with yours in the 'Annals.'

Female specimen, with nearly mature ova. Caught in February.

In the Baaken's River, near Port Elizabeth, the commonest kind corresponds to your grey specimens, and is small in size. I think I have seen the same here, but have never minutely examined them. My specimens are in the Museum at Port Elizabeth.

I have seen a specimen similar to that described, only larger and of a much paler and yellower colour, in the Eland's River at Uitenhage. It was feeding on a dead baboon; but I could not capture it. I caught, the other day, a smaller specimen than that described, with very faint spots; but the glands were very large, and almost all quite round. I unfortunately lost it, or I would have described it.

The *Dactylethræ* are called by the Dutch "Platanas," and by the Kafirs "Izeyla." They live at the bottom of muddy pools, or "zeekoe gattes," as they are called here, and are exceedingly voracious; they and the crabs give the fisherman a deal of trouble, by taking his baits when fishing for eels. They are exceedingly slimy and disgusting to handle, and are usually found in deep water. It is amusing to see them rise to take breath; they just pop their heads out, and you hear a piff, as of a jet of gas.

Mr. R. Hallack, of Port Elizabeth, told me that he was much surprised, one wet season, to see numbers about his yard, as there was no pool or stream in the neighbourhood; and he could not conceive where they came from, as he had never seen them before there; nor has he seen them since.

I trust I shall shortly be able to send you some more information. I know nothing about their larvæ. Hoping that this may prove of some interest,

Believe me, dear Sir,
Faithfully yours,
J. P. Mansell Veale.

Eland's Drift, near Adelaide.
March 6, 1866.

On the Occurrence of Bones of Marmots near Graz. By Professor Oscar Schmidt.

In the immediate vicinity of Graz, on the Rainerkogel, about 200 feet above the Mur, an old Marmot-dwelling has been discovered, with the skeletons of four individuals, belonging to three generations.

This discovery, the first and only one of the kind in Styria, leads directly to that diluvial period when, by the extension of the glaciers in the higher regions of the Alps, the Upper Alpine animals and the Alpine flora were driven down into the low grounds, the evidences of which have hitherto been detected chiefly in Switzerland. —*Bericht der Akad. der Wiss. in Wien*, March 8, 1866, p. 46.

Researches upon the Hydrobiinæ *and allied forms; chiefly made upon Materials in the Museum of the Smithsonian Institution.* By Dr. William Stimpson.

The great difficulty of studying the anatomy of the Hydrobiinæ, owing to their diminutive size, has, with few exceptions, caused conchologists to classify them merely from the form and other characters of the shell, and such parts of the animal as can be seen protruded when in motion. Hence rather widely different views have been entertained in regard to their generic relations, some referring a part of them to the genus *Paludina*, others to *Melania*, *Leptoxis*, *Cyclostoma*, &c., while other authors have more properly proposed for the reception of certain types the genera *Amnicola*, *Pomatiopsis*, *Somatogyrus*, &c. Even those who have admitted these new genera, however, still differed in regard to their family affinities, some placing certain of them in the *Melaniidæ*, others in the *Rissoidæ*, *Viviparidæ*, *Littorinidæ*, &c., while still other conchologists proposed to establish for their reception a new family, *Amnicolidæ*.

After a thorough and searching investigation of the whole subject, particularly of the structure of the softer parts and the dentition of many of these types, Dr. Stimpson arrives at the conclusion that these little snails all belong to the *Rissoidæ*, to which they had in part been referred by H. & A. Adams; though he also includes in the family the genera *Lithoglyphus* and *Paludestrina* (referred by those authors to the *Littorinidæ*), as well as several new genera he finds it necessary to establish. He likewise suggests that *Pyrgula*, *Tricula*, *Cecina*, and *Blanfordia* probably belong to this group; while he excludes from it the genus *Barleea*, which had been included by H. & A. Adams.

After thus eliminating the extraneous genera, and including others not previously known to belong to this family, he gives a full and clear diagnosis of the group, by which it can readily be distinguished from the families *Littorinidæ*, *Viviparidæ*, *Truncatellidæ*, *Melaniidæ* and *Valvatidæ*, with which it is more or less nearly allied, or has in part been confounded. He then defines the following six subfamilies, into which the group is found to be naturally divisible:—

1. *Bythiniinæ*, including *Bythinia*, Gray.
2. *Rissoininæ*, including *Rissoina*, D'Orb.
3. *Rissoinæ*, including *Rissoa*, Frém., *Cingula*, Flem., *Alvania*, Risso, and *Onobia*, *Setia*, *Ceratia*, and *Fenella*, H. & A. Adams.
4. *Skeneinæ*, including *Skenea*, Flem.
5. *Hydrobiinæ*, including *Hydrobia*, Hartm., *Littorinella*, Braun,

Amnicola, Gould & Hald., *Bythinella*, Moq.-Tand., *Stenothyra*, Benson, *Tricula*, Benson, *Pyrgula*, Christ. & Jan, *Paludestrina*, D'Orb., *Tryonia*, Stim., *Potamopyrgus*, Stim., *Lithoglyphus*, Mühlfeld, *Fluminicola*, Stim., *Gillia*, Stim., *Somatogyrus*, Gill, and *Cochliopa*, Stim.

6. *Pomatiopsinæ*, including *Pomatiopsis*, Tryon.

The memoir is mainly devoted to the subfamilies *Hydrobiinæ* and *Pomatiopsinæ*. Of the genera belonging to the former, extended descriptions, and excellent outline cuts illustrating the shell, animal, dentition, &c., are given of the typical species of *Amnicola*, *Bythinella*, and the new genus *Fluminicola*. Similar illustrations and a good description are given of the type (*Amnicola lapidaria*, Say) upon which the genus *Pomatiopsis* and the subfamily *Pomatiopsinæ* were founded. The latter type, although a true air-breathing mollusk, living habitually out of water, is shown to breathe by gills, and not, as would naturally be expected, by lungs. He remarks, however, that "it may be said to be amphibious, but only in the sense that *Succinea* and some other terrestrial mollusca are so; that is, it is capable of living for a long time under water." The foot of this type is also shown to be adapted, by a peculiar construction, to a gliding mode of progression in water, and to a stepping motion, aided by the rostrum, when on land.

Further on, he gives an extended description of the subfamily *Hydrobiinæ*, with accurate diagnoses of each of the included genera, full references, synonymy, citations of types, &c. Of these genera, the following are new:—*Tryonia*, Stim., founded upon a new species; *T. clathrata* (probably extinct) from the Colorado desert; *Potamopyrgus*, Stim., founded upon *Melania corolla*, Gould; *Cochliopa*, Stim., founded upon *Amnicola Rowellii*, Tryon; *Gillia*, Stim., founded upon *Melania altilis*, Lea; and *Fluminicola* Stim., founded upon *Paludina Nuttalliana*, Lea.

It is worthy of note that the author has not, as is too often done, gone on to refer by guess, to his new genera, all the little shells that might be supposed to belong to them, but leaves that to be done by others who may have an opportunity to study thoroughly their softer parts, dentition, &c., and determine whether or not they really possess all the characters of the newly founded groups.

Another commendable feature in this memoir is, that the author has in each instance *distinctly stated what species he regards as the types of the new genera*. Every naturalist must be aware that much of the confusion in the nomenclature of natural history has arisen from the neglect of this simple rule in the subdivisions of the group which may afterwards take place, some retaining the original name for one group of the species, and others for others, with no chance of agreement. Many, perhaps the majority, say that in such cases the old name should always be used for the group including the first species, or, in other words, that the first species mentioned or described under the old name should be regarded as its type. Others, however, insist that the original name should be retained for the group including the majority of the species first described or included; while others contend that the type most nearly agreeing with the diagnosis, or which has its characters best expressed in the name itself, should be regarded as the type of the original genus. Still others say that the first author who divides and properly restricts a genus originally founded upon heterogeneous materials has the right to determine, arbitrarily, which shall retain the old name, and which shall receive new ones. Now all such confusion is avoided by simply stating which species is recognized as the type in founding a new genus.—Silliman's *American Journal*, March 1866.

The Placentoid, a new Organ of Anthers. By M. Chatin.

The organ now to be made known has not yet been indicated. The name of *placentoid*, by which we propose to designate it, recalls the analogies of form, position, and, to a certain extent, of function which it has with the placentas of ovaria with axile placentation. We shall consider it under the points of view—

1. Of morphology or organography; 2, of histology; 3, of biology; 4, of taxonomy; and 5, of philosophy.

1. *Morphology of the placentoids.*—These organs, by the place which they occupy in the cells and the forms which they put on, recall the axile placentas of bilocular ovaria. If we make a transverse section of the ovary of a *Solanum* and of one of its anthers, we find in each of the cells of the latter, as in the ovarian cavity, a fleshy body which advances towards the middle of the chambers of the ovary and of the cells of the anther.

In consequence of the considerable space which it occupies in the cells, the placentoid often greatly reduces that left for the pollen, nearly as, in a great many Solanaceæ and Scrophulariaceæ, we see the seeds pressed between large trophosperms and the valves of the pericarp. Sometimes the placentoid advances so far towards the opposite valve as to touch this with its extremity, thus nearly subdividing each cell into two. The section of a young anther thus constructed is subdivided into eight subcells if the anther be complete (*Hemitomus*), or into four if, as in *Salvia* and *Westringia*, the anther should be reduced to a single cell. Some plants (*Justicia flavicoma*) only present placentoids upon one surface of the dissepiment; this organ is consequently wanting in the cell placed on the opposite side.

Like the dissepiment, the placentoids are shaped out of the parenchymatous mass of the young anther.

The duration of the placentoids is limited; they disappear towards the period of the maturation of the pollen, sometimes leaving their traces in the form of two small appendages approximated to the connective by the retraction of the dissepiment which bears them.

To sum up, like the dissepiment, and even still more than this, the development of the placentoids is connected with that of the pollen.

2. *Histology of the placentoids.*—We have always found the placentoids formed by a parenchymatous tissue very similar to that which

forms the dissepiment. Like the latter they admit neither fibres nor vessels; and in this respect their parallelism with the placentas can no longer be traced—just as, moreover, we cannot compare the pollen lying free in the cells, like the spores in the capsules of mosses, with ovules attached to placentas.

In the placentoids we have never observed the so-called fibrous cells which form a part of many dissepiments; it would appear, therefore, that the presence of placentoids, always of a parenchymatous nature, is connected with that of dissepiments of the same histological nature.

The placentoids, like the dissepiments, are usually covered by a fold of the nutritive membrane or third membrance of the anther.

3. *Biology of the placentoids.*—The function of the placentoids appears to be to assist in the formation of the pollen. They originate about the same period as the latter, follow it in their development, and disappear when, as its maturation approaches, they become useless to it, their persistence being even capable of hindering its dissemination.

The essentially parenchymatous structure of the placentoids, and the nutritive membrane which clothes them, and of which they thus serve to multiply the surfaces or points of contact with the pollen, are evidently conditions appropriate to the part which we ascribe to the new organ. We are, moreover, the more struck with the utility of an organization which has the effect of bringing nutriment everywhere within reach of the body to be nourished, as the latter (the pollen) does not, like the ovules, receive its nourishment by continuity, but indirectly and by simple contiguity.

4. *The placentoids in their relation to taxonomy.*—When a new organ is discovered in plants, it becomes necessary for the history of this organ to inquire what relations of existence it may possess with the natural divisions of the vegetable kingdom. This first point being determined, it will become possible to appreciate the signification of the existence of placentoids in its relations with the various degrees of organic elevation of species of plants.

Placentoids exist in no monocotyledonous plant. Among the Dicotyledons, the Dialypetalæ (Monochlamydeæ and Thalamifloræ) are also destitute of placentoids. The same might be said of the Calycifloræ if we had not observed these organs in *Cassia marilandica*. There remain the Corollifloræ; and it is in a certain number of families of this class that we have found the anthers to be habitually provided with placentoids, which exist

In the *Gentianaceæ* (*Chlora, Chironia*);

In the *Solanaceæ* (*Atropa, Habrotamus, Hyoscyamus, Lycopersicon, Solanum, Witheringia*);

In the *Scrophulariaceæ* (*Hemitomus, Pedicularis, Verbascum*; not in *Veronica* and *Chelone*);

In the *Labiatæ* (*Salvia, Rosmarinus,* and *Westringia,* genera with unilocular anthers; and *Lamium, Leonurus,* and *Marrubium* with perfect anthers);

In the *Acanthaceæ* (*Acanthus, Justicia,* &c.);

And, lastly, in some *Orobancheæ* (*Lathræa*; not in *Orobanche* and *Phelipæa*).

The following families, also belonging to the Corolliforæ, appear to be destitute of placentoids:—the *Gesneriaceæ*, *Polemoniaceæ*, *Apocyneæ*, *Convolvulaceæ*, *Primulaceæ*, *Plumbagineæ*, and *Plantagineæ*.

It is remarkable that among the Corolliforæ the orders with labiate flowers are most frequently provided with placentoids.

The presence of placentoids appearing to be in relation with organographic characters, it will be easily understood that it may be made use of as a complementary character in the investigation of natural affinities.

5. *Philosophy of the placentoids.*—Under this head we might consider the placentoids from several points of view, recurring to their biological part, &c.; but I circumscribe the question to this single point, the appreciation of the existence of placentoids with regard to the measurement of the organic gradation of vegetable species. It may be said, by reference to the facts acquired by science, that to put the question is to solve it.

In fact it is admitted (and the evidence is superabundant) that the Monocotyledons are less elevated in organization than the Dicotyledons. Now the Monocotyledons have no placentoids.

With regard to the Dicotyledons, the question of gradation among their classes, long under discussion, seems to have at last arrived at this solution:—The gamopetalous plants are of a higher order than the dialypetalous species; and among the former the families with the ovary united to the calyx must occupy a place below those with the ovary free—that is to say, below the Corolliforæ. Now we have proved the general existence of placentoids in the Corolliforæ. Hence these organs are an attribute of the plants which are most elevated in organization.—*Comptes Rendus*, January 29, 1866, pp. 215–218.

On the Method of Flight of the Flyingfish.

By Horace Mann. [*In a letter to F. W. Putman.*]

I have been watching the flyingfish to-day. They are very abundant; and though you may know all about them from persons more competent to see and describe than I, yet I venture to send you a few notes on them in my journal. I had supposed that they must acquire some considerable momentum below the surface before rising above it, and for that reason wished to see if the motion of the fish immediately after leaving the water was more accelerated than during the later portions of its flight (for it is obviously a true flight). I think that I have been able to discover some slight differences in the rates of motion immediately after leaving the water and later in their course; but I also think their motion is kept up by the fins, and also that the weight is sustained by them. They do not appear to leave the water at a large angle, but otherwise—as near as I have been able to judge, about 5° or 6°. They plainly have the power of altering their course of flight, so far as rising and falling, as I have seen them go over the rising surface of a not very high wave, and their flight is also almost always slightly dipping. I have also thought they sometimes altered their course to the right or left without touching the surface of the water; but it may have been owing to the wind. They will often barely touch the surface of the water, and rise again, keeping on in the same or an altered course. There went a shoal of a dozen or twenty this very minute, rising and falling slightly, and entering the water and issuing from it again and again, and altering their course, for the distance of seventy-five to one hundred yards. The motion of the fin is *not always* steady, as I have seen when they rose near the ship and the sun struck favourably upon them; for in those cases the motion was intermittent in velocity, though kept up all the time, and might be represented by a line more or less shaded. I have observed them fly thirty or forty yards without touching the water, though I should say usually they would not go more than half that distance. They do not usually rise much over a foot above the surface of the water, often much less, though one was said to have come on board the other day, and to do that, I should think, must have risen at least eight or ten feet.—*Proc. Boston Soc. N. H.* x. p. 21.

On some Marsupial Fishes. By L. Agassiz.

Professor Agassiz states that at Teffé he discovered several species of the family Chromidæ which carry their eggs at the bottom of the mouth in a marsupial pouch formed by the superior pharyngeal bones and the anterior cavity of the first branchial arch. This apparatus is furnished with numerous nervous filaments, which spring from a special inflation of the medulla elongata immediately behind the cerebellum. This inflation resembles the electrical lobe of the *Malapteruri*. Other species carry their eggs in the folds of their lips, such as the *Loricariæ*; others, such as the *Hypostomi*, hatch theirs like birds. . . . . The changes of form undergone by the young fish are very instructive as regards classification. A Scomberesocid of a new genus has jaws resembling those of *Belone*; but when young, the upper jaw is so short that it might be taken for a *Hemirhamphus*.—*Ann. Sci. Nat.* 1866, tome v. p. 228.

On the Occurrence of an Internal Convoluted Plate within the Body of certain Species of Crinoidea. By James Hall.

During the investigations upon the *Crinoidea* of the Carboniferous Limestones of Iowa, there were discovered in the broken bodies of several species a vertical convoluted plate, filling a large part of the cavity of the body. At that time I showed several of these specimens to Prof. Agassiz, who informed me that he had observed a similar convoluted plate in the body of *Comatula*.

This convoluted intestinal plate was first observed in the body of *Actinocrinus pentagonus*, and afterwards in *A. longirostris*, *A. erodus*, *A. Verneuili*, and in a species of the type of *A. um-*

brosus. In several of the specimens (and this is apparently true of all the *Actinocrini*), the opening into this convoluted sac is wider at the apex, and becomes gradually attenuated below and pointed toward the centre of the basal plates, where it is attached. The lower portion is twisted not unlike the lower portion of some univalve shells, and this organ in one specimen presents a very close resemblance to a small *Bulla* or similar shell. In *Actinocrinus longirostris* this organ is proportionately very large, the sides straighter and less curved, and very wide at the top.—*Proc. Boston Soc. N. H.* x. 33.

On the Fossil British Oxen.—Part I. Bos Urus, *Cæsar.* By W. Boyd Dawkins, Esq., M.A., F.R.S.

The problem of the origin of our domestic races of cattle was considered by the author to be capable of solution only after a careful examination of each of the three European fossil species of Oxen, namely, *Bos Urus* of Cæsar, *B. longifrons* of Owen, and *B. bison* of Pliny. In this paper he began the inquiry with *Bos Urus,* Cæsar, being the *Bos primigenius* of Bojanus, and he arrived at the conclusion that between this species and *Bos Taurus,* or the common Ox, there is no difference of specific value, though the difference in size and some other characters of minor value render the bones of the two varieties capable of recognition. After giving the synonymy of *Bos Urus* in some detail, and measurements of the different bones as represented by specimens from a number of localities, Mr. Boyd Dawkins described the range of the species in space and time, showing that it coexisted in Britain with the Mammoth, *Rhinoceros leptorhinus, R. megarhinus,* and *R. tichorhinus,* and was associated with *Elephas antiquus, Felis spelæa, Ursus spelæus, U. arctos, Bos priscus, Megaceros Hibernicus, Cervus elaphus, C. tarandus, Equus fossilis,* &c., and held its ground during the Prehistoric period, after most of these animals had become extinct or retreated from this country. The precise date of its extinction in Britain was stated to be somewhat uncertain, although the author inclined to the belief that it existed in the wild state as late as the middle of the 12th century; while on the continent it seems probable that it lingered until the 16th century. The author then endeavoured to explain its gradual diminution in size by the progressive encroachment of cultivation on its old haunts; and in conclusion stated his belief that at least the larger cattle of Western Europe are the descendants of the *Bos Urus,* modified in many respects by restricted range, but still more by the domination of man.—*Proc. Geol. Soc.* March 21, 1866.

Note on the Presence of Teeth on the Maxillæ of Spiders. By Miss Staveley.

I do not find in Dr. Blackwall's 'Monograph of the British Spiders,' or in M. Simon's 'Histoire Naturelle des Aranéides,' or in any other work which I have had an opportunity of consulting, that the occurrence of teeth on the maxillæ of Spiders has been noticed.

On the maxillæ of six out of seven Spiders which I have examined, belonging to various genera, there is a row of very regular and perfectly formed teeth on the outer edge of the extremity of the maxilla. These teeth vary slightly in form in the different species, and the first of the row is sometimes unlike the succeeding teeth. The species examined were:—

Agelena labyrinthica, ♀.
Salticus scenicus, ♀.
Theridion nervosum, ♀.
—— *lineatum*, ♀.
Theridion quadripunctatum, ♀.
Epeïra callophylla, ♀.
Tetragnatha extensa, ♀.

Of these only one of the Theridions showed no teeth; but the specimen was not satisfactory, being ill prepared and mounted. The jaw of one (*Agelena labyrinthica*) presented an appearance of a second row of teeth, forming a waved line running down the surface of the maxillæ, and quite distinct from the marginal row; but as this occurred in no other species examined, nor even in another individual of the same species, as it seemed much less substantial than the marginal row, and presented other suspicious appearances, and as the specimen was prepared and mounted before the teeth were observed, I cannot be sure, without the examination of other specimens, that this is a genuine row of teeth. Unfortunately the fellow jaw was thrown away without being looked at.

Fig. 1.

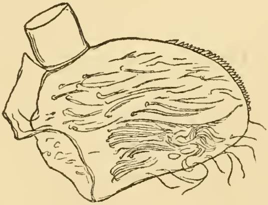


Fig. 2.

Fig. 1. The jaw of *Agelena labyrinthica*, magnified.
2. The beginning of the row, more highly magnified.

In one or more specimens the teeth appear to have been worn or broken by use. All the specimens referred to are mounted in Canada balsam, and are now in the collection of the British Museum*.—*Proc. Zool. Soc.* 1865, p. 673.

* [Since this paper was read, Miss Staveley has examined several other species of Spiders, and found these teeth developed in all of them.—J. E. Gray.]

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 102. JUNE 1866.

XLIV.—*On the Anatomy and Physiology of the Vorticellidan Parasite* (Trichodina pediculus, *Ehr.*) *of Hydra*. By Prof. H. James-Clark, A.B., B.S.*

[Plates VIII. & IX.]

There can be no doubt that a large amount of the diversity of opinion in regard to the general and classificatory relations of animals arises from the lack of a correct knowledge of the intimate structure of the subject under controversy. This is especially applicable to the lower forms of life, and above all to the fifth and lowest grand division of animals—the Protozoa. Theories which are based upon insufficient observations and a misconception of facts not only present a distorted view of nature, but mislead and give a wrong direction to the tendencies and currents of scientific research. The theory of the unicellular nature of Infusoria—so acutely upheld by the arguments of Siebold and Kölliker, and especially by the latter in his papers on the Gregarinidæ† and on *Actinophrys*‡—had no small influence in blinding the mental vision of subsequent investigators, and long delayed the conclusion (strangely enough, too, seemingly favoured by Kölliker himself) that it is not essential to the constitution

* From the memoirs read (Oct. 18, 1865) before the Boston Society of Natural History, vol. i. part 1. Communicated by the author.

† Beiträge zur Kenntniss niederer Thiere (Zeitschr. für wiss. Zool. Bd. i. (1848–49) p. 1.

‡ Das Sonnenthierchen, *Actinophrys sol* (Zeitschr. für wiss. Zool. Bd. i (1848–49) p. 198. In some remarks upon *Actinophrys* which I took occasion to make at a meeting of the Boston Society of Natural History (see Proceedings for September 16, 1863), I stated that the so-called vacuoles of the Actinophrys (*A. Eichhornii*) are "true cells with a distinct wall about them." In a new work (Mind in Nature; or, The Origin of Life and the Mode of Development of Animals: New York, 1865) just issued from the press, I have reiterated this statement, and given still further details of the anatomy and physiology of *Actinophrys*.

of a *cell* that it should possess a tangible, distinctly differentiated envelope.

At the present day we may safely consider every one of the minutest centres of organic development and action as so many individual cells (not only potentially, but as essentially so as are any of the most decidedly wall-bound cells of the highest kind of tissue), and yet not become liable to the accusation of leaning toward a visionary method of investigating or interpreting the phenomena of nature. It really seems as if the much-abused spirit of Oken were about to have its revenge, and the prophetic vision of that immortal genius were soon to be realized by the eyes of the philosophers of the present day. Happily, among the rising generation of the naturalists of this country, a growing independence of thought and action—too long under the shade of the upas tree of fictitious authority, and allured by the deceitful and fascinating exterior of superficial, glittering, swift, and hasty generalization—is leading to this result with rapid strides.

Neither the genius of a Spencer nor the incomparable ingenuity and tact of a Tolles are able to increase the availability of the microscope as rapidly as the requirements of scientific progress demand; and if one would see beyond the mere optical image of the instrument, he should, by careful and judicious treatment, train the eye to develope to the requirements of the occasion. It must become to him a sliding-scale of adjustable optical powers. The tutored eye of Ehrenberg saw far more than the microscopes of his earlier days could help him to discern. The truth of this is especially observable in the surpassing naturalness and life-like character of his illustrations, so often superior to the delineations of his more modern compeers. When we have combined the effect of the former with the more accurate details of the latter, we shall then, and not till then, have arrived at an honest representation of animal life, and have laid a firm foundation for a series of deductions and generalizations whose influence shall be felt beyond the brief flitting period in which they were produced.

That investigation which, although confined within a narrow circle, is the most thorough, and at the same time truthfully recorded, is far more valuable for the future than a course of observations which extends over a larger field and is carried out on a grander scale, but lacks the element of completeness. A thorough and elaborate study of one single species will carry the possessor of such knowledge immeasurably deeper into the secrets of life, and inconceivably further along the road of progress, than a superficial, lightly tripping survey of the whole kingdom of animals. In the former case, for each newly discovered fact the naturalist takes one step higher on the hill of science, whilst in the latter he is for ever trying to get the first foothold in the ascent.

Of all the Protozoa, there are none which have so great a claim upon the naturalist's time for investigation as the Vorticellidæ. The want of a precise understanding of their structure led, in the first place, to their being classed with the Zoophyta, and (simply on account of their similarity in form) among the Hydras. This was the first retrocession. After Ehrenberg had promulgated the opinion that they possessed a distinct intestine, whose two ends approximated each other, we find Van der Hoeven, in the second edition of his 'Handbook of Zoology,' comparing them to the Bryozoa, and avowing his belief that their future place will be among the lowest groups of Mollusca. Here we have a still deeper plunge into the vortex of confusion—not so much, however, if at all, to the discredit of the Dutch naturalist as to that of those who came after him. The apparent similarity of the organization of the Vorticellidæ to that of the Bryozoa was no small warrant for his suggestion; but after almost every microscopist of any degree of reliability who looked at these infusorians had disproved and denied the presence of the intestine so elaborately set forth by the Berlin micrographer, and nothing was left but a mere resemblance in outward form to the Bryozoa, it was, to say the least, a very far-fetched comparison when Professor Agassiz homologized them with the Mollusca, declaring that he had satisfied himself of the "propriety of uniting the Vorticellidæ with Bryozoa."

Ere this, too, Lachmann (Müll. Archiv, 1856) had shown that the whole group of ciliated Infusoria possess a conformity of organization altogether unlike that of any other. The profound researches of this early-lamented observer left no doubt as to the dissimilarity between the Vorticellidæ and Bryozoa. Here was, at last, a step taken in the right direction; and when this author, in connexion with Claparède, published the 'Etudes sur les Infusoires et les Rhizopodes,' the climax of proof was attained in the abundance of details presented in that remarkable volume. Among the many questions which are discussed in that work, that of the unicellularity of the Infusoria receives a considerable share of attention; and a decided ground is taken in favour of their *pluricellularity*—not so much, however, on account of their being known to consist of more than one cell as of the fact of their possessing such a variety of organs and performing so many diverse functions.

The greatest variety of this kind is most elaborately exemplified by the group of Vorticellidæ; but yet it rises, from the lowest of the class, through such insensible grades, that the relations of the type and of the two extremes are never lost sight of amid the growing complexity of the organization.

Among the many forms which more than usually excite the interest of the observer, there is no one in the whole class of Protozoa that surpasses the allurements of the remarkable creature which forms the subject of the present memoir. This is accounted for by a twofold reason,—in the first place, because it possesses such an unlooked-for degree of complication in its organization; and secondly, because it seems to stand intermediate between the two great groups of Ciliata—the *dexiotropic* on the one hand, and the *læotropic* on the other. The transitional forms in all departments of the animal kingdom are eminently suggestive, but none more so than the genus *Trichodina*. Combining in one animal the typical forms of two groups, and yet so singularly individualistic as to be confounded neither with the one nor with the other, the elaborate solution of the relations of the various members of its organization to each other, and the tracing of their homologies with those of the groups on either side, engage the attention no less deeply, and none the less worthily, than if it were occupied in the investigation of the most profound philosophical problem.

An attempt, therefore, at a full life-history of this animal becomes an effort at something more than a mere specific description without an aim; and whatever apparent triviality of detail there may seem to be in it, the consciousness that no one part of an organization is without relation to some other part leads the author to the opinion that an investigator should never undertake to assume what is of importance and what is not. It is no unfrequent occurrence that what at one time has been deemed worthy of very slight consideration, becomes at another the paramount object in a course of scientific research. Nature is not to be represented in full detail by the broad touches and counterfeiting portraiture of a Vandyck, howsoever striking and suggestive the likeness may be; in order to bear a closer inspection, her image must needs be mapped and copied by the more matter-of-fact hand of the humbler Flemish artist.

§ 1. Habitat.—This species (Pl. VIII., *Trichodina pediculus*, Ehr.) is found in great abundance creeping over the body, and even to the tips of the tentacles, of our common brown and green freshwater Hydras (*H. fusca* and *H. viridis*, Trembley). Oftentimes it may be seen with the middle of its base applied directly over the centre of a group of nettling-organs, the former fitting the latter like a cap, and without seeming to disturb the Hydra in the least.

Notwithstanding the apparent rigidity of the chitinous uncinate ring of the base, the latter possesses the greatest degree of flexibility, and an unlimited adaptability to whatever surface it may come upon, no matter how uneven it happens to be. The intimate structure of the chitinous ring does not interfere in the least with, but on the contrary appears to assist in, the flexures of the base. The latter is always the point of attachment; and upon this part of the body the animal may be seen, almost at all times, gliding to and fro like a miniature cup (figs. 1, 2), now on the upper side of a Hydra, and then on the lower side. At one moment several individuals are crowded together on a tentacle, and in the next instant scattered along its length from base to tip, and giving to it a singular, irregular, changeable outline. At times the Hydra seems to be strangely knotted, and ungainly in outline, when, upon close examination, we ascertain that it is crowded with a swarm of Keronas, upon several of whose convex backs one, two, or three Trichodinas are seated, enjoying the pleasure of locomotion without the effort of producing it. Not unfrequently an individual may be seen to leave its reptant mode of progress and take to the surrounding element. Then it swims, at times very swiftly, either in a fully expanded state, or half expanded (fig. 4), or even shortens its length so much that its body resembles a wheel (fig. 5) rolling on its axis, or turning end for end and performing a series of somersaults with great rapidity. Presently it returns to its more quiet mode of life, sliding spectre-like over the animate surface which forms its principal field of operations. During its act of reptation it revolves very slowly upon its longitudinal axis, as if upon a pivot, and most frequently, if not always, wheels to the right.

§ 2. Specific Relationship.—When looking at perfectly fresh and lively specimens of this Infusorian, one can hardly believe, at first, that their deep, cyathiform, dicebox-like bodies (figs. 1, 2) are specifically identical with the straight and broad cylindrical forms which are figured by Ehrenberg and Dujardin, or with the turban-shaped bodies which are illustrated in the papers of Stein and Busch; but when, upon prolonged investigation, we see that the least interference with their freedom of motion causes them to assume a depressed form and a partially retracted margin, we recognize their close resemblance, at least, to those of the above-named authors. The former state represents nature in reality; the latter exhibits her in a disguised shape. It is therefore with no small degree of reluctance that one concludes to identify the flexible, irregularly funnel-shaped, conspicuously asymmetrical body of the American Trichodina with the seemingly stiff, precisely outlined, cylindrical or conical figures illustrated in European works; but a careful study of this under various conditions, both in regard to space for movement and the quality of the water, inevitably leads to the conclusion that the European figures represent the creature in an abnormal, or at least a more or less restrained condition, certainly not in a perfectly healthy state.

If a Hydra, upon which some of these animals are living, is transferred to a flat watch-glass, and the water is frequently renewed, there is not the least difficulty in studying this Infusorian whilst in its fullest degree of expansion, and even with a magnifying-power of at least five hundred diameters. In fact it is absolutely necessary that the body should be fully expanded, in order to understand the relation and nature of certain parts of its organism—especially the vestibule and œsophagus, and the contractile vesicle. In a semiexpanded state of the body these parts are confused, and it becomes impossible to ascertain their character with even the least degree of satisfaction. It is on this account that neither the figures of Stein nor those of Busch give the faintest idea of what the anterior region of *Trichodina* is like; and we actually get a better and truer impression of its character from the almost forgotten illustrations of Ehrenberg than from the more modern and what ought to be more correct delineations of this animal.

§ 3. Form.—The form of the body is like that of a heavy wine-glass (figs. 1, 2, 8, 14) with a very thick and but slightly expanded base. The plane of the margin of the front, *i. e.* the peristome (d^1), lies parallel with that of the base, or "adherent organ," and nearly at right angles to the axis of the body. The *disk* (c, c^1), or area encompassed by the vibratory crown (b), is deeply depressed, so that the anterior end of the body, not only externally but internally, is truly *cyathiform*. In fully expanded individuals the depression of the disk extends nearly to half the depth (at c) of the body, and occupies at least nine-tenths of the diameter of this region. At times the animal suddenly recurves the edge of the cup nearly back to its base, and exposes the bottom of this hollow in a most convincing manner (fig. 6). In partially contracted individuals (fig. 10), the bottom of it becomes elevated, and projects like a boss (c) more or less beyond the inrolled vibratile organ (b). This is the condition (with the vibratory cilia more or less projecting) of those figured by all observers, and especially by Stein and Busch, and a form which the creature very frequently assumes when in a confined state.

It is an easy matter to see that their natural and accustomed shape is as we have represented these animals—if one studies them undisturbed, as they creep over the body of a Hydra which is attached to the side of an aquarium. With a Wollaston doublet, magnifying thirty diameters, or even a Tolles triplet, magnifying seventy diameters, one may, with great facility, survey, through the glass sides of an aquarium, the whole body of a Hydra, and watch the movements of the Trichodinas which infest it. Under these conditions it is no exaggeration to say that it is very rare to meet with a Trichodina whose disk protrudes (and that only momentarily) beyond the plane of the vibratile crown; on the contrary it is sunken far below this plane, thus rendering the region about this part of the body singularly transparent, light, and airy. This effect is very much enhanced, moreover, by the excessively transparent filmy exterior wall (*p*) which projects, very prominently in profile, between the two ends of the body.

The contour of the body behind the spiral vibratile crown (*b*) is singularly irregular, especially in a transverse direction. A sectional view (fig. 9) presents the form of an irregular circle with various projections, inwardly and outwardly, from its main course. This arises from the fact that the body is fluted and ribbed exteriorly by irregular longitudinal furrows and projections (Pl. IX. fig. 14, *r*, *r*), which extend from one end of it to the other. The ribs (*r*) arise with a broad expanse immediately behind the anterior ciliated margin (d^1), and gradually narrow toward the mid length, and then more gradually expand to a much less width at the posterior end. At first one is impressed with the idea that they are longitudinal muscles; but as they are more carefully examined, they do not appear to be anything but mere thickenings and folds of the body-walls.

The principal cause of the one-sidedness of the body is the protrusion of the region (figs. 8, 11, 13, *d*, d^3) about the mouth (*m*) of the vestibule (*v*), transforming the circular outline of the vibratile organ (*b*, b^1) into a broad oval figure when this ciliated margin is foreshortened (fig. 13) and brought into focus with that part which winds spirally downwards and into (at b^2) the aperture of the vestibule. In the form of the disk, and the circumambient spiral vibratory crown, we are reminded rather of *Stentor* than of the Vorticellidæ; nor would it be amiss to suggest here that, in this respect, *Trichodina* stands intermediate between the Vorticellidans and the group (Bursarinæ) to which *Stentor* belongs.

Owing to the presence of the reproductive organ (*n*), and the so-called "adherent apparatus" (fig. 10, *h*, *i*, *l*, l^1), the expanded circular base is even more conspicuous than the discal end. It most frequently presents itself as a rather abruptly widening, perfectly circular, disciform expansion whose plane trends transverse to the axis of the body. It varies in form more or less, according to the surface over which it is creeping—at one moment sunken (fig. 14) like a cast into a depression of the body of the Hydra, and at the next instant assuming the reverse form (fig. 10), and embracing some projecting group of cnidæ, or as it were wrapped around the parietes of an extremely elongated tentacle. As a further extension, the base is margined by an annular membrane, or *velum* (f, f^1), and a single row of cilia (g); both of which serve to render it more conspicuous, and give to this region of the body the appearance of greater weight and firmness.

§ 4. THE PREHENSILE ORGANS.—The motory organs appear to be divided into two groups, of which one is very active in character, and the other is comparatively passive and resistant. The members of the former group are the vibratile cilia and *velum*; and those of the latter constitute the "adherent organ."

The vibratory crown.—The vibratile cilia occupy two widely separate parts of the body, in one place fulfilling the office of purveyors of food, and in the other acting as organs of locomotion in the strictest sense. The former are the true prehensile organs, and, with the margin to which they are attached, constitute the so-called "*vibratory crown*" (b, b^1, b^2). This organ lies, in the form of a nearly flat spiral, at the anterior end of the body, and borders the edge of the cup, which forms the principal part of the front. It therefore rests on the periphery of the *disk* (c, c^1, c^3), so that a delineation of the one defines the contour of the other. The spiral commences (b^1) at the extreme right of the front, and, sweeping around ventrally and just before the edge of the mouth (m) of the vestibule (v), passes to the extreme left, and thence along the dorsal edge of the cup, whence it passes toward its starting-point on the right, but a little exterior to it, so as to overlap it. Thus far it follows the edge of the cyathiform disk, and forms a distinct border throughout its circumference; but in passing to the termination of its course it runs along the extreme brink of an inclined plane (figs. 11, 12, c^4) which rests on a cornice-like projection that extends obliquely across the body, from the right, slightly backwards, toward the left, as far as the aperture (m) of the vestibule, and then rapidly narrows and becomes blended (fig. 13, d^4) with the body beyond. In fact the vestibule (v) is buried for its major part in this oblique projection, and opens at the widest or terminal part of the inclined plane which forms the anterior face of the latter. Consequently the vibratory crown, when following the border (d^3) of this plane, passes exterior to, and along the ventral side of, the aperture of the vestibule, but, instead of going beyond it, gradually approximates to it, and finally entering at its left side, and taking an oblique course toward the right, plunges to its very bottom, in one unbroken, single line (Pl. IX. fig. 13, b^2).

In the true Vorticellidæ the disk is a prominently marked organ, and is more or less elevated above the annular peristome whereas in the *Trichodina* before us the peristome (d, d^1, d^3, d^4, d^5) is not a closed circle, but is blended with the spiral margin of the disk (c, c^1, c^3, c^4); or rather the *disk*, instead of projecting beyond the rest of the body, is sunken (c, c^1)—invaginated, as it were—and has a deep cyathiform contour, and its margin is only separated from the peristome (fig. 15, d^1) by the slight furrow (b^3) in which the cilia (b) of the vibratory crown are implanted. This relationship is strikingly exemplified in another way; for when the animal is contracted (fig. 10) and the peristome (d^1, d^2) rolled inwardly, the vibratile row of cilia (b) is not to be found at the bottom of the enclosed space, as is the case when the like phenomena occurs in *Vorticella, Zoöthamnium, Carchesium,* and *Epistylis,* but hangs down into that space, like a fringed curtain, from the inrolled edge of the peristome. The distinction between disk and peristome is therefore no more marked than in *Stentor*; and, in consequence of the relation of the two, the peristome, instead of traversing the ventral side and forming a complete ring as in the true Vorticellidæ, descends, with the vibratile organ, to the mouth of the vestibule, and then vanishes in the general surface of the body.

The vibratile cilia (b) of this organ are very long and slender thread-like bodies, which stand in close rank, in a single row. They arise from the bottom of a slight furrow (fig. 15, b^3) which extends along the inner side of the peristome (d^1), from its beginning (b^1) on the right, throughout its first turn (d^5), and thence to its termination (d) at the left margin of the aperture of the vestibule. They usually incline in the direction which leads toward the mouth and along the margin of the disk (*i. e.*, throughout the extent of the first turn of the spiral), and they at the same time spread outwardly as if in continuation of the curve of the cup; but occasionally they incline toward the centre of the depressed disk, and produce a vortex therein by their combined action.

The œsophageal cilia.—The vibratile cilia which line the œsophagus (o, o^1) and seem to be continuous with those of the vibratory crown (b) which enter the vestibule, are much more delicate and shorter than they; and although they perform an analogous duty in the preparation of the food before it is finally taken into the general cavity of the body, yet, inasmuch as they are occupied in the more special office of moulding the intussuscepted matter into nutritive pellets, they in all probability are to be looked upon as belonging to a separate system from those of the vibratory organ.

The so-called *bristle of the vestibule* of Vorticellidæ, which was first described as such by Lachmann (Müll. Archiv, 1856,

p. 348, taf. xiii. figs. 1–5, *eg*), *is an optical illusion*! It was almost by accident that we were induced to doubt the character of this seemingly definite body. After having successfully followed two rows of cilia from the stem of the rotatory organ into and to the very bottom of the vestibule of an *Epistylis* (*E. galea*, Ehr. ?), it seemed very strange that the "bristle of Lachmann" had not been met with during such a close and searching scrutiny. Recalling its position, as described by Lachmann and by Claparède, and as we thought we had seen it on former occasions, it was observed that, whilst one of the rows of cilia, which had just been traced into the vestibule, occupied its right side, the other row was in the position of the so-called bristle; *i. e.* it trended along the left side of the vestibule. Occasionally it was noticed that both the right and left rows of cilia had the appearance of single vibratory lashes, and that the left row, where it ran out beyond the aperture of the vestibule and thence upon the stem of the rotatory organ, had a particularly strong resemblance to a single lash or bristle, especially when the cilia projected toward the eye, so as to foreshorten the whole row. In the latter case it is easy to see how, when the cilia vibrated in regular succession, they would produce the effect of an undulating line. The closest scrutiny with a Tolles one-eighth-of-an-inch objective and a B ocular (equalling a magnifying-power of 750 diameters) utterly failed to discover the least trace of anything else which might correspond to the so-called vestibular bristle; and it was therefore fully determined upon that there is no such body existing in the vestibule of the *Epistylis*. The same observations were also made upon another species of *Epistylis* (*E. grandis*, Ehr. ?), and upon *Carchesium* (*C. polypinum*, Ehr.) and *Vorticella* (*V. nebulifera*, Ehr.), with the same result.

Notwithstanding this forewarning, it was very difficult to dispel the illusion when the vestibular cilia of *Trichodina* were under investigation. If one observes attentively, however, it will be noticed, in the first place, that what appears to be a single cilium or bristle never projects beyond the *tips* of the cilia, which lie outside of the aperture of the vestibule; and secondly, that when the tips of these cilia are followed along with the eye the row appears to terminate abruptly, and exactly at that point there seems to be the end of a bristle; *i. e.* the tip of the latter ends just where the line of ciliary points terminates; *the two are coincident*! Sometimes the point of coincidence is seen opposite the left side of the vestibular aperture, at other times opposite the middle of the same, or considerably to the right of it. Again, this point of coincidence appears to run rapidly from left to right, and then back again from right to left, as if the tip of the bristle were sweeping along the row of cilia and pushing them back in succession. In addition to this, it will be noticed that the end of this false bristle varies in thickness from moment to moment during the shifting of the point of coincidence; and finally it may be remarked that it frequently seems to be broken into a series of dots, or short irregular pieces. This last feature gives the clue to the mystery. The apparently disjointed pieces of the tip of the false bristle are nothing more or less than the foreshortened points of the closely approximated successive cilia as they project towards the eye during the descent of the row into the vestibule. The point of coincidence mentioned above is the place where the row bends abruptly towards the aperture of the vestibule; and the shifting of this point is the changing of the trend of the ciliary tips. The line of attachment of the cilia is not changeable, and it may be readily traced to the bottom of the vestibule; but the cilia, whilst projecting at various and constantly diversified angles from their base of attachment, are so disposed that their approximated tips form a frequently varying undulating line. That the "bristle" sometimes unaccountably disappears during observation, arises from the fact that the cilia have so changed their position that they do not afford a view which presents the appearance of such a body. Usually, however, the cilia are curved transversely to the axis of the vestibule, so that they form as it were a cylinder of juxtaposed hoops or circles; and it is not to be wondered at, therefore, that in almost any position the outline of this cylinder should appear as a single line or filament. In a view directly into the aperture of the vestibule the bristle, so called, is not to be seen, for the very reason that the cylinder is presented endwise; and on this account, too, the vestibule appears to have a double contour, the inner one of these contours being nothing less than the series of curved cilia placed closely side by side and trending transversely to the axis of the cavity in question. This is a particularly facile observation in *Vorticella,* and none the less so in *Carchesium.* Finally, it may be said on this point—and, coming last, it is of no less importance than what has preceded, but, on the contrary, is worthy of the utmost consideration in an optical point of view—that were the so-called bristle a genuine body it would be in focus at only one particular adjustment of the lens; whereas we find that, having obtained what appears to be a clear and definite view of a filament, it does not go out of view by a change of the focus over a considerable extent above or below that horizon. This, one may readily perceive, would be the case in observing the outline of a transparent cylinder; and as the closely approximated curved cilia form such a cylinder, the outline of the latter is likewise as variable as that of any other similar form.

§ 5. The Locomotive Organs.—The locomotive organs are divided into three quite distinct sets, and appear to have as many diverse offices. They are all situated at the extreme posterior end of the body. Taken in their order, they stand thus:—1st, a veil, or membranous annular margin (f, f^1); 2nd, a row of vibratile cilia (g), which lies immediately behind the veil; and 3rd, a complex "adherent organ," in the form of a circle of centrifugal hooks (figs. 10, 17, 18, h) and centripetal rays (i) which are firmly attached to the truncate posterior face of the body.

The *velum* (f, f^1) is merely an excessively thinned margin of the abruptly expanded, truncate, circular base. It has a breadth which is at least one-third as great as the length of the vibratile cilia (g), which are attached in a single row immediately behind its basal edge (fig. 17, f^2). The free edge (f^1) of the *velum* is smooth and regularly curved. It is not very difficult to distinguish from the closely set row of cilia (g) just posterior to it. Although these cilia move so uniformly in concert, or in regular succession, as to appear at times like a vibrating frilled margin (fig. 10), yet when they are nearly quiet the veil may be distinctly seen (especially with a one-eighth-of-an-inch objective) as an overlying, separately undulating membrane. With oblique light, at about twenty degrees from direct illumination, the velar edge is very conspicuous, and may be seen to be margined by a thickening (fig. 17) which is easily traced across the whole width of the body, and at a decidedly different focus from that in which the bases of the vibratile cilia underlie it. In a profile view it may be recognized as an abruptly terminating, marginal, tongue-like projection, vibrating by fits and starts (fig. 11, f), at the periphery of the circular base.

The *basal vibratile cilia* (g) form a complete, symmetrical circle about the truncate posterior end of the body. They are more delicate and much longer than those of the anterior vibratory crown (b), and arise, in a single, closely set row, from a slightly projecting annular ridge which immediately subtends the line of attachment of the *velum.* This annular ridge, as will be seen presently, is the border (figs. 10, 17, l^1) of the adherent organ. Owing to their excessive fineness, the close proximity in which they are set, and the almost uniform succession with which one cilium follows the other in the series of vibrations, this system gives to the unaccustomed eye the impression of an undulating fringe-like membrane, when it is viewed with only a moderate magnifying-power; but with an amplification of five hundred diameters, if the objective be a good one, one may trace the cilia to their very bases, with the perfect confidence of not having seen amiss, and at the same time satisfy himself conclusively that they are unequivocally distinct from the veil which lies in front of them. There can be no hesitation, therefore, in pronouncing the veil and the vibratile row of cilia to be two distinct and separate systems, with no connexion whatever other than a close proximity of attachment to the basal margin of the body, and their similar duties in the process of locomotion*.

The *adherent organ* (figs. 10, 17, *h*, *i*, *l*) is a complex apparatus, which altogether forms a thin circular disk, whose border (l^1) reaches to the margin of the base, or, in other words, to the inner edge or line of attachment (f^2) of the *velum* (f).

About one-third of the radius of the adherent organ, at the peripheral margin, is occupied by a *striated annular membrane* (l, l^1, l^2, l^3, l^4, l^5), which is separable from the rest of the apparatus. It lies in *front* of the centrifugally projecting hooks (h), but closely pressed against them, and extends centripetally (to l^3) as far as their bases. This membrane is possessed of two sets of *striæ*, which radiate from its inner to its outer margin. *One set of striæ* occupy the anterior face (fig. 17, l^1 to l^4), and are comparatively quite coarse (l^2), and in number about ninety-six, *i. e.* four times the number of the hooks (h) of this organ. They lie wide apart, and are arranged so uniformly that two traverse the interval between every two hooks, and two overlap every hook, where they run to the proximal margin (l^3) of the membrane. In dead or dying specimens this membrane becomes folded or wrinkled (fig. 16, l^1) transversely, and then these *striæ* (l^2) overlap each other and appear to fork more or less, or seem to be linear processes, divergent from the curved ends of the hooks (h)†.

* See the note on the "adherent organ" at the end of this section, p. 415.

† In the 'Proceedings of the Boston Society of Natural History' for November 6, 1850, p. 354, Prof. L. Agassiz makes the following statement in regard to the relation of *Trichodina* to the *Medusæ*, and especially in reference to these apparently forked, radiating striæ, which remind one of the numerous radiating tubes of certain Hydroid Acalephæ. He says:—"These parasites at times leave the *Hydra* and swim free, changing their form in a remarkable degree. In addition to the internal ring, he was able to trace rays going from the hooks to the margin, divided into numerous branches, and also rays proceeding toward the centre from this ring; the margin has a fringed undulating edge, under the tentacles. By feeding them with colours, he was able to see that the internal folds are the margin of a mouth, as in *Rhacostoma*; so that these parasites on *Hydra* are diminutive *Medusæ*. In the egg of *Hydra*, he had been able to trace all the forms from a segmental yolk to these parasites; the freshwater *Hydra* is the Polypoid form of *Medusæ*, while these parasites are the Medusoid form."

The other or *posterior set of striæ* (l^4, l^5) is much more readily detected than the anterior one, and the *striæ* are about three times as numerous. They are so closely set together that it is a difficult matter to count them, although viewed with a one-eighth-of-an-inch objective. They extend, like those of the anterior set, over the whole breadth of the membrane, and, terminating abruptly at the peripheral margin (l^1, l^4), give to the thickened edge a milled appearance. This milling is, moreover, rendered conspicuous by an incrassated, scalloped border (l^1), in which the striæ (l^2) of the front set terminate*. The striated membrane is very flexible, and is frequently made to undulate, apparently by the successive impacts of the vibrating cilia.

The apparently most important members of the adherent organ are the ***hooks*** (h). They vary in number from twenty-two to twenty-four, and curve in a direction which is diametrically opposite to the upward coil of the vibratory organ; *i. e.* they are *læotropic*. They are *separate pieces*, of an £-formed (fig. 18, h, h^3) shape; the upright part of the £ being the *hook* (h) proper, and the horizontal limb (h^3) the base of it. These £'s are arranged in a circle with their horizontal limbs all pointing one way—*i. e.* the same as the upright part or hook—and nearly or quite touch each other, according to circumstances. A spur-like, slender point (h^2) projects from the horizontal part, in the opposite direction, and is about half as long as the latter. Along this spur and the convex side of the hook a broad, lunate crest (k) arises, and, nearly filling the interval between two succeeding hooks, projects peripherally beyond the tips of the latter. This crest is excessively faint, and not recognizable as a distinct body unless the striated membrane is removed; although it is to be

---

If this be true, then the whole group of Vorticellidæ (from which no one would for a moment think of separating *Trichodina*) must be removed to the class of Acalephæ! We must, for own part, however, unequivocally dissent from this view, since it is quite at variance with our own observations. But, again, according to another, more recent statement of Prof. Agassiz, in his 'Essay on Classification' (Boston, 1857, p. 72; London ed., 1859, p. 108), he has satisfied himself of the "propriety of uniting the Vorticellidæ with Bryozoa," *i. e.* the group of Vorticellidæ; and consequently the *Acalephan* (*vide* preceding paragraph) *Trichodina* is Molluscan! From this view, also, we would modestly, but unequivocally, dissent, not only as the result of our own investigation, but in accordance with the observations of other very competent authorities. This view would also seem to argue that the Bryozoa—if they do not strictly belong, with Polypi, to the division Radiata, as is insisted upon by other and eminent authority—are at least a transitional group between Radiata and Mollusca.

* The separation of these two sets of *striæ*, or radiating ridges, is an excellent test of the quality of a quarter-inch objective; a one-eighth-of-an-inch lens can do it easily.

seen when in place, especially where it projects beyond the tip of the hook, and forms with the others a succession of scallops (fig. 17, *k*) lying in a circle parallel with the margin (l^1) of the striated membrane.

Immediately within the row of hooks a series of *nail-shaped pieces* (i^1, i^2) extends in a circle, and they are arranged in such order that each one lies opposite the horizontal part (h^3) of a hook. The pointed, conical head (i^2) of the nail-shaped piece corresponds in position with the point of contact of the bases of two successive hooks, and at the broadest part protrudes sideways between the latter. The tip of the nail-head projects between the point (i^4) of the succeeding nail and the base (h^3) of a hook, the two latter constituting a sort of socket in which the former appears to slide. This would seem to show conclusively that this complicated ring may be enlarged or diminished at the will of the animal.

The faint radiating ridges (*i*) which occupy the central two-thirds of the adherent apparatus are attached one by one to the point (i^4) of the nail-shaped body just mentioned, and at right angles to it. The basal third of these *radii* is easily seen with a one-fourth-inch objective; but even a one-eighth does not distinctly trace the pointed end to the centre of this apparatus. Each *radius* (*i*) and the nail-shaped body (i^1, i^2) seem to form a solid piece, a sort of Greek Γ whose angle is occupied by a *faint membrane*, or web (i^3), which extends from one-third to one-half the way along the nail, and nearly, or altogether, to the end of the tapering radius. This faint membrane appears to fill the whole space between the *radii*, in healthy animals.

In dying specimens the adherent organ readily separates from the body, *en masse*; but shortly afterwards the striated membrane loosens from the circle of hooks; and in a brief space of time the latter becomes disjointed, and each hook detaches from its fellow, but remains for a longer period in conjunction with its corresponding radius and nail-shaped piece *.

* Various opinions (and all of them at variance with the one promulgated in this paper) have been expressed in regard to the nature of the adherent apparatus and its motory appendages, the vibratile row of cilia. Siebold (Zeitschr. für wissenschaftl. Zool. Bd. ii. p. 367), as the following translation shows, has mistaken the row of vibratile cilia (*g*) for an *undulating membrane* and has entirely overlooked the *velum* (*f*). He says, "Among the Infusoria, the genus *Trichodina* is endowed with a distinct, undulating membrane, which, applied to the lower margin of the body, in the form of a circle, adheres to, and is supported by, a solid toothed apparatus not unlike a watch-wheel. In *Trichodina pediculus* this vibrating border is entire-margined; in *T. mitra* . . . . the free border of this appears to be deeply and delicately fringed. Trembley, Goeze, O. F. Müller, Carus, Dujardin, and others have, in consequence of an optical illusion, considered this undulating membrane in *T. pediculus* to be a vibrating-cilia-crown."

§ 6. The Digestive System.—This infusorian takes so readily to an indigo diet that the process of collecting food and forming it into pellets at the bottom of the œsophagus and its passage into the general cavity of the body may be seen at any time, and without any particular preparation. On this account it is no difficult task to ascertain the position of the mouth and the trend of the vestibule and œsophagus, as well as the posterior termination of the latter.

The *vestibule* (*v*) is as distinct from the œsophagus (*o*) as in most of the Vorticellidæ. Its aperture (*m*) is very broad, and diverges almost insensibly into the peristome (*d*). It passes into the body in a direction which is in strict continuation (fig. 13) of the spiral trend of the border (*d*) of the disk; that is to say, it winds posteriorly, dorsally, and toward the

---

Stein (Infusionsthiere, 1854, p. 176) controverts the assertion of Siebold, and insists that the "undulating membrane" of the latter is a crown of cilia; but yet, as in Siebold's case, the *velum* has entirely escaped his notice. He writes as follows:—"The posterior cilia-crown . . . on account of the very closely set cilia, does certainly readily produce the impression of an undulating membrane margining the rear-body, which, not only in *T. mitra,* but also in *T. pediculus,* appears to be denticulately notched; but let one kill the animal with diluted acetic acid or alcohol, and he will separate each single cilium sharply. That the posterior cilia-crown is connected neither with the toothed horn-ring nor with the annuliform membrane, let one convince himself thereof by crushing the animal, by which one easily separates the entire adherent apparatus, in all its integrity, from the body."

Next Busch (Müll. Archiv, 1855, p. 358) appears in the field of controversy, and, commenting upon the observations of the two foregoing authors, makes a compromise between their views by uniting the vibratile cilia to the edge of the undulating membrane. This idea is set forth in the following words:—"On the so-called hind body is found the (by Stein first very correctly described) saucer-shaped rim, on whose base is fastened the ring of the rigid-bâton crown, from which the hooks arise. On the foundation of, and exterior to, the saucer-shaped membrane is implanted the chief locomotive organ of the animal, the posterior cilia-crown. Siebold has explained this as an undulating membrane, whilst Stein has evidently recognized the separate cilia of the same, and only speaks of a cilia-crown. The truth seems to me to lie intermediate; for though I clearly observed the single cilia, especially in dying animals, yet I could never follow them to the margin of the saucer, unless a fissure was present. This organ consists, then, of a membranous undulating border, on whose free edge vibratile cilia are inserted. One may convince himself best of this on dying animals, where one sees the gentle pulsations of the border and the cilia." Although it is certain that Busch did not see the velum, as such, and in its proper relations, yet it is not equally clear that he did not have it in view, but confounded it with the row of vibratile cilia which underlie it.

Finally, as the latest investigator, Claparède (Études sur les Infusoires et les Rhizopodes, Mémoires de l'Institut Genèvois, 1858–59, p. 130) sustains the view of Stein, demurs to the opinions of Siebold and Busch, and says nothing about the true *velum*.

right side of the body. In an end view (fig. 13) of the animal, the vestibule narrows rapidly from its aperture to its bottom, whereas when seen in profile (fig. 8, *v*) the diminution of its diameter is more gradual. When the body is fully expanded, its aperture (*m*) is always open, and is circular, or broadly oval (fig. 12, *m*), in outline. This aperture lies just behind and exterior to the first spiral turn (fig. 11, b^1 to d^5) of the vibratory margin of the cyathiform disk, and receives the termination (fig. 13, b^2) of that spiral within its depths. It might therefore, with propriety, be designated as the internal prolongation of the disk.

The anus (Pl. IX. figs. 12, 13, *a*).—When the anus is open, which not unfrequently happens, it appears as a distinctly bounded, seemingly margined aperture, which lies very conspicuously on the right side of the vestibule, and near its mouth.

The *œsophagus* (o, o^1), in conjunction with the vestibule (*v*), is an elongate-sigmoid (fig. 13) funnel-shaped cavity, which extends obliquely backwards and across the body, nearly to its axis. When not in the act of taking in food, the œsophagus terminates in a fusiform point or pharynx, and may be recognized as a clear colourless space in the midst of the light-yellow tissue of the body. From the point where it joins the bottom of the vestibule it curves to the left, and thus forms the dorsal termination of the sigmoid. In a profile view (fig. 8, o, o^1) it lies nearly parallel with the proximate or ventral surface of the body. When the pellets of food are forming, its posterior fusiform termination (o^1)—the so-called pharynx—gradually expands into a globular cavity, which eventually exceeds in diameter the breadth of the mouth; but as soon as the food passes into the general digestive cavity, it assumes its accustomed funnel-shaped outline. As has already been stated in the section on prehensile organs, it is lined by vibratile cilia, which, it may be added here, seem to cover its whole interior.

The digestive cavity.—Beyond the œsophagus there is no special cavity for the preparation or assimilation of food; the latter passes from the posterior end of the former through a simple expansible aperture directly into the general digestive cavity. The final assimilation of the food is accomplished, as in all other Vorticellidans, in a space which embraces every part of the body except that which is immediately occupied by the contractile vesicle (*cv*) and the reproductive organ (*n*). This space, therefore, serves both the purpose of a stomach and intestine; nor does it appear to have any accessory glands or appendages of whatever kind that may assist in the process of digestion.

The *walls of the body*, therefore, form the immediate parietes of the digestive cavity. There are, at least, two of these walls. The inner one (p^1) consists of a clear, amber-coloured, homogeneous, formless tissue, in which all the organs are imbedded. The other, or *exterior wall* (p), embraces the inner one like a film, and has more of the character of a colourless excretion than a true tissue. It is thickest about midway between the two ends of the body, and gradually thins out to an inconspicuous stratum at the anterior and posterior borders. Its surface is beset with excessively minute, short cilia, which, although occasionally and with great difficulty seen to move, cannot be called vibratile cilia in a strict sense, but rather pointed roughenings which are agitated by the varied contractions and expansions of the tissue from which they arise. The thickness of this wall is more or less deeply corrugated, principally in a longitudinal direction (fig. 14, *r*, *r*), and to a certain extent independently of the irregular folds and furrows on the outer surface of the inner wall *.

§ 7. The Circulatory System.—It would seem a little remarkable, at first thought, that the Vorticellidæ, which hold the highest rank among Infusoria, should possess a circulatory system which, in all but one genus, seems as simple in character as that of the lowest forms of the class, and apparently much less complicated than in *Stentor* and *Paramecium* and others of the læotropic division. If, however, we look upon the numerous contractile vesicles of *Amphileptus*, *Trachelius*, &c., as indications of a diffuse, lowly organized circulatory system, and upon the fewer branching vesicles of *Paramecium*, *Spirostomum*, *Stentor*, &c., as tendencies to a greater degree of concentration, then the unique contractile organ of Vorticellidans would represent the consummation of this process, and consequently the most elevated status of the system as it exists in this class of animals.

The *contractile vesicle* (*cv*) of *Trichodina* is a simple cavity which lies near the ventral side (figs. 8, 11) of the animal, a little to the left of the axial plane (figs. 12, 13), and consequently on the same side of the œsophagus, and about halfway between the anterior and posterior truncate ends of the body †. It contracts once in fifteen seconds. The systole occupies

* See, for further details, the section (§ 3) on the *form* of the body.

† There is a singular error in Stein's figure (Infusionsthiere, 1854, taf. vi. fig. 56) of the animal as seen from the basal end. The view of the base is underlain by a view of the anterior end of the body; but the latter is posited *as if seen from the front*. To correct it, the contractile vesicle should lie to the right of the œsophagus, and the sigmoid flexure of the vestibule and œsophagus should be reversed.

between two and three seconds, and the diastole proceeds slowly and continuously during the remainder of the quarter of a minute, until the vesicle has attained its maximum size (figs. 8, 11, 13, 14), and then it immediately contracts again. In specimens which are confined, or in the least restrained in their movements, the systole and diastole succeed each other much less frequently. At the full diastole the vesicle is perfectly globular, and occupies at least one-third of the diameter of the mid region of a fully expanded animal. The systole reduces it to an almost invisible point; and from this it gradually expands, first into a jagged (fig. 10, *cv*) star-like cavity, then into an irregular spheroid (fig. 12), and finally assumes, at full diastole, a globular contour.

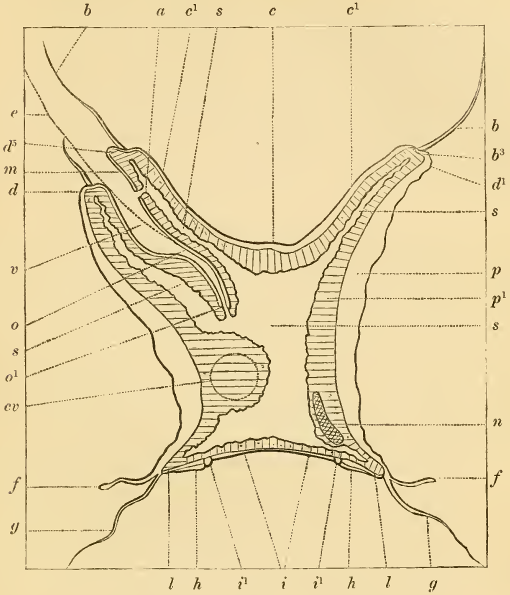
§ 8. The Reproductive System.—As these observations extend over but a few days (mostly at the beginning of October of this year), the different phases in the development of the *nucleus* were not investigated. At the period just mentioned, this organ (n, n^1) had the form of a thick, knotted, or moniliform band, which extended in a uniform curve, over three-quarters of a circle, around the truncate base, and in a direction exactly transverse to the axis of the body. Its two ends (n^1) lay next the ventral side, and right and left of the plane which passes through the œsophagus; and its breadth ran parallel with the axis of the body. It had a decidedly yellow colour, and was finely granulated throughout. In profile, or rather in a foreshortened view of its length, it was quite conspicuous; but where it extended across the vision, it was so excessively faint as to nearly escape the eye, even though the utmost care was taken to ascertain its presence and exact position.

§ 9. Résumé*.—Reducing, now, the details which have been given in this memoir to the briefest expressions, we have the following summary in an aphoristic form. In its healthy, unrestrained condition, *Trichodina pediculus* is very dissimilar to the hitherto published representations of it. The illustrations of Ehrenberg, Dujardin, Stein, and Busch represent the animal in an abnormal, more or less *reverted* attitude, the result of studying the animal in a confined state, or when in an unhealthy condition. It has a deep, cyathiform, or dice-box shape, with an irregularly and longitudinally furrowed and plicated exterior. There is no *disk*, or it is represented by the depressed cupuliform area which is bordered by the *vibratory crown*. The *peristome* is not a closed circle, as in Vorticellidæ proper, but

* The principal points of this *résumé* are to be found in the 'Proceedings of the Boston Society of Natural History,' Oct. 18, 1865.

follows the spiral course of the vibratory crown, and vanishes near the aperture of the vestibule. The *vibratory crown* consists of a single row of vibrating cilia, which winds along the margin of the spiral dexiotropic peristome, just at the edge of the cupuliform disk, and descends thence to the left of the vestibular aperture, and, entering it, plunges to the bottom of the vestibule in an unbroken line. Neither *Trichodina* nor any of the Vorticellidæ possesses a vestibular lash or bristle; and the latter is an optical illusion. The posterior truncate end of the body is margined by a well-defined annular *velum*, immediately behind which, and arising from the same basis, is a complete circle of vibrating cilia. The so-called *adherent organ*, or apparatus of hooks and *radii*, consists, *first*, of a distinct, separable, annular border, whose opposite faces are dissimilarly striated by perfectly straight, transverse ridges; *secondly*, of a complicated circle of disseverable hooks, which are applied to the *posterior* face of the striated annular border, along its proximal edge; and *thirdly*, of a series of Γ-shaped radii, which lie one by one opposite the several hooks, and converge toward the axis of the basal plane of the body. The vestibule and œsophagus are as well marked, each in its own way, as in any of the Vorticellidæ. The vestibule opens near, and posterior to, the cilia-crowned margin of the sunken cupuliform disk. The anus opens into the vestibule a short distance from its mouth, and on the right side. The contractile vesicle is a simple cavity, which performs its systole *once in fifteen seconds*. The reproductive organ is a knotted band whose antero-posterior thickness is much greater than at right angles to that; and it lies, in the form of a crescent, near the base and transverse to the longitudinal axis of the body.

The extraordinary and almost incomprehensible position and form of the disk of this singular appendage of the Vorticellidan group seem to render it desirable that no pains should be spared to make the relations of its organs to each other as clear to the understanding as it is possible to do with the help of figures. The accompanying diagrammatic illustration of a longitudinal, sectional, or rather profile, view of *Trichodina pediculus* is particularly intended to exhibit the outline of the sunken cup-shaped disk (c, c^1) and its close connexion with the peristome (d^1, d^5); but, in addition to this, it is designed to show, in an outline sketch, the relations of the internal organs to the walls of the body. The contractile vesicle (cv), not being strictly in the plane of the section, is represented in dotted outline. The nucleus (n) is cut across its middle. The sigmoid figure of the vestibule (v) and œsophagus (o), being seen as it were edgewise, is foreshortened upon a flat surface. The lettering is the same as that used for the figures of the plates.



EXPLANATION OF THE PLATES.

The corresponding parts in all the figures of the plate and the woodcut are lettered alike as follows:—a, anus; b, vibratory crown; b^1, beginning of the vibratory crown; b^2, end of the vibratory crown within the vestibule; b^3, furrow of the vibratory crown; c, the bottom of the cupuliform disk; c^1, the side of the disk; c^2, the side of the disk rolled back; c^3, a front view of the disk; c^4, the "inclined plane" which lies upon the cornice-like oblique projection below the aperture of the vestibule; cv, the contractile vesicle; d, the peristome opposite the vestibular aperture; d^1, the dorsal region of the peristome; d^2, the inrolled edge of the peristome; d^3, the peristome at the edge of the inclined plane (c^4); d^4, the peristome where it becomes blended with the general surface of the body; d^5, the first turn or ventral region of the peristome; e, the lumen of the edge of the row of vibrating cilia, hitherto supposed to be a distinct vestibular lash ("bristle"); f, the profile of the *velum*; f^1, the free edge of the *velum*; f^2, the basal edge or line of attachment of the *velum*; g, the basal cilia-crown; *h*, the hooks of the adherent organ; h^1, the circle formed by the bases of the hooks; h^2, the spur of *h*; h^3, the horizontal limb of the hook; *i*, the *radii*; i^1, the "nail-shaped piece;" i^2, the head of the same; i^3, the "*faint membrane*" or web of the Γ-shaped radii; i^4, the point of the nail-shaped piece; *k*, the crest of the hooks; *l*, the profile of the "striated membrane;" l^1, the distal edge of the last; l^2, the coarser striæ of the same, on its front face; l^3, the proximal edge of the same; l^4, l^5, a portion of the posterior face of the striated membrane, showing the finer striæ; *m*, the mouth of the vestibule; *n*, the nucleus, or reproductive organ; n^1, the left end of the nucleus; *o*, the œsophagus; o^1, the bottom of the same; *p*, the outer, and p^1, the inner walls of the body; *q*, digestive vacuole; *r*, longitudinal ridges on the surface of the body; *s*, the general digestive cavity; *v*, the vestibule.

All the figures represent the whole or portions of *Trichodina pediculus*, Ehr.

Plate VIII.

Fig. 1. An individual in the fullest degree of expansion. This is the most common form of the animal. 200 diameters.

Fig. 2. Another, less frequent form of a fully expanded individual. 200 diam.

Fig. 3. An attitude occasionally, but briefly, assumed by healthy specimens. The body is simply shortened, but without changing or reversing the relative position of the organs. 200 diam.

Figs. 4 & 5. Shapes assumed when swimming, different from those already described. 200 diam.

Fig. 6. An individual with the edge of the cup-shaped front (disk) rolled back so as to expose the bottom of the cup. 200 diam.

Fig. 7. A partially retracted individual, with one side of the cupuliform front rolled back. 200 diam.

Fig. 8. A profile view of the left side, showing the following parts: viz., the left flank (c^2) of the front partially reverted, and the right flank in the distance bearing the vibratory crown (*b*); the bottom (*c*) of the cupuliform disk in the distance, and its flank in profile (c^1); the contractile vesicle (*cv*), at full diastole, lying near the ventral side of the body; the peristome (*d*) opposite the mouth (*m*), *i. e.* where the cilia—of the vibratory crown (*b*)—leave it and enter the vestibule (*v*), also the profile (d^1) of the same at the dorsal margin; the falsely called vestibular lash (*bristle*) (*e*) apparently attached near the dorso-anterior side of the vestibule; the *velum* in profile (*f*), and nearer the observer (at f^1) overhanging the base of the posterior row of cilia (*g*); the ring (h^1) of hooks of the adherent organ foreshortened, *i. e.* seen strictly edgewise; the left half (n^1) of the nucleus most conspicuous next the back, where its length is foreshortened; the œsophagus (*o* to o^1), partially filled by a nutritive pellet in the process of formation and rapidly revolved by the action of the vibratile cilia; the filmy, colourless outer wall (*p*) projecting very conspicuously in profile, and in marked contrast with the bright amber-coloured inner one (p^1); the general digestive cavity, occupied by numerous "digestive vacuoles" (*q*), nutritive pellets, and smaller alimentary concretions; the wide aperture (*m*) of the vestibule (*v*), and the latter obliquely traversed by the posterior termination of the spiral vibratory crown. 850 diam.

Fig. 9. A transversely sectional view of the mid region of the body, to show its irregular contour and the corrugations of the outer (*p*) and inner (p^1) walls. 850 diam.

Fig. 10. A dorsal view of an individual whose peristome (d^1, d^2) is inrolled, and with it the vibratory crown (b), which hangs down into the enclosed space about the partially raised boss-like bottom (c) of the disk. The contractile vesicle (cv) is in partial diastole. The nucleus (n) lies next the back. The principal feature in this figure is the adherent apparatus (i, h, l, l^1), which is copied whilst in the act of embracing a highly convex surface, and has therefore an inverted saucer-shaped contour. The radii (i) are in the extreme distance; the hooks (h) project in the opposite direction; the striated membrane shows its breadth in the profile (l), and exhibits its milled edge (l^1) and the coarser striæ where it projects toward the observer. The *velum* (f) is at its fullest expansion, and allows its thickened margin (f^1) to be seen very distinctly where it overlies the gaps between the groups of vibrating cilia (g). The cilia of the basal vibratory crown are represented as they appear sometimes when moving in groups or successive waves, and when they most resemble a torn, undulating membrane. 6. 0 diam.

Fig. 11. A bird's-eye vie of the left side and of the anterior end of the body, partially exposing the depressed face (c^3) of the cupuliform disk. The vibratory crown (b) is displayed throughout its length, from its beginning (b^1) on the right side, over its spiral sweep by the ventral and dorsal sides, and thence to its downward coil into the mouth (m) of the vestibule. The peristome follows the same course as the vibratory crown, and appears as a distinct rim (d^3, d^5) just outside the base of the cilia, until, after descending along the edge (d^3) of the inclined plane (c^4), it vanishes on the left of the mouth (m). The false vestibular lash (e) or *lumen* of the vibrating tips of the cilia. The *velum* (f, f^1), shown very clearly in the profile (f), projecting like a tongue, and undulating independently of the vibratory cilia (g). The circle (h) of hooks and the striated membrane are drawn but just distinct enough to show their position. The mouth (m) of the vestibule appears as an oval aperture, lying between the first (d^5) and second (d^3) coils of the peristome. The œsophagus (o) is very much expanded at its bottom by a fully formed nutritive pellet, just at the moment when the latter is about to be passed into the digestive cavity. The nucleus (n, n^1) lies fully in view, with its left end (n^1) nearest the observer, and its right half in the distance beyond the contractile vesicle (cv). 650 diam.

Plate IX.

Fig. 12. A bird's-eye view of the ventral side and front of a slightly retracted individual, exposing the dorsal flank (c^3) of the cupuliform disk. The anus (a) appears as a distinct opening (when the fæces are making their exit) at the right side of the vestibule, whose interior is here partially exposed in the full-face view of the gaping mouth (m). The descent of the vibratory crown along the edge (d^3) of the inclined plane (c^4) is its most noteworthy feature in this view. Its beginning (b^1) on the right side of the front is also clearly brought out. The dorsal flank (c^3) of the cup-shaped disk presents an unobstructed view, but its bottom (c) is seen in profile through the side of the body. Its extension in the form of the inclined plane (c^4) has already been noticed. The contractile vesicle (cv) is represented in partial systole, a very marked feature when contrasted with its hemidiastole (fig. 10, *cv*). The peristome is particularly noticeable as a distinct border (d^3) along the edge of the inclined plane (c^4), and for its disappearance at the left side of the mouth (m). The pseudo-vestibular lash (e) or tips of the vibrating cilia raised above the position which they usually occupy, and in the attitude assumed during the expulsion of the fæces. The *velum* (f, f^1) is only partially expanded. From the position of the animal, the basal cilia (g) are exposed at full length. The hooks and radii of the adherent apparatus (h) are but dimly seen through the corrugated walls of the body. From its peculiar position in this view, the vestibule is seen through the open mouth (m). The moniliform nucleus (n) is seen in the extreme distance; its right (n) and left ends are foreshortened, and appear as two very conspicuous, dark-yellow, oval spots, easily seen even with a low magnifying-power. 650 diam.

Fig. 13. An end view of the anterior face, looking directly into the cupuliform disk (c^3), and through its walls upon the various organs. The ventral region corresponds to the lower side of the figure. The anus (a) appears as a faint slit on the right border of the vestibule (v). The vibratory crown (b) commences abruptly on the right (b^1) side, and appears clearly defined as a spiral just within the peristome (d^1), and equally well marked where it forms a curve (b^2) at the bottom of the vestibule (v). It is quite evident, from this view, that the disk (c^3) is inseparable from the peristome (d^1), except by the slight, narrow furrow from which the cilia arise. The peristome is designated by a double border (d^1) (the outer and inner walls) along the spiral course of the vibratory row (b, b^1); but at the mouth (at d) of the vestibule (v) it loses that character, and gradually shades off (at d^4) into the surrounding surface. The lumen of the vibrating row of cilia—the vestibular lash (e) falsely so called—appears distinct from this point of view. The contractile vesicle (*cv*) is in full diastole. Its distance from the ventral side of the body is rendered apparently unusual by the expanse of the disk (c^3). The circle (h, h^1) of hooks and the *radii* are in the extreme distance, the hooks partially overlain by the knotted nucleus (n, n^1) and the œsophagus (o). The œsophagus (o) is in a scarcely expanded state, having but a few granules within it. The principal feature is its decidedly marked curve in the opposite direction to that of the vestibule (v). The "digestive vacuoles" (q, q) lie nearest the observer. 650 diam.

Fig. 14. A dorsal view of the body. The læotropic leaning of the cilia (b) of the vibratory crown is more decidedly marked than in the previous figures. The bottom (c) and flank (c^1) of the cup-shaped disk are seen in strict profile through the corrugations (r) and furrows of the outer (p) and inner (p^1) walls. The contractile vesicle (*cv*) is in the extreme distance, at its full diastole. The peristome (d^1) appears as a distinct ridge just exterior to the vibratory crown. The *velum* (f) is in a semi-expanded state. The cilia (g) of the basal crown are stretched to their full length. The circle (h) of hooks is scarcely recognizable as such in an edge view like this. The nucleus (n) lies next the observer. The outer wall (p), as in previous figures, bristles with numerous immobile, short cilia. The inner wall (p^1) is dotted everywhere by a minute scattered granulation. The longitudinal ridges (r) of the body bear a singular resemblance to muscles. 650 diam.

Fig. 15. A diagrammatic enlargement of the edge of the disk, principally to show how the cilia (b) arise from the furrow (b^3), and also the relation of the peristome (d^1) to the furrow. The outer (p) and inner (p^1) walls are represented in their relative proportions.

Fig. 16. A portion of the adherent apparatus, from a dead animal, to show the wrinkling of the striated membrane (l^1) and the overlapped, apparently forked, coarser striæ (l^2). The latter are seen through the thickness of the membrane, the finer striæ being omitted. The hooks (h) and radii (i) lie on the side next the eye. 950 diam.

Fig. 17. A basal view of the adherent apparatus, velum, and a part of the posterior row of cilia. The hooks (h) with their crests (k) lie nearest the observer, and partially covering the striated membrane (l^1 to l^5). The radii (i, i^1) with their webs (i^3) fill up the central area. The posterior face of the striated membrane with its finer striæ is shown from l^4 to l^5, and the anterior face of the same, as seen through its thickness, with its coarser striæ (l^2), between l^1 and l^4. The distal edge (l^1) is crenated and thickened. The proximal edge (l^3) runs along the bases of the hooks. The velum (f^1, f^1) is attached by its proximal edge (f^2) close to the distal margin (l^1, l^4, l^5) of the striated membrane, and almost the same with, but just anterior to, the line of attachment of the cilia (g, g) of the basal crown. Between l^5 and f^2 the striæ of the membrane are omitted. 950 diam.

Fig. 18. Two of the hooks and their corresponding radii, from the adherent apparatus of a dead specimen. The hook (h), its horizontal limb (h^3), the spur (h^2), and the crest (k) apparently form one solid piece. The *radius* (i) and the nail-shaped transverse piece (i^1, i^2) are united at the angle by a triangular web (i^3). The mechanical contrivance for the sliding of these pieces upon and between each other is too obvious to need any comment. 2400 diam.

Cambridge, Mass., October 1865.

XLV.—*Contributions to an Insect Fauna of the Amazons Valley.* Coleoptera : Longicornes. By H. W. Bates, Esq.

[Continued from p. 373.]

Genus Amphionycha (Dej. Cat.), Thomson.

Thomson, Archiv. Entom. i. p. 311.

The numerous species which compose this genus agree in the possession of long filiform antennæ, with the joints more or less densely fringed with fine hairs, but never partially thickened, clothed, or tufted; the third joint is more or less disproportionately elongated. The body is variable in shape, but is generally elongated and linear, in some species greatly elongated, in others much shorter and oblong. All have well-developed lateral carinæ on the elytra; the apices of the latter are variable, being in some species broadly truncated and toothed, in others briefly truncated, and in some species rounded and entire.

1. *Amphionycha Diana,* Thomson.

Amphionycha Diana, Thoms. Classif. des Cérambyc. p. 65.

A. elongata, postice paulo attenuata, castaneo-rufa, occipite fascia brevi et macula laterali, thorace vitta laterali et macula postica, elytris fascia communi subbasali maculisque utrinque tribus posterioribus cretaceo-albis; prothorace pectoreque lateribus cretaceo plagiatis; pedibus fulvo-testaceis; antennis ciliatis, articulo tertio modice elongato; elytris breviter truncatis. Long. $6\frac{1}{2}$ lin. ♀.

This very handsome species occurred only in the forests of the Tapajos. It is found also in the interior of French Guyana.

2. *Amphionycha seminigra,* n. sp.

A. elongata, parallelogrammica, ferrugineo-testacea; antennis, elytrorum dimidio postico, pedibus posticis, tarsis omnibus et abdomine nigris; thorace tuberoso; elytris late truncatis, angulis productis. Long. 5 lin.

Head coarsely punctured, testaceo-ferruginous. Antennæ longer than the body (♂?), finely fringed to the apex; joints all slender, third double the length of the fourth; black. Thorax with three large, smooth tubercles on the disk, and one on each side, red; margins marked with a few very large punctures. Elytra parallelogrammical, broadly truncated, with both angles of the truncature produced into sharp teeth; surface closely punctured, the punctures and also the lateral carina ceasing abruptly at three-fourths the length of the elytron; black, basal third rusty testaceous. Body beneath reddish testaceous; hind part of the breast dusky; abdomen black. Legs reddish testaceous; tarsi and the hind legs black.

S. Paulo, Upper Amazons.

3. *Amphionycha nigripennis,* n. sp.

A. elongata, parallelogrammica, ferruginea; elytris, tarsis apicibusque tibiarum nigris; thorace tuberoso; elytris late truncatis, angulis productis; antennis parce setosis. Long. $6\frac{1}{2}$ lin. ♀.

Head broad, muzzle dilated and having prominent angles, testaceous red, shining, and marked with a few shallow punctures. Antennæ shorter than the body, slender and tapering to the extremity, very sparingly setose; third joint nearly twice the length of the fourth; testaceous red. Thorax with a large elevated rounded tubercle on the disk, and a large obtuse one on each side, constricted near the anterior and posterior margins; bright testaceous red, marked with a very few shallow punctures. Scutellum bright testaceous red. Elytra parallelogrammical, broadly truncated at the apex, with both angles of the truncature produced and acute; surface closely punctured, the punctures as well as the lateral carinæ ceasing abruptly before the apex;

deep black, suture near the scutellum red. Body beneath and legs testaceous red; apical part of the abdomen, tarsi, and apices of the tibiæ black.

Ega.

4. *Amphionycha miniacea*, n. sp.

A. elongata, parallelogrammica, glabra, rufa; elytris nigris, medio castaneo-rufis, utrinque maculis quatuor suturaque rufis; antennis nigris, articulis tertio quartoque rufis; thorace postice paulo dilatato; elytris truncatis, angulis externis valde productis, internis dentatis. Long. 4½–5½ lin. ♂ ♀.

Head bright red, marked with large, distinct, scattered punctures. Antennæ a little longer than the body in the ♂, shorter in the ♀, sparingly setose, black; third, fourth, and sometimes also the fifth, joints reddish testaceous; third joint one-fourth longer than the fourth. Thorax marked with very large scattered punctures, red; sides behind the middle dilated. Elytra parallelogrammical, depressed above; apex broadly truncated, with the external angle of the truncature much elongated, and the sutural angle produced into a point; surface closely punctured, dark red on the disk, shining black on the sides, glabrous, each elytron with four elongate patches, and a streak down the middle part of the suture, of dense bright-red tomentum (pallid in dried examples); one spot is near the scutellum, another underneath the shoulder, a third a little before, and a fourth a little after the middle. Body beneath and legs red.

I took numerous specimens of this beautiful species on the leaves of a tree in the forest at Obydos, Lower Amazons. In life the red colour is of a clear vermilion hue.

5. *Amphionycha megalopoides*, n. sp.

A. brevis, oblonga, flavo-testacea; capite lato, fronte nigra, bipenicillata, occipite nigro, bifasciato; thorace postice transverse sulcato; elytris singulis maculis duabus nigris; antennis rufo-testaceis, articulo quarto flavo, articulis 5^{o}–11^{m} fuscis. Long. 4½ lin. ♂.

Head broad, pale testaceous, clothed with fine pubescence and long pale hairs; face much narrowed below the eyes; forehead, near each eye, furnished with a cluster of long, black hairs; occiput with a black vitta behind each eye. Antennæ a little longer than the body, fringed with long scant hairs; third joint nearly twice the length of the fourth; basal joints reddish testaceous; fourth joint yellow, the rest dark brown. Thorax widened behind, and marked with a transverse sulcus near the hind margin; pale testaceous, opake. Scutellum dusky. Elytra short and broad, oblong, slightly narrowed behind, apex rounded; lateral carina thick and flexuous; surface punctured towards the base; disk with two slightly raised lines, pale yellowish testaceous, clothed with fine silky tomentum; a triangular spot over the shoulder and a round one near the suture, towards the apex, black. Body beneath and legs testaceous; breast with a black belt.

Santarem. Resembles in form and colouring certain species of *Megalopus* (family Phytophaga).

6. *Amphionycha Sapphira*, n. sp.

A. elongata, angustata, postice sensim attenuata; nigra, fronte, vitta coronali, vittis lateralibus thoracis lineisque quatuor elytrorum cæruleis; his disco bicostatis, apice sinuato-truncatis, basi macula magna aurantiaca; antennis corpore longioribus, robustis, filiformibus, nigris, dense ciliatis. Long. 5½ lin. ♂.

Head a little broader than the thorax, deeply impressed on the crown, clothed with pale-blue tomentum; occiput coarsely punctured, black, naked except on the pale-blue tomentose vittæ. Antennæ one-fourth longer than the body, stout, filiform, black, densely fringed to the apex; third joint elongated. Thorax elongated, cylindrical, uneven, broadest in the middle, black, coarsely punctured; sides each with a broad vitta of clear light blue, the black parts naked. Scutellum black. Elytra narrow, elongated, tapering from base to apex, the latter briefly sinuate-truncate, with both angles produced and acute; disk coarsely punctured, except near the apex and along the two slightly raised lines; lateral carina straight; colour blue black, shining, with the suture, a line along the disk, and lateral margins pale blue; a rounded orange-coloured spot at the base of each elytron. Body beneath and legs clothed with fine blue-grey pubescence.

I met with one example only of this remarkable species, at Ega, on the Upper Amazons, on a leaf.

7. *Amphionycha cephalotes*, Pascoe.

Amphionycha cephalotes, Pascoe, Trans. Ent. Soc. n. s. vol. iv. p. 250.

A. modice elongata, linearis, rufescens; elytris lateribus fuscis, apice suturaque antice cinereo sericeis; capite lato, convexo; thorace postice strangulato; elytris linearibus, supra planis, punctato-striatis, apice rotundatis; antennis corpore paulo longioribus, longe ciliatis, nigris, articulis tribus vel quatuor terminalibus flavis; tibiis extus fuscis. Long. 4 lin.

Found at Ega, Upper Amazons, and on the banks of the Tapajos, on foliage.

8. *Amphionycha megacephala*, n. sp.

A. linearis; capite valde convexo, nigro, polito; antennis nigris;

thorace nigro, lateribus vitta castanea testaceo plagiata, marginis postici lineola et scutello albis; elytris supra planis, crebre punctatis (apice excepto), basi fulvo-brunneis, medio nigris, apice cinereo-sericeis. Long. $4\frac{1}{2}$ lin.

Head large and convex both above and in front; mandibles large, strongly curved; glossy black, lower part of the face greyish tomentose; cheeks with a small white spot under each eye. Antennæ a little longer than the body, filiform, finely fringed, black; third joint about twice the length of the fourth. Thorax cylindrical, uneven, marked above with a few large punctures, black, sides each with a broad tawny-chestnut stripe, in which is a paler spot; anterior margin with two small spots; hind margin in the middle with a short white line. Scutellum white. Elytra linear, apex rounded; surface plane, closely punctured (except near the apex); colour tawny brown near the base, black across the middle, ashy tomentose towards the apex, the colours not sharply defined. Body beneath black; breast and base of abdomen glossy tawny red; sides of the mesosternum with a white spot. Legs black.

Ega. There is another species of large-headed *Amphionycha* found on the Isthmus of Panamá, in which this part assumes still larger proportions*.

9. *Amphionycha concinna*, White.

Phœbe concinna, White, Proc. Zool. Soc. 1856, p. 408.

A. linearis, capite lato, albo, fronte bicorni; thorace postice angustato, convexo, albo, supra plaga magna postica colore lavandulæ, disco maculis tribus lævibus nigris; elytris linearibus, apice truncatis (angulis externis productis acutis), colore lavandulæ, apice fascia lata cretaceo-alba fusco bimaculata; corpore subtus cretaceo-albo, sternis fuscis; abdomine, pedibus et antennis rufo-testaceis, his longe ciliatis, corpore duplo longioribus. Long. $5\frac{1}{2}$–6 lin. ♂.

Ega, Upper Amazons.

10. *Amphionycha bicornis*, Oliv.

Saperda bicornis, Olivier, Entom. t. iv. 68. 27, pl. 4. f. 46.

A. linearis, cretaceo-alba; thorace maculis octo, elytris singulis apice maculis tribus, griseis; abdomine, antennis pedibusque rufo-

* *Amphionycha capito*. Robusta, linearis, nigra, nitida; thorace flavo, macula discoidali nigra. Caput magnum, convexum, corpore latius, nigrum, grosse punctatum. Antennæ corpore longiores, nigræ, ciliatæ, articulis sex terminalibus flavis. Thorax capite angustior, postice paulo constrictus, tomento flavo dense vestitus, macula quadrata discoidali nigra. Elytra brevia, linearia, supra plana, punctata, apices versus lævia, nigra, nitida, apice macula cinerea tomentosa. Corpus subtus et pedes nigra, femoribus anticis et intermediis flavis. Long. $4\frac{1}{2}$ lin. ♂. *Hab.* in Panamá.

testaceis; capite lato, fronte bicorni; antennis corpore duplo longioribus, longe ciliatis. Long. 5 lin. ♂.

Forests of the Tapajos.

11. *Amphionycha testacea*, n. sp.

A. cylindrica, setosa, testacea, pube fulvescente sericea induta, thoracis marginibus pallidioribus; elytris disco abdomineque basi fuscescentibus; antennis tenuiter longe ciliatis, nigris, articulo basali (apice excepto) rufo, articulis quarto et quinto (apicibus exceptis) flavis; thorace antice angustato. Long. $3\frac{1}{2}$ lin.

Head small, pale testaceous, crown darker; face convex, prominent; upper and lower lobes of the eyes connected by a very slender thread. Antennæ a little longer than the body, furnished with a scanty fringe of long straight hairs; basal joint red, except at the apex, which, together with the second and third joints, is deep black; third joint about one-third longer than the fourth, the latter (except the apex) and the basal half of the fifth pale yellow, the rest black. Thorax narrowed in front, and broadest in the middle; surface (except the disk) marked with large punctures, reddish testaceous, anterior and lateral borders paler. Elytra very briefly truncated at the apex; lateral carinæ vanishing considerably before the apex; surface punctured in lines, clothed with pale silky pubescence, brown testaceous, paler anteriorly. Body beneath and legs testaceous yellow, basal three-fourths of the abdomen blackish brown.

Ega.

12. *Amphionycha roseicollis*, n. sp.

A. brevior, linearis, nigra, subsericea; fronte, antennis (apice exceptis), corpore subtus, et pedibus flavo-testaceis; abdomine apice nigro; thorace (basi excepta) læte roseo, elytrorum lateribus et apicibus rufo-testaceis; unguiculis simplicibus. Long. $3\frac{1}{2}$ lin. ♂.

Head as broad as the elytra; face yellow and densely pubescent; vertex black, naked, coarsely punctured. Antennæ one-third longer than the body, furnished with a scanty fringe of straight hairs, yellowish testaceous, sixth to eleventh joints dusky; basal joint subclavate; third joint about one-fourth longer than the fourth. Thorax with an obtuse prominence in the middle on each side, and narrowed behind; surface pale, and clothed with silky pink pubescence, hind border black, coarsely punctured, lateral prominences pale. Elytra linear, sinuate-truncate at the apex, with both angles prominent; lateral carina obsolete before reaching the apex, and accompanied in that part by a lower carina, parallel to it but not reaching the middle of the elytra; surface punctured, black, with changeable greyish pubescence; lateral margins reddish; apex testaceous.

Body beneath and legs yellowish testaceous; apex of the abdomen blackish.

Ega; one example. The claws in this species are simple: it ought therefore to rank amongst the group Saperdinæ, if the evidence were complete that this is not a sexual character in this instance. As only one example exists of the species, its true position cannot at present be decided.

Group *Phytœciinæ.*

Genus Erana, nov. gen.

Body cylindrical. Head rounded, scarcely depressed between the eyes, the latter with the upper and lower lobes connected. Antennæ moderately elongated, filiform, setose, and beneath ciliated; third joint much longer than the fourth, the remaining joints gradually diminishing in length. Thorax short, cylindrical. Elytra cylindrical, obtuse at the apex, and rounded at the sides, the discal portion not being separated from the lateral by an elevated line. Legs somewhat short, tarsal claws bifid.

I have adopted this genus from the collection of Mr. Alexander Fry, to whom is due the credit of having first detected its distinctness from *Amphionycha* and *Hemilophus.* It embraces numerous tropical American species, including *Saperda triangularis* (Germar), *S. læta* (Newman), and others.

Erana cincticornis, n. sp.

E. cylindrica, nigra, pilosa, fronte et vitta laterali thoracis albo sericeis; antennis nigris, articulis tertio et quarto basi dense setosis, quinto et quarto apice albis; elytris apice conjunctim rotundatis, angulis suturalibus spinosis. Long. $3\frac{1}{2}$–4 lin.

Head convex above; front and cheeks clothed with silky whitish pubescence; vertex naked, black, coarsely punctured. Antennæ a little longer than the body, ciliated (except near the apex), black, the fifth and apical half of the fourth joints white; the third and basal half of the fourth joints appear to be thicker than the rest of the antennæ, owing to their dense clothing of short hairs. Thorax transversely depressed near the apex; surface clothed with very long and fine but erect hairs, centre part black; sides each with a pale vitta, emitting a short branch in the middle. Elytra cylindrical, apex rounded, with the sutural angles each armed with a short spine; surface clothed with erect hairs which are longest near the base, thickly punctured, dull black. Body beneath black, thinly clothed with grey pile; sides of breast and abdomen pale. Legs yellowish; tarsi and apices of tibiæ black.

Ega and S. Paulo, Upper Amazons.

Group *Saperdinæ.*

Genus Amillarus, Thomson.

Thomson, Archives Entom. i. p. 312.

In this very distinct genus of Saperdinæ the body is elongate linear, and, in the males, narrowed behind. The eyes are hemispheric, with a narrow angular emargination for the reception of the antennæ, the latter being greatly elongated (twice the length of the body), with very long and gradually thickened basal joint. The legs are moderately elongated, together with the tarsi. But the most characteristic peculiarity of structure is the form of the claw-joint of the tarsi and of the claws. In both sexes the claw-joint is longer than the second and third joints taken together; but in the males it is also rather abruptly dilated and thickened beneath from a short distance beyond the base. The claws are nearly straight, compressed, and scarcely divergent.

Amillarus mutabilis, n. sp.

A. elongatus, linearis, breviter parce setosus, fulvo-rufus, pectore medio et abdomine plumbeo-nigris, antennarum articulo basali nigro; tarsis tibiisque posticis fuscis; maris elytrorum parte postica, fœminæ elytris totis plumbeo-nigris. Long. 4–6 lin. ♂ ♀.

Head tawny red, vertex marked with a few shallow punctures and a smooth central line. Antennæ with a scanty fringe of short stiff hairs, reddish; basal joint and tips of other joints black. Thorax narrower than the head, broadest in the middle, constricted behind, marked with a few shallow punctures, tawny red. Scutellum reddish. Elytra tapering in the male, nearly linear in the female; apex obliquely truncated, with the outer angles dentate; surface smoothly punctured, partly in lines; colour in the males tawny red, with the posterior part more or less black, with pale silky pile; in the females wholly black, with pale silky pile. Body beneath tawny red; centre of breast and abdomen almost entirely black, with silvery silky pile. Legs tawny red, tarsi and posterior tibiæ dusky.

Abundant at Santarem on the leaves of shrubs, borders of woods. The species seems to differ from the New Granada form which has been described by M. Thomson under the name of *A. apicalis*.

Addenda.

The following species were accidentally omitted in treating of the genera to which they belong:—

Subtribe Acanthocinitæ.

Group *Acanthoderinæ.*

Genus Oreodera.

13. *Oreodera* (*Anoreina*) *biannulata*, n. sp.

O. oblongo-ovata, convexa, fulvo-brunnea; thorace lateribus tumidis obtusis; elytris apice singulatim rotundatis, supra tenuiter punctatis fulvo-brunneo et fuliginoso variegatis, lateribus apud medium macula fulvo-brunnea annulo cinereo-albo circumcincta; antennis setosis, fuscis, articulis basi testaceis. Long. $2\frac{3}{4}$ lin.

Head clothed with tawny-brown tomentum, impressed between the antennæ; eyes distant on the vertex. Antennæ longer than the body, clothed beneath with numerous stiff hairs; basal joint reddish, the rest dark brown, with bases of joints pale testaceous. Thorax short, transverse, nearly as broad in the middle as the base of the elytra; sides tumid, obtuse; surface clothed with a mixture of tawny-brown and dark-brown tomentum. Elytra oblong, narrowed towards the apex, at the latter singly rounded; surface convex, free from tubercles, finely punctured and clothed with a mixture of dark-brown and tawny-brown pile, in which are two short, zigzag, blue-grey fasciæ, one before, the other after the middle; each side in the middle with a tawny spot encircled by a whitish ring. Body beneath ashy tawny. Legs blackish, short, stout; femora clavate.

S. Paulo, Upper Amazons.

Group *Leiopodinæ.*

Genus Lepturges.

25. *Lepturges ovalis*, n. sp.

L. ovalis, paulo convexus, griseo-brunneus; elytris crebre punctatis, griseo lineatis, apice oblique sinuato truncatis, angulis productis; femoribus valde clavatis. Long. $2\frac{1}{2}$–$3\frac{1}{2}$ lin.

Head clothed with dingy tawny-brown pubescence. Antennæ dull red, sparingly clothed with short bristles. Thorax widening from the front towards the base; lateral spines short, acute, and situated very near the hind angles; disk with a transverse depression near the hind margin; colour brown, clothed with dingy-grey pubescence. Elytra oval, slightly convex; apex obliquely sinuate-truncate, both angles produced, sutural one very slightly; surface rather closely and coarsely punctured, light brown; each elytron with about eight narrow lines of grey pubescence, interrupted in some places. Body beneath and legs brownish red; femora abruptly clavate.

Santarem. The species will come next to *L. griseostriatus*;

but it is shorter and more oval and convex than any other *Lepturges* hitherto described.

26. *Lepturges scutellatus*, n. sp.

L. subovatus, paulo convexus; thorace fusco-nigro, griseo vario, spinis lateralibus validis, rectis, paulo ante basin sitis; elytris ovatis, apice breviter oblique truncatis, fulvo-brunneis, nigro maculatis, macula magna basali communi fusco-nigra fulvo-cinereo marginata. Long. $2\frac{3}{4}$ lin.

Head clothed with tawny-brown pubescence; epistome and labrum testaceous; palpi black. Antennæ reddish, tips of joints dusky. Thorax widened and rounded from the fore to the hind part; lateral spines stout and uncurved, placed a short distance from the hind angles, and the thorax greatly narrowed behind them; surface blackish, varied with silky grey marks. Elytra ovate, slightly convex, narrowed near the apex, and briefly and obliquely truncated; surface punctured, tawny brown, varied with blackish spots of various sizes, and having over the scutellar region a large black triangular spot broadly margined with tawny ashy. Body beneath dusky tawny, clothed with fine ashy pile. Legs dull red; thighs dusky and distinctly clavate.

S. Paulo, Upper Amazons. The place of this species will be in the second division of the genus, near *L. dorcadioides*.

Genus Sporetus.

3. *Sporetus decipiens*, n. sp.

S. elongatus, *Colobotheæ* speciei simillimus, setosus, olivaceo-niger; capite cinereo trivittato; thorace vitta lata laterali cinerea, medio nigro lineolata; elytris thorace basi duplo latioribus, elongatis, sinuato-truncatis, maculis cinereis in lineas transversas flexuosas irregulariter ordinatis, apice albo marginatis. Long. $4\frac{3}{4}$ lin. ♂.

Head narrow, black; forehead with three ashy stripes, besides a streak underneath each eye; vertex with an ashy central line, and a broad lateral stripe, the latter continuous with both the lateral stripe of the forehead and the cheek stripe. Antennæ black, fourth joint ringed with ashy. Thorax very slightly widened from the front to beyond the middle, armed at that point with a minute tubercle, and then narrowed again to the base; surface black, sides each with a broad ashy stripe, in the centre of which is a short black line. Elytra twice the width of the thorax at its base, elongated, narrowed near the apex, the latter broadly sinuate-truncate (angles not produced); surface punctured, olivaceous black, marked with a number of small dingy-ashy spots, most of which are confluent, and tend to form three transverse flexuous lines. Body beneath plumbeous black;

sides, from the prothorax to the apex of the abdomen, ashy. Legs black, basal joint of tarsi grey.

♂. Apical ventral segment truncated, sharply notched in the middle; dorsal segment slightly emarginated in the middle.

Pará. The species resembles greatly in form and coloration certain species of *Colobothea*. The absence of a lateral carina to the elytra readily distinguishes it from that genus.

Eutrypanus Colobotheides, White (Cat. Long. Col. Brit. Mus. ii. p. 372), belongs also to our genus *Sporetus*.

XLVI.—*Note on the Identity of certain Species of Diurnal Lepidoptera.* By Arthur Gardiner Butler, F.Z.S.

For the information contained in the present paper I am indebted to M. Victor von Bönninghausen, who visited the British Museum a few days ago for the purpose of seeing the collections. This gentleman has resided for some years at Rio Janeiro, where he has been engaged in studying the transformations of Lepidoptera.

Whilst looking through the collection of Diurnal Lepidoptera, M. Bönninghausen pointed out several apparently good and distinct species as opposite sexes of the same insect; and, upon examination, I find the one form to be represented by males only, and the other by females.

There can be no doubt of the possible identity of apparently distinct species, as many curious instances of dissimilarity in the sexes of Diurnal Lepidoptera are already well known; yet men are generally slow to believe what they have not personally proved; and thus in many instances the opposite sexes of a species have been kept apart until the continued assertions of eye-witnesses, or perhaps the arrival of an hermaphrodite specimen, have at length removed all doubt of their identity.

The following insects have been bred by M. Bönninghausen, and are said by him to be sexes:—

♂. *Papilio torquatus*, Cramer, Pap. t. 177. f. A. B. (1776).
♀. *Papilio Polybius*, Swainson, Zool. Ill. ser. 1. t. 137 (1821).
Bred from larvæ, and taken *in copulâ*.

♂. *Papilio torquatinus*, Esper, Aust. Schmett. t. 45. f. 2 (1785–98).
♀. *Papilio Argentus*, Martyn, Psyche, pl. 14. f. 34 (1797).
Bred from ova found on orange-trees.

In Mr. G. R. Gray's 'Catalogue of Lepidoptera,' pt. 1. p. 40, *Papilio Lysithous* is placed as the male of *P. Argentus*. We do not, however, possess this insect; but, judging by the figure, I hould myself imagine it to be a variety of *P. Argentus*. The abdomen is rather narrower than in our specimens of that insect, but, I think, too stout for a male insect; however, it is impossible to be sure of the sex of an insect merely by an examination of a figure.

Mr. H. W. Bates, in two papers on the Lepidopterous Fauna of the Amazons Valley, gives *P. Caudius*, Hübner, as the female of *P. torquatus*; but I think it possible that *P. Caudius* may be an Amazonian form of *P. Argentus*, as the two insects are very similar in pattern and coloration.

The following notes on the species I take from Mr. Bates's papers:—

Trans. Ent. Soc. vol. v. n. s. pt. 8. Nov. 1860. "Group 6.

"*P. torquatus*, ♂, Cramer, pl. 177. f. A. B.
♀, Hübner, Samml. (as *Caudius*).
Local var. *Patros*, ♀, Gray, Cat. B.M. p.43, pl. 7. f. 5,7,8.

"The female varies very much between the Upper and the Lower Amazons. The difference is so great between the sexes that it is only the evidence afforded by having captured *P. torquatus* and *P. Caudius* in copulâ that induces me to place them together. Every example examined shows all the individuals of *P. torquatus* to be ♂, and all those of *P. Caudius* and *P. Patros* to be ♀.

"The female frequents, like the species of the *Æneas* group, the shades of the forest, coming out only on dull days to the borders. The male, although choosing the open sunlight, descends also into the sunny breaks and open glades of the forest. I have often seen the male in pursuit of the female, although I have only once detected it *in copulâ*."

Journal of Entomology, December 1861, p. 228. no. 30.

"The ♂ inhabits open places in company with *P. Thoas* and allies, but sometimes descends into sunny breaks in the forest; the ♀ almost exclusively inhabits the forest, being found at flowers on its borders only in cloudy weather."

We have an analogous instance of difference in the sexes in the *Pammon* group, where almost precisely the same changes in pattern and coloration take place.

The two following are also said to be sexes:—

♂. *Euterpe Swainsonii*, G. R. Gray, in Griffith's 'Animal Kingdom,' t. 38. f. 2, 3 (1832).

♀. *Euterpe Leucodrosyme*, Kollar, Wien. taf. 44. f. 3, 4. Reared from pupæ.

Besides these species, there were many others which M. Victor von Bönninghausen pointed out, the sexes of all which had, however, been previously known to science.

XLVII.—*Notulæ Lichenologicæ*. No. VI. By the Rev. W. A. Leighton, B.A., F.L.S.

Dr. Ernst Stizenberger, of Constance (Baden), Germany, has kindly sent me a copy of his valuable paper on the saxicolar species of *Opegrapha*, illustrated with two plates containing about two hundred figures of spores, &c., which has recently appeared in vol. xxxii. of the Transactions of the Academy Naturæ Curiosorum at Dresden. As this paper contains so much that is interesting to British lichenists, a "Conspectus," which appears in the 'Flora' of Feb. 22, 1865, is here given.

Conspectus specierum saxicolarum generis Opegraphæ. Auctore E. Stizenberger, Med. Dre.

A. Species saxicolæ, sporis 6–plurilocularibus.

1. *Opegrapha farinosa* (Hmpe.), Hepp.

O. rupestris β. farinosa, Hmpe.

Thallus rimoso-areolatus, flavo-griseus. Apothecia primum immersa, rotundata, denique paulum emersa, oblonga, plerumque simplicia (1–1·5 millim. longa, 0·3–0·5 millim. lata), nigra; epithecio e rimiformi plano, margine primum rotundato, deinde angustato vel obliterato. Hymenium (50–60 mik. altum) hyalinum, in hypothecio dilute fusco, e paraphysibus discretis et ascis clavatis (50–55 mik. longis, 10–14 mik. latis) compositum. Sporæ $8^{næ}$, crasse aciculares, rectæ vel curvulæ, 5–7- (raro 3-) septatæ, hyalinæ (20–28 mik. longæ, 2–3 mik. crassæ). Hymenium tinctura iodii fulvescens. Spermogonia non reperta.

In rupibus ad Blankenburg (Hercyniæ), leg. Dr. E. Hampe.

2. *Opegrapha vulgata* f. *lithyrga*, Ach.

O. lithyrga, Hepp., Körb. (incl. *β. grisea*). *O. vulgata*, vv. *lithyrga* et *steriza*, Nyl. Scand. Exs. Fw. 83; Zw. 1 a b, 3. 354; Hepp. 348; Körb. 138; Krypt. Bad. 302.

Thallus tenuis, subdeterminatus, farinaceus, sordide griseus vel cinereo-viridis v. albus v. ochraceus, interdum deficiens. Apothecia sessilia, plerumque anguste linearia recta vel flexuosa (1–2·5 millim. longa, 0·1–0·2 millim. lata), simplicia vel divaricato- rarissime radiato-ramosa vel conglobato-difformia nigra; epithecio rimiformi, ætate paulum dilatato, margine tumido, rotundato. Hymenium (60 mik. altum) in hypothecio nigro, hyalinum, e paraphysibus distinctis et ascis clavatis (40–55 mik. longis, 14 mik. latis) compositum. Sporæ $8^{næ}$, fusiformes vel bacillares vel clavatæ rectæ vel curvulæ, 5–7-septatæ, hyalinæ (20–28 mik. longæ, 3, raro 4–5 mik. crassæ). Hymenium tinctura iodii vinose rubescens. Spermogonia globosa, alba, apice denigrata. Spermatia cylindrica, recta vel curvula (4–5 mik. longa, 1 mik. crassa).

In rupibus schistosis, granitaceis, gneisiacis, porphyricis, arenaceis, trachyticis, raro in radicibus vel rhizomatibus, Germaniæ, Helvetiæ, Hungariæ, Fenniæ.

Obs. Thallus valde variabilis at nil typici in hisce formis inest. Formæ apotheciis radiato-ramosis ad varietatem *subsiderellam,* Nyl. Scand. accedunt.

3. *Opegrapha zonata,* Körb. Syst. et Pg.

O. tristis, Fw. p. p. Exs. Körb. 18; Arn. 183; Rbh. 517.

Thallus tenuis, fuscus, albo-soreumaticus, lineis atris decussato-limitatus (sæpe *Chroolepo* conspurcatus). Apothecia aggregata, sessilia, rotundata vel ovalia (0·5 millim. longa, 0·3–0·4 millim. lata), nigra; epithecio rotundato vel elliptico, concavo, margine prominente rotundato, ætate attenuato. Hymenium in hypothecio fusco, dilute fuscescens (80 mik. altum), e paraphysibus ramosis intricatis et ascis clavatis (70 mik. longis, 16 mik. latis) compositum. Sporæ $8^{næ}$, fusiformes, graciles, rectæ vel curvulæ, hyalinæ, raro infuscatæ, 5–11-septatæ (25–37 mik. longæ, 4–6 mik. crassæ). Hymenium præsertim protoplasma ascorum tinctura iodii pulchre vinose rubescens. Spermogonia minute punctiformia. Spermatia tenella, cylindrica, recta (6 mik. longa, 0·5 mik. lata), in sterigmatibus brevisetiformibus.

In regione montana Silesiæ, Franconiæ, Badeniæ, Longobardiæ ad rupes varias.

4. *Opegrapha varia,* Pers. (*notha* Ach.) *saxicola.*

O. variæformis, Anzi, Comm. Soc. Critt. It. p. 160 (ut videtur).

f. *pulicaris* (Hffm.) *saxicola.*

Syn. ut formæ sequentis.

Thallus tenuis, farinaceus vel leprosus vel nullus (interdum *Chroolepo* conspurcatus). Apothecia sparsa, sessilia, elliptica vel lanceolata, apicibus obtusis, simplicia, raro tridentata, recta (0·5–1 millim. longa, 0·2–0·5 millim. lata), nigra; epithecio pliciformi, ætate dehiscente, interdum viridi-suffuso, margine persistenter prominente. Hymenium (60 mik. altum) hyalinum, superne olivaceum e paraphysibus conglutinatis et ascis clavatis (50–55 mik. longis, 16–18 mik. latis) compositum. Sporæ $8^{næ}$, subfusiformes vel clavatæ, 5-septatæ, ætate fuscæ (20–23 mik. longæ, 6–7 mik. crassæ). Hymenium tinctura iodii vinose rubescens. Spermogonia punctiformia, nigra. Spermatia cylindrica, recta (5 mik. longa, 1 mik. crassa), in sterigmatibus setiformibus (ca. 15 mik. longis).

Obs. Maximam partem sub forma sequente adhuc latet. Eam e Franconia (in rupibus dolomiticis prope "Gailenreuther Höhle," necnon ad Casendorf et ad rupes arenaceas montis Hohenlandsberg. Hbb. Rehm et Arnold), necnon e Badenia (ad rupes arenaceas prope Heidelberg, in Hb. Zw.) vidi.

f. *diaphora,* Ach. *saxicola.*

O. variæ, ff. Fries, Nyl. *O. tridens β. arenaria,* Ach. *O. argillicola,* Duby.

Graphis saxatilis, Wallr. *O. saxatilis*, Leight., Körb. (incl. *β. pruinosa*), Arn., Mudd. *O. lithyrga*, Moug.-Nest. *O. Mougeotii*, Mass. Anzi, Venet. *O. saxicola*, *β. amylacea*, Mass. Anzi Venet. *O. Körberiana*, Müll. *O. pruinosa*, Hepp. Herb. Exs. Moug.-Nest. 856; Zw. 2. 145 B; Rbh. 620; Anzi, Longob. 407, Id. Venet. 103, 106; Hepp. 765 (ined.).

Thallus effusus, farinoso-pulveraceus vel tartareus, tenuior vel rarius crassior, imo tuberculoso-areolatus, albus (sæpius algis conspurcatus), raro deficiens. Apothecia sparsa vel cumulata, majora (ad 2·5 millim. longa, 0·5 millim. lata), elongata, utrinque attenuata, recta vel curvula vel plicata, simplicia, raro ramulo laterali nigra; epithecio primum rimiformi, dein dilatato, plano, albo-cæsio- vel viridi-pruinoso vel nudo, margine subpersistente. Hymenium hyalinum (60–100 mik. altum), superne fuscatum, in hypothecio denigrato, e paraphysibus capillaribus sat distinctis et ascis clavatis 60–80 mik. longis) compositum. Sporæ 8^{næ}, crasse fusi- vel claviformes, 5- rarius 3–7-septatis, ætate fuscæ (20–32 mik. longæ, 6–8 mik. latæ), sæpe halone involutæ. Hymenium tinctura iodii vinose rubens. Spermogonia nigra, punctiformia. Spermatia cylindrica, in sterigmatibus setiformibus (5 mik. longa, 1 mik. crassa).

In rupibus calcareis vel arenaceis, tegulis, raro in rupibus azoicis et in terra argillacea Italiæ, Helvetiæ, Germaniæ, Galliæ, Angliæ, Sueciæ meridionalis. Interdum in Rubos et Hederas transmigrans.

B. Species saxicolæ, sporis 4-locularibus.

5. *Opegrapha atra*, var. *calcarea*, Turn. Ach. non Aut.

O. saxatilis, Fr. p. p.

Thallus pulveraceo-tartareus, rimuloso-areolatus, albus. Apothecia sessilia, elongato-elliptica, utrinque obtusa, recta, nigra, opaca, stellatim conferta (vix 1 millim. longa, 0·2 millim. lata); epithecio anguste rimiformi, margine tumido. Hymenium (ca. 60 mik. altum) hyalinum, in hypothecio nigro-fusco, ex ascis pyriformibus (35–50 mik. longis, 18 mik. latis) pariete apicali incrassato et paraphysibus distinctis compositum. Sporæ 8^{næ}, elongato-ellipticæ vel soleæformes, 3-septatæ, hyalinæ (14–16 mik. longæ, 4–5 mik. crassæ). Hymenium tinctura iodii cærulescens. Spermogonia nigra punctiformia. Spermatia tenella, recta (5–6 mik. longa, vix 1 mik. crassa).

In rupibus calcareis Galliæ et Angliæ.

f. *tenuior*, Nyl. sec. spec. miss.

Apotheciis gracilioribus linearibus differt. Sporæ et spermatia sicut in typo.

Ad Oran in Algeria.

Var. *trifurcata*, Hepp.

O. trifurcata, Hepp. in Müll. Genev. p. 67. *O. exilis*, Garov. in hb. Zw. *O. confluens*, Hepp. Arn. in hac Flora. *Arthonia confluens*, Körb. Pg.

Thallus tenuis, tartareus, continuus, albus. Apothecia insulari-aggregata, sessilia, minuta, linearia (0·3–1 millim. longa, 0·2 millim. lata), sæpius trifurcata, recta v. curvula, nigra; epithecio angusto, margine tumido, inflexo, splendente. Hymenium (ca. 50 mik. altum) vel hyalinum vel viridi-flavescens e paraphysibus dilutis et ascis pyriformibus pariete apicali incrassato (40–45 mik. longis, 18 mik. latis) compositum. Sporæ 8^næ^, 3-septatæ, hyalinæ (14–16 mik. longæ, 5–7 mik. crassæ). Hymenium tinctura iodii vinose rubens. Spermogonia non reperta.

In rupibus Italiæ superioris, Helvetiæ, Franconiæ.

Var. *Chevallieri* (Leight.).

O. Chevallieri, Leight. Brit. Graph. p. m. p., minime *O. saxatilis*, *β. pruinosa*, Körb. Pg. Exs. Leight. 67. 242; Anzi, Etr. 37.

Thallus effusus, tenuis, tartareus, interdum rimulosus, albus vel flavescens, raro deficiens. Apothecia sessilia, insulari-aggregata, lineari-cylindrica (0·1–0·2 millim. latæ, longitudinis variæ), curvula, utrinque obtusa, simplicia vel ramosa vel stellatim conferta, nigra; epithecio anguste rimiformi, margine tumido splendente. Hymenium (ca. 55–60 mik. altum), hyalinum e paraphysibus sat distinctis et ascis pyriformibus (40–50, raro 60 mik. longis, 18 mik. latis) compositum. Sporæ 8^næ^, elongato-ellipticæ, 3-septatæ, hyalinæ (14–18 mik. longæ, 4–6 mik. crassæ). Hymenium tinctura iodii vinose rubens. Spermogonia nigra, punctiformia. Spermatia cylindrica, recta vel curvula (8 mik. longa vix 1 mik. crassa).

In saxis calcareis Italiæ, Dalmatiæ, Galliæ, Angliæ, Cypri.

f. *heteromorpha*, Hepp.

O. Chevallieri, Leight. et Mudd, p. p. *O. Chevallieri* forma Nyl. Armor.

Thallus obsoletus. Apothecia majora (3 millim. longa, 0·4 millim. crassa) utrinque subacuta, simplicia vel ramosa, recta vel curvata, interdum congesta, nigra. Epithecium nonnihil dilatatum. Structura interna sicut in var. *Chevallieri*. Spermogonia crebra.

In saxis schistosis Galliæ et Hiberniæ ad litora maris.

6. *Opegrapha confluens* (Ach.).

O. lithyrga, *β. confluens*, Ach. Univ. *O. vulgata* v. *steriza*, Nyl. Gall. *O. tesserata*, Bagl. *O. conferta*, Anzi. Exs. Nyl. Paris, 144; Anzi, Etr. 36; Rbh. 339; Erb. Critt. 396, 695.

Thallus effusus, tenuissimus, griseo-viridis, sæpius obsoletus. Apothecia sessilia, simplicia, nigra, opaca, crasse cylindrica (1–2 millim. longa, 0·25–0·5 millim. crassa), recta vel sæpius curvata vel contorta, rarissime solitaria, sparsa, vulgo conferta vel conglobata; epithecio anguste rimiformi, ætate subdilatato, margine primum rotundato, inflexo, mox acuto. Hymenium (ca. 60 mik. altum) hyalinum, in hypothecio nigro, e paraphysibus liberis septatis ramosis superne capitatis infuscatis et ascis crasse claviformibus (55 mik. longis, 18 mik. crassis) compositum. Sporæ 8^næ^, elongato-ovales vel soleæformes, 3-septatæ, vulgo hyalinæ (15–20 mik. longæ, 4–7 mik. crassæ). Hymenium tinctura iodii cærulescens. Spermogonia nigra punctiformia. Spermatia cylindrica (6–7 mik. longa, 1 mik. crassa).

In rupibus granitaceis, schisto-talcaceis, et arenaceis Italiæ, Galliæ, Angliæ, Scandinaviæ.

7. *Opegrapha saxicola*, Ach. Syn. p. 71 ; Mass. Mem. p. 102 (excl. syn. et var.) ; Nyl. Scand.

O. rupestris, Pers. et Aut. *O. saxatilis*, Schär. p p. ; Kremph. p. p. *O. gyrocarpa*, Körb. p. p. *O. rupestris* v. *dolomitica*, Arn. Exs. Schär. 94; Hepp, 346; Leight. 243; Zw. 145 A; Körb. 197 ; Arn. 104 ; Rabh. 334.

Thallus crustaceus effusus, continuus, tenuis, leprosus, albus v. griseus v. cæsius v. flavescens (interdum algis varie coloratus). Apothecia sparsa, nonnihil innata, lævia, rotundata vel elliptica, alterutro apice plerumquė obtuso vel abbreviato-linearia (1 millim. longa, ad 0·5 millim. lata), recta vel curvula, simplicia, rarius triradiata, rarissime tuberculato-difformia vel glyphiformia, nigra, margine primum rotundato, mox attenuato, acutiusculo, epithecio primum angusto tandem dilatato. Hymenium in hypothecio nigro vel hyalinum vel flavescens vel fuscescens, superne infuscatum (80–120 mik. altum), e paraphysibus filiformibus plus minusve liberis et ascis crasse claviformibus (60–80 mik. longis, 12–20 mik. latis), pariete apicali vix incrassato. Sporæ 8[næ], oblongo-ellipticæ vel clavatæ, altero vel utroque apice rotundato, 3-septatæ (20–30 mik. longæ, 5–8 mik. crassæ), hyalinæ, rarius fuscæ. Hymenium tinctura iodii vinose rubens. Spermogonia punctiformia, nigra. Spermatia cylindrica, tenella (5–6 mik. longa, 0·5 mik. crassa), in spermatophoris filiformibus.

In rupibus arenaceis, calcareis et dolomiticis Italiæ, Helvetiæ, Galliæ, Angliæ, Germaniæ.

Var. *Decandollei*, Stizb.

O. saxatilis, DC. Fl. Franc. (teste J. Müll. Genev.); Schär. p. p.; Mass. Mem. 102. *O. saxigena*, Tayl. *O. rupestris*, *β. saxigena*, Hepp. Exs. Leight. 311 ; Hepp. 347; Anzi, Longob. 406, Id. Venet. 104.

A typo differt, thallo crassiore, albido, apotheciis magis immersis, minoribus (0·5–0·6 millim. longis, 0·2–0·4 millim. latis), rotundatis, insulatim confertis, margine tumido, persistenter rotundato, epithecio nunquam dilatato, ascis sporisque nonnihil minoribus. Spermogonia et spermatia sicut in typo.

In rupibus calcareis Italiæ, Helvetiæ, Germaniæ, Angliæ.

Obs. Nomen novum propter homonymiam nominum saxatilis et saxigenæ cum nomine specifico allatum benevole excusare velis.

Var. *centrifuga*, Mass.

O. centrifuga, Mass. Misc. et Aut. Exs. Anzi, Venet. 102.

Thallus effusus, farinoso-leproso-tartareus, cinereo-albescens vel cæsius. Apothecia in annulos circulares disposita, nigra, splendentia, rotundata vel elongato-elliptica (0·5 millim. longa, 0·2 millim. lata); margine rotundato epithecium rimiforme nonnihil dilatatum obtegente. Hymenium in hypothecio fusco e paraphysibus crassis, septatis ramosis et ascis clavatis (60 mik. longis, 17 mik. latis) compositum. Sporæ 8næ, hyalinæ vel fuscæ, 3-septatæ, oblongo-ellipticæ (15 mik. longæ, 5 mik. crassæ). Spermatia cylindrica, recta, in spermogoniis punctiformibus, nigris.

Ad saxa dolomitica prope Eichstadt.

Var. *gyrocarpa* (Fw.).

O. gyrocarpa, Fw., Körb. *O. gyrocarpa α arenaria,* Id. Pg. 251. *O. rupestris* v. *rufescens,* Fw. *O. rupestris,* Fr. Exs. Fw. 79 A, B, C; Körb. 229.

Thallus lineis nigris determinatus, tenuissimus, fusco-cinereus (sæpe *Chroolepo* conspurcatus), nonnunquam obliteratus. Apothecia dispersa, sessilia, rotundata vel rotundato-elliptica, rarissime elongata, nigra; epithecio plano vel plicato per exceptionem concavo, margine tenui, rotundato. Hymenium hyalinum (80–100 mik. altum) in hypothecio nigro-fusco, e paraphysibus crassis liberis et ascis late claviformibus (65 mik. longis, 15 mik. latis) compositum. Sporæ elongato-ellipticæ vel clavatæ, rectæ vel curvulæ, 3- (rarissime 1- vel 4–6-) septatæ (20–25 exceptione 30 mik. longæ, 4–5 mik. crassæ), hyalinæ. Spermatia cylindrica, recta 6 mik. longa, 5 mik. crassa), in spermogoniis punctiformibus, nigris.

In saxis primitivis Germaniæ, Hiberniæ.

Var. *Persooni* (Ach.).

O. Persooni, Ach., Nyl.

A typo differt, thallo griseo leproso-soreumatico, apotheciis plicatis, confluentibus, sporis vulgo utrinque acutiusculis.

In Scandinavia, Gallia, Franconia superiori.

8. *Opegrapha lutulenta,* Nyl. Prodr. Gall. 153.

(Non vidi.)

["Thallus opacus, sordide rufescens effusus, satis tenuis, fere leprosus, integrior rimose diffractus; apothecia atra, nuda, superficialia, ellipsoidea vel oblongo-difformia, crasse marginata, epithecio in vetustioribus dilatato-concaviusculo vel plano, in junioribus rimiformi, intus nigricantia; sporæ oblongæ, 3-septatæ, longit. 0·015–0·018 millim., crassit. 0·006–0·007 millim.; hypothecium crasse nigrum, paraphyses discretæ. Gelatina hymenea partim cærulescens, partim vinose fulvescens.

"Ad lavam prope Agde Galliæ meridionalis. Affinis *O. grumulosæ.*"]

9. *O. endoleuca,* Nyl. ibid.

(Non vidi.)

["Thallus tenuis, albus; apothecia superficialia, lineari-lanceolata, persistenter marginata, epithecio concaviusculo, albo-suffuso, intus albida; sporæ oblongo-ovoideæ, 3-septatæ, longit. 0·013–0·016 millim., crass. 0·005–0·006 millim.; hypothecium dilute rufescens, lateribus (margine) modo denigratum. Gelatina hymenea iodo cæruleo tincta.

"Ad cimentum muri prope Agde, versus pharum. *O. Duriæi* est affinis, sed apotheciis aliis."]

10. *O. grumulosa*, Duf.

Lecanactis, Fr. *O. varia*, var. *calcaria*, Schær. p. p.
Exs. Anzi, Longob. 404.

Thallus determinatus, crassus, ambitu undulatus, tuberculoso-tartareus, superficie farinosus, albus. Apothecia primum immersa, elliptica rotundatave, denique elevata, sessilia, lanceolata vel difformia, nigra (ca. 1 millim. longa), margine tenui, persistente, nudo, elevato; epithecio plano, cæsio-pruinoso. Hymenium hyalinum (60 mik. altum), in hypothecio crasso, nigro-fusco, e paraphysibus crassis, superne brevi-ramosis, subconglutinatis, et ascis lanceolatis (50 mik. longis, 15 mik. latis) compositum. Sporæ $8^{næ}$, elongato-ellipticæ, interdum fusiformes, 3-septatæ, hyalinæ (15–17 mik. longæ, 3–4 mik. latæ). Hymenium tinctura iodii vinose rubens. Spermogonia non reperta.

Obs. De hujus speciei varietatibus tribus cf. Nyl. l. c. De varietate *arthonoidea* hic adnotare liceat sporas in ea multo majores necnon aliter formatas esse quam in typo.

11. *Opegrapha Monspeliensis*, Nyl.

Thallus deficiens. Apothecia in *Lecanora calcarea* parasitice vigentia innata, elongato-elliptica vel nonnihil difformia (0·5–0·7 millim. longa, 0·2–0·3 millim. lata), simplicia, raro furcato-divisa, margine prominente rotundato. Hymenium (50–70 mik. altum) hyalinum, in hypothecio nigro-fusco, e paraphysibus crassis, ramosis, liberis, et ascis late clavatis (50 mik. longis, 15–18 mik. latis) compositum. Sporæ $8^{næ}$, oblongo-ovoideæ, raro ellipticæ, 3-septatæ (16–20 mik. longæ, 6–7 mik. crassæ) fuscæ. Hymenium tinctura iodii vinose rubens.

Prope Monspelium.

12. *Opegrapha opaca*, Nyl. Prodr. Gall. 154.

(Non vidi.)

["Thallus opacus, fuscus, rimoso-areolatus; apothecia parva, innata, ellipsoidea vel nonnihil difformia; epithecio primum rimiformi, dein dilatato concaviusculo, intus nigricantia; sporæ oblongo-ovoideæ, 3-septatæ, long. 0·012–0·017 millim., crass. 0·005–0·006 millim.; hypothecium crasse nigrum (infra, ut lateribus). Gelatina hymenea iodo (e levissime cærulescente) dilute vinoso rubens. Spermatia recta.

"Prope Monspelium, ad lapides calcareos."]

13. *Opegrapha herpetica*, Ach.

Calcicola prope Parisios a cl. Nylandero reperta a typo corticicolo vix diversa est.

14. *Opegrapha Duriæi*, Mont. Nyl.

O. calcarea, Rbh. Exs. Rbh. 22!

Thallus sat tenuis, linea nigra determinatus, superficie amylaceus vel cretaceus albus. Apothecia innata, dispersa, simplicia vel varie ramosa, late linearia (1–1·5 millim. longa, 0·25 millim. lata); epithecio albo-suffuso, rimiformi. Hymenium (100 mik. altum) in hypothecio fere incolori e paraphysibus liberis et ascis clavatis (70 mik. longis, 18 mik. latis) compositum. Sporæ 8næ, elongato-ellipsoideæ vel late clavi- vel fusiformes, 3-septatæ, hyalinæ (20–26 mik. longæ, 6–8 mik. crassæ). Hymenium tinctura iodii vinose rubens. Spermatia cylindrica, recta, vel leviter curvula (5–6 mik. longa, 1 mik. lata).

Ad rupes calcareas Algeriæ nec non insularum maris Adriatici.

C. Species saxicolæ, sporis 2-locularibus.

15. *Opegrapha Elisæ*, Mass.

Encephalographa, Id. Symm. 66. Exs. Anzi, Venet. 108.

Thallus linea nigra determinatus, tenuissimus, e viridi flavo-cinereus. Apothecia linearia, primum solitaria, nonnihil immersa, denique sessilia et acervulos contortos formantia, margine rotundato, epithecio rimiformi. Hymenium hyalinum, superne denigratum, in hypothecio nigro, e paraphysibus gracillimis coalitis et ascis late claviformibus (40 mik. longis, 16 mik. latis) compositum. Sporæ 8næ, ellipticæ vel ovales, 1-septatæ, olivaceæ (12–14 mik. longæ, 6–7 mik. crassæ).

Ad rupes dolomiticas Italiæ superioris.

16. *Opegrapha aphoristica*, Nyl.

In lit., descriptione ampliori non addita.

Ad rupes insularum Canariensium (non vidi).

XLVIII.—*Observations on the "Prodrome of a Monograph of the Pinnipedes, by* Theodore Gill." By Dr. J. E. Gray, F.R.S., V.P.Z.S.

In the fifth volume of the 'Proceedings of the Essex Institute,' published on the 7th of April, 1866, Mr. Theodore Gill has published a "Prodrome of a Monograph of the Pinnipedes." He states that it is founded on the examination of the skins, skulls, and skeletons possessed by the Smithsonian Institution, the Academy of Natural Sciences of Philadelphia, the museum of the Essex Institute, and of Professor Wyman. It may be observed that the "Prodrome" founded on the examination of these museums does not furnish the author with a single species that has not been described in Europe; and the author informs us that they did not afford him any specimens of several well-known genera, as *Monachus, Lobodon, Leptonyx, Ommatophoca,* as is recorded in page 8. And it is evident also that the author has not seen the American genus *Halicyon*; for he refers it to the genus *Phoca*, as "*Gill ex Gray*." Indeed, as far as this paper is concerned, the author need not have consulted any specimens whatever, as almost all the characters he gives are to be found in published papers which have chiefly appeared in the 'Proceedings of the Zoological Society of London.'

This absence of new matter is more extraordinary, as there are several Seals noticed and imperfectly described in American voyages and travels which seem, from the short account given of them and from their habitats, to be very probably distinct from those known in Europe.

In the Appendix to the "Prodrome," there is a list of the Pinnipedes of California, Oregon, &c.; and in it Mr. Gill mentions "*Macrorhinus angustirostris*, Gill, California," observing, in a note, "It is distinguished by its narrow snout and the form of the palatine bones, &c. It will be described in the Proc. Chicago Acad. Sc." But he takes no notice of it in the "Prodrome of the Monograph." A Sea-Elephant from the North Pacific is very probably a distinct species, and certainly was worthy of being more fully described.

This is not the only species that is left out of the "Prodrome." No notice is taken, for example, of the *Phoca Largha* of Pallas, from Japan, or of the Australian Eared Seals *A. lobatus*, *A. cinereus*, and *A. australis*; and he even does not include the two Seals from Jamaica, viz. *Cystophora Antillarum* and *Phoca tropicalis*, and only mentions them, in a note, as if they were a single species—saying, "Its West-Indian habitat requires confirmation," overlooking the fact that they were both collected in Jamaica, and sent home direct from the island, by Mr. Gosse.

As the author has nothing new to describe, or, at least, refers all the materials at his command to well-known species, he proceeds to change the names which have been applied to well-established genera (always a great evil to science); but it is a change that any tyro in natural science, however little acquainted he may be with a group, can easily make, and find an excuse for so doing.

Naturalists have generally agreed that the twelfth edition of Linnæus's 'Systema Natura' is to be regarded as the standard of the Linnean nomenclature; but Mr. Gill says "the tenth edition, of 1750, the first in which the binominal system was introduced," is the standard; and thus he finds an excuse for changing the type used for the genera *Phoca* and *Trichechus*, and this gives him the opportunity of applying the name *Erignathus* to the genus *Phoca* as defined by F. Cuvier. In the same manner Mr. Gill says F. Cuvier quoted *Phoca ursina* as the type of the genus *Arctocephalus,* and therefore that generic name must be retained for the true *Phoca ursina*—overlooking the fact that the skull figured and described by F. Cuvier as the type of his genus is not that of the *Phoca ursina* of Behring's Straits, to which Mr. Gill wishes to attach it, the fact being that until lately almost all the sea-bears or *Arctocephali* were called *P. ursina.* This allows Mr. Gill to give the name of *Eumetopias* to the *Arctocephali* of F. Cuvier, and *Arctocephalus* to the genus which I defined as *Callorhinus.*

In the 'Proceedings of the Zoological Society,' when describing the skulls of the sea-bears in the British Museum, I divided a genus into sections according to the form of the palate. Mr. Gill has applied to two of these sections the generic names of *Zalophus* and *Halarctus.*

There is one observation of importance in the paper: Mr. Gill observes, "the *Halichœrus antarcticus* of Peale, very erroneously identified with *Lobodon carcinophaga* by Dr. J. E. Gray, is a typical species of *Phoca.*" But he might have stated that Cassin, in his text to the plates of the Peale Expedition, refers it to *Lobodon carcinophaga* (see p. 25), and that I stated the figure of the skull was "not good" for *Lobodon,* that Peale says it inhabited the *Antarctic Sea,* and that the teeth in the figure of the skull given by Peale and repeated by Cassin are very unlike those of a typical *Phoca,* and somewhat like those of *Lobodon.* On re-reading Peale's description, I think that it is very probably a new genus, more allied to *Phoca* than to *Lobodon*; for he says it has six cutting-teeth in the upper jaw, and that the four posterior molar teeth in both jaws are double-rooted, their crowns many-lobed, the cutting-teeth short, simple, and curved; the whiskers flattened, waved on the edges. To the animal so characterized the generic name of *Haliphilus* may be applied.

Though Mr. Peale distinctly says this Seal inhabits the Antarctic Sea, Mr. Gill observes, it "appears to be identical with a species occurring along the Californian and Oregonian coasts; consequently there must be some error as to its assigned habitat in the Antarctic Sea. I am happy to add that Mr. Peale himself now doubts the correctness of the label on the faith of which he gave its habitat; and as a change of name is desirable, I would propose that of *P. Pealei.*" Mr. Peale does not describe the colour of his Seal. Probably the Seal with which Mr. Gill compares it is the *Hair Seal,* figured in Hutching ('Scenes of Wonder and Curiosity in California,' p. 180) as the "Hair Seal, *Phoca jubata*" (!), from the Tarallone Islands, the *Halicyon? Californica* of my Catalogue of Seals and Whales in the British Museum, p. 367.

XLIX.—*On the Developmental History of the Nematode Worms.* By Rudolph Leuckart.

[Continued from p. 347.]

I am acquainted with phases of development similar to those last described in *Sclerostomum equinum*, the notorious palisado worm of the horse (*Strongylus armatus*, auctt.), not, however, from the intestine, in which I have always found the worm in full sexual maturity, but from aneurismatic dilatations of the mesenteric arteries, which are produced by the parasitism of this animal, and frequently (when great numbers are present) increase to a very considerable size. Contrary to what occurs in the intestine, we find in these aneurisms nothing but young forms of the worm (the so-called small variety), from which I am inclined to think that the worm passes only thence into the intestine, probably through the peripheral ramifications of the mesenteric arteries. If my supposition be well founded, the worm must certainly bore through the wall of the intestine at a time when it is already of the considerable length of 15–20 millims. (thickness = 1 millim.); but the powerful armature of the mouth, and especially the denticulation of the margins of the lips, which almost involuntarily remind one of a trephine, show that this process cannot be attended with any great difficulties.

The youngest of the worms detected by me (as also previously by Mehlis, Gurlt, and Dujardin) in the aneurisms had a length of about 10–12 millims. From their grade of development, they might be compared with the intermediate forms of *Dochmius* and *Cucullanus*, although differing from these not only by their larger size, but also by the want of the buccal cup. Instead of the latter, the worms (like the young forms of *Ollulanus*) possess in the periphery of the gaping buccal orifice a rosette-like plate with six laminæ, which exhibit an elegant sculpture. The caudal extremity is short and pointed, and, in the small specimens, of perfectly concordant structure; whilst among the larger worms we may distinguish specimens with slenderer tails, and others with a shorter and plumper posterior extremity. In the former the tail is longer than broad; in the latter, on the contrary, broader than long, and truncated at the apex (which is directed dorsally).

If we subject the latter specimens to a closer examination, we at once find that they are the male animals. However, we are led to this conviction less by the still rudimentary internal sexual organs than by the copulatory apparatus, which is developed beneath the cuticular covering of the inflated posterior extremity, and becomes more and more recognizable with increasing age.

The formation of these organs is commenced by the parenchyma of the body in the periphery of the anus separating from the chitinous envelopes and gradually removing further from it. In this way a dome-shaped cavity is produced in the interior of the caudal extremity, its axis being traversed by the lobately projecting rectum. Of course, the dome is not perfectly symmetrical, but is obliquely truncated at its lower extremity in correspondence with the structure of the tail, with a shorter ventral and a longer dorsal lateral margin.

As soon as the walls of the dome have been enlarged so as to produce a certain amount of surface, their parenchyma begins to undergo unequal division in a definite manner. There are produced numerous radiating blastema-streaks, which are united to each other by a more lamellar diffusion,—in other words, the ribs of the caudal hood, with their uniting membranes, structures which consequently correspond morphologically with the previous caudal extremity, and no doubt have the same origin essentially also in *Dochmius* and the other Strongylidæ.

But during the formation and development of the caudal hood a peculiar transformation has also taken place at the anterior extremity of our worm, the future buccal cup having presented its first traces here, especially in the periphery of the anterior extremity of the œsophagus. The developmental history of this apparatus agrees in its essential particulars with the processes already described in *Cucullanus*, except that, in consequence of the much larger size of the worm, they are much more striking and may be more distinctly traced. To this may be added the circumstance that the buccal cup of *Sclerostomum* is composed of several (four) different portions, lying one behind the other like segments, so that it has a more complicated structure than in *Cucullanus*. Of course this circumstance has an influence on the development. It would, however, lead me too far if I were to attempt a detailed description of the different developmental processes; consequently I shall only remark that the segments of the buccal cup very early rise like so many terraces on the inner wall of the new buccal cavity. As this takes place at a period when the œsophagus is still situated close behind the buccal rosette, it follows that at their first appearance these rings occupy precisely a reversed position; that is to say, the finally last segment is at first the foremost one. A change of position commences only at the retrogression of the œsophagus, which gradually brings the buccal cup to its definitive structure.

The first embryonic form of *Sclerostomum equinum* is still unknown to me; but I can hardly doubt that it is essentially constructed as in *Dochmius*, and also leads the same life. I am less doubtful about this, because in *S. hypostomum* of the sheep*, the eggs of which pass out in a state of segmentation, I observed *Rhabditis*-like young in the course of a few days, and these differed from the embryos of *Dochmius trigonocephalus* only by a somewhat larger size (0·46 millim.) and an extraordinarily long, subulate caudal extremity (of fully 0·15 millim.). The animals lived in mud for several weeks, but only increased a little in size (to 0·53 millim.), and then, towards the end of the third week, underwent a change of skin, in which the tail was lost. As the dental apparatus of the posterior pharyngeal bulb had previously disappeared, and the two dilatations were not very prominent, the embryo at this period of development (length = 0·46 millim., of which only 0·04 was due to the abbreviated tail) had a great resemblance to the embryos of *Strongylus filaria*. Unfortunately I did not succeed in observing the further metamorphoses. The worms remained unaltered in water, and gradually began to die off; so that I was induced to administer the remainder of them at two different times (on the 20th and 27th of February) to a young sheep; but on dissection (on the 6th of March), I could not find any trace of them. It is therefore possible that the life-history of our *Sclerostomum* is more complicated than that of *Dochmius*, and that its free existence is not followed immediately by parasitism in its definitive host.

The Strongylidæ with a buccal armature are not, however, the only Nematoda with Rhabditiform embryos. The same young forms recur in other species, even systematically distant—for example, in *Ascaris acuminata* of the frog, the embryos of which, as is well known, are developed in the body of their mother, and have been kept alive for a long time in water by Göze and Dujardin†. On close examination, we recognize in these embryos the *Rhabditis*-form above described, with teeth in the posterior pharyngeal dilatation, and a pointed but short tail. The length of the little worm is 0·6 millim., and its thickness 0·035 millim.; the embryo has consequently a tolerably thick form. But this appearance is altered in the course of a few days. The embryo grows, and, indeed, so rapidly that in a week the length of its body has increased almost threefold (nearly 1·5 millim.). But

* It may be mentioned, in passing, that this *Sclerostomum*, which inhabits the colon, belongs, like *Oxyuris curvula*, to the *dung-feeding* Nematoda. In the buccal cup and intestine we constantly find numerous vegetable particles derived from the vicinity; these form black excrements, which accumulate at the anal orifice, and in the females form an incrustation surrounding the whole abdominal extremity like a hood.

† The same is stated by Spencer Cobbold of *Ascaris osculata* and *A megalocephala*, but probably, as regards the latter, incorrectly; for I have preserved its eggs, with the embryos contained in their interior, unchanged in water for two years.

it is only the length that increases. The transverse section of the body remains almost unchanged, and thus the worm gradually alters its original form for a more slender one, at the same time increasing in mobility in the same proportion. The pharynx and tail retain their previous form, and undergo but little alteration in size, whilst in the periphery of the buccal orifice three small papillæ gradually sprout forth, and a few (usually four) oil-drops accumulate in the body-cavity on each side behind the anterior pharyngeal dilatation, and, remaining pretty regularly grouped, produce almost the impression of eyes destitute of pigment.

In this state I have sometimes met with the young worms in the nasal cavity and rectum of the frog; so that one might be led to suppose that they may be converted, after immigration, directly into the definitive form. The experiments made by me in this direction, however, produced no results. Once, certainly, the young worms were found still unchanged in the rectum on the sixth day after their transfer; but otherwise they seem generally to die pretty quickly.

The example of *Ascaris acuminata* shows us, even more strikingly than that of *Dochmius*, that the free young states of the Nematoda not unfrequently attain a high degree of independency. But *A. acuminata* by no means reaches the final limit of this development. There are Nematoda *the embryos of which even attain sexual maturity in their* Rhabditis-*form, and only become parasitic again in their progeny*—Nematoda, consequently, the history of which presents us with no simple alternation of the conditions of life, but with an alternate sequence of free and parasitic generations. And, what is most wonderful, *both these generations are sexually developed*—both are produced from ova. Here, therefore, we have nothing to do with an ordinary alternation of generations, such as occurs, for example, in the *Distomeæ*, but with a process hitherto almost unheard of in the animal kingdom, and which calls for our consideration the more, because we are accustomed to regard the sexual development of an animal not merely as the sign of its perfect maturity, but also as the criterion of specific individuality.

The roundworm which undergoes this peculiar development is one which has been repeatedly investigated—the well-known *Ascaris nigrovenosa* of the lungs of our brown frog (*Rana temporaria*).

The embryos of this Nematode worm*, as everyone knows,

* In the investigation of the life-history of *Ascaris nigrovenosa* I was gratified by the participation of a talented young zoologist, M. Elias Mecznikow, of Charkow, who has also taken a lively interest in my other observations and experiments upon Nematoda. With regard to the pre-

are developed in the body of the mother like those of *Ascaris acuminata*, and usually pass into the stomach of the host still in the egg-capsule, in order there, after boring through the latter, to collect gradually in many hundreds in the rectum, in the form of small rapidly-moving vermicles; they present in their external structure a great agreement with the Rhabditiform young states of other species. They have a rather stout form, and a length of 0·4 millim. The tail is short and pointed, and the anterior, buccal extremity is furnished with three small cuticular papillæ, which I have not met with elsewhere among the allied forms. The structure of the commencement of the genital organs is still more divergent. Whilst this is elsewhere (except in the *Trichinæ*, the embryos of which are peculiar in many other respects) always developed in the form of a small and nearly homogeneous clear corpuscle (0·02 millim. in length, with usually a simple nucleus), which shimmers through the ventral wall of the embryos about the middle of the chyle-intestine, it appears in the youngest forms of *A. nigrovenosa* as a considerable sac, of 0·08 millim. in length and 0·012 millim. in thickness, enclosing numerous distinctly recognizable cells with vesiculiform nucleus and nucleolus (cell = 0·007 millim., nucleus = 0·0043 millim.). In previous grades of development this sac is recognized as an aggregation of embryonal cells, which separates from the other elements of the body of the embryo, and only changes in this respect, that the cells lose their previous coarsely granular texture, and acquire a more transparent appearance.

When the embryos are removed from the rectum of the frog (or even from the body of the mother) and kept in moist earth, they begin not only to grow rapidly, but also to develope their sexual organs; so that in a short time we have, instead of the previous young forms, sexually mature male and female animals. The duration of this period of development depends on external circumstances, especially the surrounding temperature. In the height of summer a single day sometimes suffices, whilst in winter it is a week or more (in the case of embryos taken from the body of the mother even as much as twelve days) before the animals arrive at sexual maturity.

The sexual differentiation commences before the middle of this developmental period. It is introduced by a change of skin, after which the male individuals are to be distinguished by the shorter and blunter form of the caudal extremity, from the

---

tensions raised by him in connexion with these investigations (Müller's Archiv, 1865, Heft 4) I refer to the next part of that journal, and the communication published in it by me.

otherwise still perfectly concordant females. At this time the genital sac measures about 0·15 millim., or more than half the length of the chyle-intestine, which, like all the rest of the body, has hitherto increased but little in length. After the change of skin, the growth advances far more rapidly, with increasing sexual development, especially in the female individuals, which, at the time of copulation, are about 0·65 millim. in length, while the males scarcely measure more than 0·50 millim. The transverse diameter also is pretty considerable, still especially in the females (at the level of the genital orifice, about the middle of the intestine = 0·05, in the males only 0·037 millim.), so that the form of our animals cannot well be denominated slender. In accordance with this, the movements in general are slow and clumsy.

In the female apparatus we distinguish, besides the two ovaries, which run through almost the whole length beneath the intestine, and the short vagina with its thin chitinous tube seated perpendicularly upon the outer integuments, also a middle section of moderate length, the walls of which possess a distinctly cellular structure. From its position, this section represents the so-called uterus of other Nematoda; but this denomination is perhaps not very applicable in this case, although in pregnant individuals it assists in the reception of the young. Before the development of the latter it is very distinctly and sharply marked off from the extremely thin-walled ovarian tubes, the contents of which are formed, throughout their whole length, of coarsely granular ova. In the blind extremities of the tubes, which are sometimes extended and sometimes bent in the form of horns, the ova are but small. But this is not the case at their commencement, where, at the time of copulation, we find ova fully 0·04 millim. in length (transverse diameter 0·013, germinal vesicle 0·008, germinal spot 0·0016 millim.). The number of these large ova is, however, but small, rarely exceeding four (in winter scarcely ever more than two).

The male apparatus, as usual, consists of a single testis, which runs backward beneath the intestine in the form of a thin-walled, usually simply extended tube, and, before its union with the end of the intestine, is produced into a short and muscular vas deferens. Beside the cloaca there are two short lanceolate spicula, which, with a third smaller chitinous piece, function as the copulatory organ. All three are produced by local development from the originally quite simple chitinous tube of the extremity of the intestine, as is also observed to be the case in other Nematoda. The short caudal point of the male is incurved and beset with a few small papillæ to the right and left of the median line. The extreme end bears a larger cylindrical papilla.

The seminal elements have retained their early cellular form in the upper extremity of the testis. Posteriorly these cells increase, with simultaneous formation of granules, to balls of fully 0·02 millim., which break up by quadripartition, and then form the genuine seminal corpuscles (of 0·005 millim.) not unfrequently met with after copulation, even in the interior of the female organ among the ova.

After impregnation the eggs continually increase in size (up to 0·08 millim. in length and 0·04 millim. in thickness); and at the same time commences the ordinary segmentation, which soon (in summer sometimes on the third day) leads to the separation of a long and slender embryo of disproportionate size (0·25 millim. in length). The number of these embryos of course depends upon that of the mature ova; and this, as already remarked, is in summer nearly twice as great as in winter. However, it is not only the ova (even the immature ones) that increase in size after impregnation, but also the female animals, which in the gravid condition (although only in summer) grow to a length of 1 millim.

Originally, of course, the embryos lie within the genital tube, enclosed in a thin egg-membrane. But the latter is lost as soon as the rolled-up embryo begins to extend itself. The delicate wall of the genital tube also can only resist the movements of the embryo for a short time. Soon after their development the young are seen free in the body-cavity of the mother, the wall of the genital tube being destroyed, and the mass of eggs scattered through the whole body.

This destruction of the genital tube is, however, only the introduction to a further breaking-up, which does not continue confined to the ova, but soon attacks the chyle-intestine, and finally even the pharynx and the muscular mass of the body. All these structures break up, under the constant lively movements of the embryos, into a finely granular detritus. In four or five days after the commencement of the experiments (at least in summer, for in winter this period is extended to ten or twelve days) there remains nothing of the original worm except the external chitinous envelope, with the embryos, whose undulatory movements are so strong that, at the first glance, the mother might be supposed to be still alive.

As long as the embryos remain in the body of their mother they are, as regards the structure of the pharynx, regular Rhabditides, with two dilatations, and teeth in the posterior bulb. But hardly have they escaped from their surrounding membrane than both the teeth and the dilatations are lost. The pharynx then forms a slender cylinder, with a slight thickening at the hinder extremity. The animals are also remarkably different from their parents in other respects. They have a more slender form (length=0·5–0·6, thickness=0·02–0·023 millim.) and an extraordinary mobility. The tail bears a small stiff point. The cuticle is distinctly longitudinally striated, and the genital rudiments in the interior are of small size.

In this state the young worms remain for a long time, perhaps for weeks, without any alteration. They live both in mud and water, and also occasionally penetrate into the mollusks (*Physæ* and *Paludinæ*) which live in company with them. Apparently they select the mouth as the starting-point of their wanderings; at least I have repeatedly met with them in the intestines of these animals, as well as in the body-cavity. In the latter situation the worms have cast their former cuticle and the caudal point, and likewise somewhat changed the form of the head.

This immigration into snails is, however, by no means absolutely necessary for our worms. The young worms may also be converted into the known form of *Ascaris nigrovenosa* by direct transfer to the frog.

The method employed by me in these experiments was as follows. I placed the earth inhabited by the little worms in the throat of the frog, and spread it out as much as possible with the handle of the scalpel. Direct transfer into the lungs (through the glottis and penetrating skin-wounds) did not answer. The frogs certainly survived the operation; but the change occurring in consequence of injection in the lungs (strong congestion) acted so injuriously on the parasites, that they could never be found a few days afterwards. However, I will not assert that the method above recommended led to the desired result in all cases. As the frogs soon swallow the introduced earth, most of the young worms get into the stomach of the animal experimented on, where they are certainly to be met with alive for one or two days; but finally they all die without undergoing any essential alteration. Never more than a few specimens penetrated (through the glottis) into the lungs—at the utmost eight to ten, often only a single one, and not unfrequently none at all.

I presume that the worms usually immigrate into the throat of the frog by their own motory powers. As they live in moist earth, we might also in this way explain the fact that *Ascaris nigrovenosa* is more frequently met with in the land-frog (*Rana temporaria*) than in the water-frog (*R. esculenta*), although the latter is as available as the former for the helminthological experiment.

The first changes of the immigrated worms (even of those which passed into the stomach) consist in the change of skin already mentioned. Within twelve hours after transfer the worms are seen with an obtuse tail. In the periphery of the buccal orifice there are three small lip-like processes, enclosing a small, almost spherical buccal cavity, with a strong chitinous wall. In the following days the size of the body increases considerably. At the end of the first week, the worms not unfrequently measure as much as 1 millim.; in the second week they increase to 3·5 millims. All the individuals do not, however, grow equally fast; among the larger ones we occasionally find small specimens measuring scarcely two-thirds of the former, as, indeed, is not unfrequently observed in helminthological experiments. The increase in thickness at first pretty nearly keeps pace with that of the length. At 0·85 millim. it is about 0·04, and at 2 millim. about 0·09. But when the worm has attained the latter size, and the intestine, previously slightly coloured by the browning of the epithelial cells, begins to be filled with blood, the transverse diameter of the young worms increases considerably, so that the original slender form gradually gives place to a shorter and stouter one. Worms of 3·5 millims. are fully 0·16 millim. in thickness, and those of 5 millims. in length (such as are met with towards the end of the third week) are as much as 0·23 millim. thick. The extreme caudal point alone takes no part in this thickening. It remains thin and slender, as in the worms of the first week, and then, as might be expected, is very sharply marked off from the rest of the body, almost in the form of a spine.

This increase of size of the young *A. nigrovenosa* does not, however, take place without repeated sheddings of the cuticle. This is most distinct in the later stages, where the swelling body is usually surrounded by the remains of the cast-off and wrinkled skin, as if by a scaly covering. Of course, also, the cuticle constantly becomes thicker with the increase of the size of the body, and the musculature makes its appearance more and more distinctly.

The differentiation of the sexual organs commences even before the length of the body has reached 1 millim. About this time the vagina may first be perceived, a little behind the middle of the body, with two horns running from it forward and backwards, which are at first short and thin, and terminate cæcally at a distance of about 0·07 millim. from the genital orifice. In individuals of 2 millims. in length each of the two genital tubes measures about 0·3 millim. Their course is very irregular, so that the end is scarcely 0·2 millim. from the orifice. The inferior section of the tube is the thickest (0·025 millim.), and is distinguished by an internal epithelial coat. A little further up we see a portion with delicate annular fibres; and this is followed by the longest and thinnest section, the true ovary, in the cæcal extremity of which we may already detect distinct ova, of 0·01 millim. in diameter (germinal vesicle = 0·007 millim.). In worms of 3·5 millims. these ova have attained nearly their full size (length = 0·08, thickness = 0·035, germinal vesicle = 0·028, germinal spot = 0·0085 millim.), and a granular yelk-mass has accumulated in them. They are contained in the genital tube, which measures about 3 millims. and is strongly folded together, and have not yet passed into the uterus, which is still short, and are destitute of shells. Perfectly developed eggs with shells are first seen in individuals of 5 millims. When the length has reached 6 millims., the uterus, which has in the meanwhile considerably increased in size, not only contains numerous mature ova, but also ova in all stages of embryonic development, and even perfectly mature embryos.

It is, however, exceedingly remarkable that the immigrated worms always develope only into female individuals. Even the pregnant animals bred by me were always unaccompanied by males. As I have nowhere else met with male specimens of *A. nigrovenosa,* although I have examined many hundred females, and have never found a trace of semen in the sexual organs, I have no hesitation in regarding the lung-worm of the frog as a *parthenogenetic creature.* That this is the first case of the kind among the Nematoda, or indeed among the Entozoa in general, can no more invalidate my supposition than the fact that older writers occasionally mention the male of *Ascaris nigrovenosa.* What they (Zeder, &c.) state about these so-called males by no means proves their existence, and leaves room for the supposition that younger specimens have been regarded as males.

How widely the developmental processes here described for *A. nigrovenosa* may be diffused among the Nematoda can only be ascertained by further investigations. At any rate, it would be too precipitate, starting from the preceding facts, to regard all the numerous *Rhabditis*-forms of mud and dung as mere developmental stages of parasitic roundworms. I am acquainted with nearly thirty different species of this group, but have not met with a single one which I could with any probability bring into the developmental cycle of a parasite.

However, I am not the first to assume alternating generations of parasitic and free forms for certain Nematoda. About ten years ago, an excellent naturalist, Carter, of Bombay, asserted that the embryos of the notorious *Filaria medinensis* did not become developed into parasites, but into free-living Rhabditiform worms (*Urolabes,* Carter), which grow to sexual maturity in water, and only resume a parasitic existence in their progeny. That doubt should have been repeatedly thrown upon this statement is perfectly explicable, considering the want of all objective foundation: even now it can only be regarded as questionable.

I know the embryos of *Filaria medinensis* from my own examinations, and can assert that they furnish no point of support for Carter's hypothesis. They are especially destitute of that peculiar development of the rudimentary sexual organs which appears so strikingly in the embryos of *Ascaris nigrovenosa,* and as it were foreshadows the remarkable destiny of this worm. To this may be added that the embryos of *Filaria* have been kept alive in water for a considerable time without change, by different observers.

If I were to put forward a supposition with regard to the destiny of these embryos, it would be to the effect that they are destined to an active immigration. I found this especially upon the considerable development of the tail, and the similarity which they present to the embryos of *Cucullanus.* The latter goes so far that one might easily be led to confound the two forms with one another, although the proportionate sizes do not exactly coincide. But it must be left to the future to decide whether it is the definitive host into which the embryos penetrate (through the sudoriferous pores, as Carter supposes), or an intermediate host, which is then probably introduced into the stomach. Indeed there are numerous surgeons who, in spite of all apparent reasons to the contrary, suppose the *Filaria medinensis* to penetrate into the muscles from the intestine.

On the other hand, and from the analogy of *Ascaris nigrovenosa,* I think I may accede to Bastian's supposition, *that the embryonal development of* Filaria medinensis *takes place without the concurrence of male individuals.* Hitherto no male example of this parasite has ever been found; and yet, although it is no doubt smaller than the female (considering the enormous fertility of the latter), it could hardly be overlooked on account of its size. The same consideration also excludes the supposition that the *Filaria,* although its size when seeking its definitive dwelling-place will be but small, has already received its store of seminal fluid.

Unfortunately I must here admit that my investigations upon the Nematoda of man present many other gaps. And yet, of course, the fate of these parasites is of the greatest importance to us. I can, however, add something even about these animals.

I may state, in the first place, that most of the Nematoda of the human subject belong to the species with hard and firm egg-shells. This applies especially to the more abundant species, *Trichocephalus dispar, Ascaris lumbricoides,* and *Oxyuris vermicularis.* The ova of the last-mentioned worm contain an embryo at the period of their escape from the female organs;

and this was probably in general overlooked (up to the time of Claparède) only in consequence of its peculiar form. It consists of a short and plump oval body (0·049 millim. in length, and 0·022 millim. in breadth), which occupies almost the whole space of the ovum, and of a thin conical tail (of 0·034 millim. in length) which is bent up on one side. Slender embryos, coiled up and moving briskly, such as occur in most Nematoda, and were ascribed by Vix also to *Oxyuris vermicularis,* have never been met with by me.

The ova of *Ascaris lumbricoides* and *Trichocephalus dispar* are only developed after a long sojourn in water or damp earth. (I have never been able to bring this development to completion in urine and in artificially prepared pits). In the first-mentioned worm the separation of the embryo usually requires from four to six months in summer, and in the other perhaps six to eight months; but the periods frequently oscillate in one or the other direction. Under certain conditions, the ova of *Ascaris lumbricoides* are not developed until the lapse of more than a year.

The embryo of *Ascaris lumbricoides* is much more slender than that of *Trichocephalus,* and is furnished with a short pointed tail, and a small tooth-like projection on the ventral side of the buccal orifice. It measures 0·25–0·28 millim., while the embryo of *Trichocephalus affinis,* which is rather larger than that of *T. dispar,* with the same thickness (0·01 millim.), only measures 0·127 millim. The embryos of *Ascaris mystax* and *A. marginata,* which inhabit the intestines of the cat and dog, and also require a period of several months for their incubation, although generally a shorter time than those of *A. lumbricoides,* present precisely the same characters, and only differ in size, the length in *A. mystax* being 0·38 millim., and in *A. marginata* even 0·42 millim. As, moreover, the egg-shells of the Nematode worms just mentioned possess the same thickness and resistant power, we may suppose that the fate of the young brood agrees with that of *A. lumbricoides.*

From the observations on other Nematoda above described, it might perhaps be anticipated that these embryos slip out of their shells when their development is completed. The shells are certainly thicker and firmer than in *Dochmius,* for example; but nevertheless such an assumption cannot be regarded *à priori* as erroneous—and this least of all with respect to *Trichocephalus,* the egg-shells of which bear an orifice at each pole, closed by a soft, nearly albuminous substance, like a stopper, which might easily be removed by the pressure of the worm. In *Ascaris,* indeed, these orifices are wanting; but, to make up for this, the embryos bear a dentary apparatus at the anterior end of the body (like that of *Ascaris acus*), and this might certainly aid them in breaking out of the egg-envelopes. Moreover it is not difficult to ascertain that the firmness of the egg-shells considerably diminishes in course of time.

Nevertheless I have not been able to effect the exclusion of the embryos of *Trichocephalus* and *Ascaris*, either in water or in moist earth. Even the addition of putrefying substances (such as fruit, potatoes, and beet) produced no result. It is true that during the investigation (especially with *Ascaris*) we sometimes find a few ruptured egg-shells, and even free embryos, but always in such small quantity that we remain in doubt whether their exclusion has been effected by the mechanical treatment of the objects or by the activity of the embryos. By far the greater part of the embryos remain within the egg-shells, and die there after a longer or shorter period.

The duration of life in the embryos seems to be longest in the species of *Ascaris*, which may not unfrequently be observed lively and mobile in their envelopes after the lapse of a year. Davaine states that he saw a portion of the embryos alive even in ova of five years old. In my experiments, however, decomposition commenced sooner, especially in the earth, where only a few living embryos could be detected after the lapse of fourteen months.

The embryos of *Oxyuris vermicularis* died within a few days, without any change of form, whether the ova were kept in water or in damp earth*.

Of course the only thing that remains to be done is to employ the mature ova with living embryos for the purpose of experiment. Starting from the assumption, already repeatedly expressed, that these ova could become developed at once in the ultimate parasite-bearer into the definitive worm, I made experiments in their administration several years ago. For this purpose I chiefly employed *Ascaris marginata*. The result was always negative. The dogs, which were killed at from six to twenty-one days after the administration, certainly often contained *A. marginata*, but always under circumstances which excluded all notion of their having possibly originated from the germs administered. I had no better success with *A. mystax* and *A. megalocephala*, or with *A. lumbricoides*, the ova of which were repeatedly administered to children by a surgeon of my acquaintance, and were twice swallowed in large quantities by adults.

Notwithstanding these constantly negative results, certain observations on the occurrence of the *Ascarides* led me to resume

* This applies also to the ova of *Oxyuris ambigua* of the Rabbit, which are deposited at the commencement of segmentation, and cannot be brought to any further stage of development.

these experiments at different times. In young dogs which were still sucking at their mother I repeatedly found these worms of from 1 to 2 inches in length, which must consequently to all appearance have been living as parasites for several weeks; on the other hand, I sometimes observed, in dogs which had been shut up for a long time, and fed upon broken victuals, worms measuring only a few millimètres, which therefore could not long have immigrated. The idea of the probability of a transfer in the egg-state seemed the more admissible in the latter case, because my dog-kennel was infected by previous experimental animals, so that, on microscopic examination, numerous ova of *Ascaris,* in earlier and later stages of evolution, were found on its floor. In one of these dogs, some of the *Ascarides* of which were only 3–4 millims. in length, a few ova with developed embryos were likewise to be found in the stomach.

In the presence of such observations, the assumption of an infection by means of mature ova must acquire more and more probability. It is true that experiments in this direction have hitherto given only negative results; but was it quite impossible that these were governed by certain individual and temporary peculiarities (age, nature of the stomachal fluids, &c.) of the experimental animal?

Taking these circumstances into consideration, the new experiments were made under varying conditions. Not only were dogs (and cats) of various ages employed, but these were subjected to experiment sometimes with a full, sometimes with an empty stomach, at a longer or shorter period after feeding.

Unfortunately the result in all these cases was equally negative with those of the previous experiments; and yet the number of experimental animals was not less than ten; moreover large quantities of ova were always administered, in some cases repeatedly at longer or shorter intervals. The examination was usually made soon after the last administration, sometimes only from six to twelve hours. In such cases there were usually still in the stomach numerous fragments of egg-shells, and even a few ova with a clear chorion and disintegrated (or at least decolorized) contents; but neither a living embryo nor a young *Ascaris* was ever found either in the intestine or in any other organ.

I must admit that it is with difficulty and unwillingness that I have given up the notion which served as the foundation of the above-mentioned experiments. By the proof that the ova furnished with mature embryos were developed directly into *Ascarides* in the intestine of man and the higher animals, the mode of occurrence of these worms with all its peculiarities would have been both simply and easily explained. But the facts were too clear and too accordant to permit one any longer to imagine an infection of this kind. If we had to do with matters of rare occurrence, we might certainly at least suppose that the circumstances of the experiment had not fulfilled the conditions necessary for the development of the parasites; but the worms in question are, as is well known, so abundant, that this objection can hardly be maintained.

That, however, there are really Nematoda which *migrate directly into their definitive host by the medium of ova containing embryos,* in the manner here indicated, is indubitable, from the results of other experiments made by me. The proof of such a development was most strikingly obtained in the case of *Trichocephalus affinis* of the sheep, the destiny of which, considering the perfect agreement of the ova and embryos, must be regarded as furnishing a rule for the *T. dispar* of man.

The embryos of this animal have already been mentioned as short plump worms, of 0·127 millim. They have a thick and a thin end, and terminal orifices to the alimentary canal, like the embryos of *Trichina,* but unlike those of all other Nematoda. They also resemble the embryos of *Trichina* in the fact that their organization exhibits but little differentiation. Their movements consist of very slow changes of position within the egg, during which the thicker end of the body is usually pushed in advance.

My material for experiment consisted of the whole of the ova of some twenty female individuals, which had been kept for about seven months in water, and had been completely decomposed therein. Sixteen days after administration, the experimental animal (a young lamb) was killed. To the naked eye the large intestine presented nothing unusual, but the microscope immediately revealed upon it many hundreds of young *Trichocephali.* The majority of these worms measured about 0·8–1 millim.; but there were specimens of only 0·5, and others of nearly 2 (one even of 2·4) millims. in length. Leaving out of consideration the absence of sexual development, they presented exactly the aspect of the intestinal *Trichinæ.* They were clear capilliform filaments (0·024 millim. thick), which, notwithstanding the presence of a diminished anterior end, showed as yet no indication of the characteristic ultimate form. In the interior, besides the cellular body, which traversed nearly the whole cavity of the body, the œsophagus and the short chyle-stomach were to be distinguished, the latter with a muscular terminal piece which, in the larger specimens (in the males), was not unfrequently clearly divided from the true stomach in the form of a distinct section. In the larger worms the genital tube could already be distinguished, running down beside the chyle-stomach.

The result of this experiment is so precise and convincing, that the above statement requires no further proof. But for this very reason it seems to me scarcely to be any longer doubtful that the *Ascarides* are developed in some other way, different from that of *Trichocephalus*. But if the embryos of these animals neither escape of themselves from their shells, nor pass with the shells into their definitive bearer, there hardly remains any other course except the assumption of an intermediate host.

But where are we to find this intermediate host?

I have administered the ova of *Ascaris lumbricoides* to a mouse without any result whatever. They passed out again undigested and with the embryos still living. I was led to make this experiment not by any hope of seeing the embryos developed into an intermediate form in the muscles of the mouse (for man will hardly introduce his roundworms by feeding on mice), but by the statement of Davaine that the embryos of *A. lumbricoides* fell out of their egg-capsules in great quantities in the intestines of the rat. It might perhaps be that the young worms only became capable of development when they had passed through the intestine of another animal and by this means had lost their shells. But here, again, I got a negative result.

The attempt to bring certain of the widely diffused lower animals to take up the ova of our *Ascarides* was equally unsuccessful. Earthworms, woodlice, and *Tenebriones*, which I kept in earth mixed with an abundance of the ova of *Ascaris lumbricoides*, never presented these ova or their embryos when dissected. The only animal which took them (and this was from water) was the *Asellus aquaticus*; but it yielded them in as unaltered a state as the mouse.

As, therefore, all my experiments left me just where I was before, I thought it necessary to strike into a new course. I put a number of young cats to live in a place from which I had repeatedly obtained animals with numerous young specimens of *Ascaris mystax*. This was a house outside the gates, with dunghills and kitchen-gardens in which the animals ran about freely and without any particular care being taken of them. After residing there for six or eight days, the animals were caught (usually in the morning), killed, and submitted to examination.

I had the satisfaction, in this way, not only of repeatedly detecting *Ascarides* of no great size (4–8 millims.), but also of making a discovery which, if it does not completely solve the question of their mode of importation, at least throws much light upon the destiny of our animals.

This related to a cat about eight weeks old, which had remained for six days in the above-mentioned place. The stomach and small intestine of the animal had collapsed, and contained no chyle; but the former contained a few bitten fragments of straw and all sorts of vegetable débris, among which a microscopic investigation distinctly showed fragments of potatoes and of potato-parings.

But the same stomach contained also at least forty to sixty Nematode embryos, some of which measured only 0·4–0·6 millim.; so that the smallest individuals were scarcely larger than the embryos of *Ascaris mystax* while still enclosed in their egg-capsules. However, there could not be the least doubt that the embryos which I found here free and twisting about briskly on the mucous membrane of the stomach of the young cat were those of *Ascaris mystax*. Not only did they, especially the smallest specimens, agree exactly with the animals from the eggs with which I was so well acquainted, but I could also follow them through all stages of development up to young *Ascarides* of 3–4 millims. in length, which occurred, together with the larger embryos, in the small intestine, and, notwithstanding their small size and slender form, already presented precisely the characters of the *Ascaris mystax* of the cat.

In the first place it was proved by this discovery that *Ascaris mystax* (and also decidedly the other allied *Ascarides*, including therefore *A. lumbricoides*) retains its original developmental condition up to the time of its introduction into its definitive host, or, in other words, *immigrates into its definitive bearer in the embryonic form*. In this respect *A. mystax* therefore behaves like the above-mentioned *A. acus*; nay, it even surpasses the latter, as before its transfer to its definitive habitat it does not even increase in size.

But what the embryos previously wanted is made up immediately after their immigration. The embryos grow, without, however, essentially altering their structure; they grow rapidly, and pass, when about 1·5–2 millims. in length, from the stomach into the small intestine. The intestinal cells gradually acquire a brownish colour during the increase of size. The muscular sac is thickened, and the glandular stomach gradually separates from the posterior extremity of the œsophagus as a special structure. But the rudimentary sexual organ still remains without any further development, and the mouth still bears the embryonic boring-tooth instead of the three lips. These conditions are altered only when the next change of skin takes place, at a length of 2·8 millims. A little while before this, the genuine structure of the Ascaride mouth may be distinguished under the cuticle of the head; and the increase of the genital rudiment into a short sac, either simple or Y-shaped, according to the sex, may be observed. The formation of the spicula only takes place subsequently, when the worm has already attained a length of 10–12 millims., and long been furnished with the wing-like cephalic ridges (which make their appearance when it is about 6 millims. in length).

Unfortunately this interesting discovery has given us no definite information as to the mode of introduction. No remains of animal matters could be detected in the contents of the stomach; but who can tell how long the embryos had already been in the stomach? A second young cat, which had eaten the mucous membrane of the stomach of the former, together with the parasites still living in it, showed the worms on the following day likewise in the stomach, and hardly perceptibly altered from their previous condition.

It appears clear to me, however, that it is not by any of the larger animals that the embryos of *Ascarides* are conveyed into the intestine of their definitive bearer. As things remain from the preceding observations, we need for the completion of our knowledge of the life-history of the *Ascarides* only a single element. May we soon succeed in filling up this gap, and thus bring the commonest of the human Entozoa completely within the domain of science.

L.—*Note on some new Facts in Botanical Geography.* By Edmond Boissier*.

By generalizing observations which are nearly always incomplete (as we are still but imperfectly acquainted with most floras), botanists, ascertaining the predominance in some particular botanical region of certain families or genera, hurry sometimes, and prematurely, to the conclusion that this region is their exclusive habitat. Nevertheless new facts come from time to time to show us that there is nothing absolute in the laws which have governed the present distribution of plants upon the surface of the globe; and some interest attaches to the registration of these facts and to the combination in this manner of the materials which will perhaps hereafter assist in explaining the formation of the different floras.

There have recently been discovered in Europe and Asia Minor some species which are particularly interesting, inasmuch as their congeners inhabit very distant regions. The first of these is a *Dioscorea*. The *Dioscoreæ* are diœcious monocotyledonous plants with generally a twisting and climbing stem. Their root is a tuber; and that of some species is employed as food, under the name of Yam. The genus *Dioscorea* is very numerous in

* From the 'Bibliothèque Universelle,' March 25, 1866, Archives des Sciences, pp. 255–260.

all the tropical regions, both of the Old and New World. Only a few species inhabit the temperate regions of the northern hemisphere, and among these I may cite the *D. villosa* of the United States, and in Japan the *D. Batatas,* recently introduced among us as an alimentary root under the name of the Japanese Yam. Hitherto no European species of *Dioscorea* has been known, until, a few years ago, it was reported that M. Bubani, an Italian botanist, had found one on the Pyrenees. As the details of this discovery were nowhere published, it was supposed that there might be some error of determination; it was thought that this could only be a *Tamus,* a European genus of the same family, very distinct from *Dioscorea* in having its fruit a berry and not a capsule, but of which the very similar aspect may easily, when it is only in flower, lead to its being confounded with the latter genus. This, however, was by no means the case; I have just received from M. Bordère, of Gèdre, in the Hautes-Pyrénées, some specimens of the plant in question, which, from its tuberous root and its membranous 3-celled capsules, undoubtedly forms part of the genus *Dioscorea. Dioscorea pyrenaica,* Bub., is an alpine plant which grows upon the calcareous débris on the southern slope of the Col de Gavarnie; and, what is very remarkable, by its dwarfed and flexuous and not climbing stems it exactly recalls (although specifically distinct) other alpine *Dioscoreæ,* such as *D. nana* and *D. multinervis,* which must be sought in the Andes of Chili and Peru and upon the mountains of Mexico.

A second curious fact is the discovery, also dating a few years back, of a *Pelargonium* among the mountains of the East. The genus *Pelargonium,* which includes the so-called Geraniums cultivated in our conservatories, is characterized, in the family of which it forms a part, by the nectariferous tube, which descends from the calyx and becomes united throughout its length with the peduncle; it has hitherto been regarded as exclusively indigenous in the southern hemisphere, most of its species inhabiting the Cape of Good Hope, and a few Australia. But M. Kotschy brought from the Taurus in Cilicia a beautiful plant belonging undoubtedly to this genus; and it has since been found along the whole of the same chain, from Pamphylia to Armenia. Like some other species from the Cape, *Pelargonium Endlicherianum* has the inferior petals very small and nearly aborted; the upper ones, which are very large and of a fine purple, render it an ornamental plant, which is the more valuable as it can bear our winters.

I now pass to the third species that I have to mention here. It is already many years since Bertero collected in Chili a parasitic plant growing in great abundance upon the branches of an

Adesmia, a shrub belonging to the family Leguminosæ. M. Guillemin found that it formed a new genus, which he described under the name of *Pilostyles.* It has no root, stem, or leaves, and consists only of a campanulate flower of 2 lines in length, sessile upon the bark of the *Adesmia,* the epidermis of which it tears during its development. It is diœcious; and hitherto only the male plant is known. The flower is surrounded at the base by a few bracts, and consists of a calyx of four oblong and imbricated parts, of a corolla with four spathulate petals, also imbricated, and exceeding the calyx a little, and, lastly, of a thick, short, obtuse central column, which is attenuated in its lower half and surrounded about the middle by a ring formed of three rows of unilocular anthers, above which there is another, narrower one, composed of closely approximated papillæ. This column is solid, and formed of cellular tissue; but a transverse section, when magnified, shows the orifices of a very few isolated tracheæ. The flowering over, the flower falls, leaving a concave depression upon the bark of the *Adesmia.* This curious production of flowers with no stalks gave rise at first to the strange notion that the *Pilostyles* is only a monstrosity of the normal flower of the shrub on which it grows; but this opinion could not maintain its ground for a moment in the presence of the details of structure and the non-axillary insertion of this singular plant, which may be arranged very naturally in the family *Rhizantheæ,* as a miniature of those gigantic *Rafflesiæ* which, in the Sunda islands, are parasitic upon the roots of other shrubs.

The naturalist Pohl also brought from Brazil a second species of the same genus, growing upon the branches of a *Bauhinia*; but for many years no new fact has been added to the history of *Pilostyles* until this winter, when, in examining a collection of dried plants collected in the alpine region of the mountains of the east of Asia Minor by M. Haussknecht, I found the branches of a spiny *Astragalus* covered at the base and round the points of insertion of the leaves with small reddish globular bodies which immediately reminded me of the Chilian plant. It was, in fact, a *Pilostyles,* resembling *P. Berterii* in all its principal characters, but differing specifically in the absence of bracts, the shorter flower, and having the pieces of the calyx and corolla to the number of five or six instead of four. My friend Dr. J. Müller has been kind enough to make a very particular microscopic analysis of this curious production, and has found other differences. Thus, in the oriental plant, the ring of unilocular anthers round the central column is formed of two instead of three rows of anthers; the column itself is shorter, and is not narrowed in its inferior portion. It is a very singular fact, that whilst the male individuals of *Pilostyles* grow so abundantly upon the branches of the *Adesmia* in Chili and on those of the *Astragalus* in the east, the female plant still remains unknown; there is here a gap to be filled up, in order to complete the description of this curious genus. Perhaps, according to Dr. Müller, the ring of papillæ surmounting that of anthers in both species may represent a row of aborted ovaries, as would seem to be indicated by a certain analogy of position with the flowers of the Aroideæ.

Here we have, therefore, an oriental and alpine species, *Pilostyles Haussknechtii*, coming to complete a genus hitherto known only from South America, and of which all the species, singularly enough, are parasitic upon shrubs of the family Leguminosæ. Hitherto we did not know, either in Europe or in Asia Minor, any Rhizanth,—the *Cytinus*, another plant parasitic upon the roots of the *Cisti* in the Mediterranean region, being arranged in a neighbouring family on account of its stem (which bears several monœcious flowers), its bilocular anthers, and other important characters.

It would have been easy for me to enlarge this list of *disjointed* species—that is to say, species growing in a botanical region very distant from that in which the rest of their genus or family live; but, without going in search of other little-known examples of this curious fact in botanical geography, we are acquainted with some which surprise us the less because we have them always under our eyes. Is it not singular, for example, that we find in the floras of Southern Europe only a single Myrtle and a single Laurel, whilst all the rest of the very numerous families to which these shrubs belong inhabit the tropical or subtropical countries of both continents? If, however, we consider that in the Tertiary period the Myrtles and Laurels were diffused in Central Europe, we get a glimpse of an explanation, being led, as has been so well shown by M. Alph. Decandolle in his 'Géographie Botanique,' to assume species of different antiquities, and to hope that, as our knowledge of the floras of preceding geological epochs becomes more complete, it will by degrees make us better understand the present distribution of plants.

BIBLIOGRAPHICAL NOTICE.

The Geology and Scenery of the North of Scotland; being Two Lectures given at the Philosophical Institution, Edinburgh. With Notes and an Appendix. By James Nicol, F.R.S.E., F.G.S., &c. 12mo. Edinburgh, 1866.

Professor Nicol has three chief objects in these Lectures,—first, to elucidate the close and very evident connexion of the geological structure and geographical features of his native country; secondly, to claim his share of credit for early and long-continued labour in working out the geology of Scotland; and thirdly, once more to protest against the now very generally accepted interpretation of the complicated phenomena of granites, schists, limestones, quartzites, and other altered rocks in the north-west Highlands, as elaborated by Murchison and Geikie, Harkness, Ramsay, and others. We must leave the disputed point, as to whether there be one (Nicol) or two sets of gneissose rocks in the Highlands, to the personal observation of working geologists, who for years to come will have to tramp over moss and moor many a weary day before all the details of stratification are conned and noted, and before what belongs to Lower and what to Upper Silurian is rightly determined in those wild regions. Nor can we be historians of the progress of geological knowledge in Scotland. The part that Prof. Nicol has so worthily performed can be readily known by reference to the publications quoted (and almost the only ones quoted) in the little book before us. We can, however, assure our readers that we have had real pleasure in reading some very eloquent passages in Prof. Nicol's Lectures, which are clear, earnest, and conscientiously true to the author's hard-won experience. Excepting that so many equally well informed geologists interpret the natural sections of the strata otherwise than he does, his view, of the great gneissic area being fissured from N.E. to S.W., with an alteration of level, might well command belief as being quite in accordance with the general structure of the region, where the edges of the strata run S.W.–N.E., partly from longitudinal folds, partly from great faults, holding the same direction and intersected by transverse fissures, breaking the land into large irregular masses. "These lines of elevation and of fraction have determined the lines along which rivers and other denuding agents have acted; and consequently the systems of mountain-chains and river-valleys." The action of ice in this disintegration of the surface is little alluded to; but the student can turn to Geikie's account of the Scottish scenery for an enthusiastic treatment of its effects. Our author, among his other "conservative" tendencies, ignores the hypothesis that refers many lake-basins to ice-action, which, he says, "may somewhat widen or deepen a valley, but not excavate a lake below its level. There is, however," he adds, "no mystery in the formation of lakes. Like the valleys in which they lie, they have been produced in more ways than one. Some have originated in great slips, —masses of the strata being thrown down, and the hollow then filled with water. Such is Loch Maree, as shown by the sandstone islands lying far below the gneiss hills on the shore. Many may have been excavated entirely by river-action—frequently, however, along the line of faults. The changes in the relative level of the different portions of the country explains the origin of very many. The western division, as the form and character of the coast prove, has subsided, gone down into the sea, since the eastern rose. By this change of level, valleys formerly dry and drained by rivers may have been converted into lakes. Their formation, therefore, requires no extraordinary excavating action, but only, as is now happening in Scandinavia, that one portion of the land should rise or sink more rapidly than another. The absence of detritus in the west explains how the lakes once formed have long continued unfilled by river-washings." On the other hand, "a wide mud-filled sea-bottom, with icebergs floating and stranding in its shallow waters," was slowly lifted up on the eastern side of Scotland into a low undulating country, without such cliffs, and lochs, and inlets as mark the rugged western side.

The little conical holes or pipes in the old Silurian quartzite, or altered sandstone, of Assynt have their recent analogues in the burrows made by "small Crustacea on the Kyle of Duirness in sand washed out of these very rocks." Well may Mr. Nicol say, "yet the mind almost refuses to grasp the myriad ages that have intervened." Again, to quote our author, "Once the true history of the region is known and can be read off from a distance, there cannot be a more impressive lesson to the geologist than, from some lonely hill or moor in the Lewis, to trace the long line of strange fantastic mountains on the mainland, rising over the low gneiss platform on which they are built up. When we try to fathom the innumerable ages involved in these two steps in the history of the earth—and they are only two—the mind feels crushed with the interminable lapse of time, and is glad to seek repose in the view of the quiet ocean, with a few ships peacefully floating on its bosom. But it is only to be thrown back into the remote past. For was it not this ocean, these now invisible beating waves, that levelled that platform, fashioned and laid down these high masses of conglomerate, and moulded all these mighty mountains into form? And that, too, is a period dating, not centuries or millenniums, but world-ages, counted by birth and death, the creation and extinction of tribes and families of plants and animals, before man had a place on the earth!" Admirably, but from his own point of view alone, does Prof. Nicol sketch out the chief points in Scotland's primeval history; and some of its bearings on the living present are thus clearly indicated:—"To Scotsmen the structure of their own land should be specially interesting. We pride ourselves on being a peculiar people; and, were we willing to forget it, our neighbours are not slow to remind us of the fact. Now, be our peculiarities good or bad—virtues or vices—they have been in part produced, in part encouraged, by the character of the land in which we dwell. Like generous wine, they taste of the soil; they acquire new strength whenever they touch their mother earth. We rejoice in the skill and industry which have carried the rich culture of the Lothians far up the steep sides of the Lammermuirs and the Pentlands,—which have changed the skirts of Cairntable, where the Douglas defied the threats of England's proudest king, into fields of waving corn, and have converted the black wilds of Buchan, where the Bruce sought refuge in dire extremity, into storehouses of cattle and grain. Let me ask, What would this skill and industry have availed, had not the soil contained the elements of that fertility they were to draw forth? Look at the merchant princess of the west, and tell me if

Glasgow would have multiplied her people tenfold in a century, unless the great estuary of the Clyde had opened its bosom to fleets from many lands—unless she had possessed those stores of coal and iron that furnish the means and materials of her increasing labours. And our ancient metropolis in the east—were not the true foundations of Edinburgh then laid when internal fires pushed up through the level shales and sandstones that grand basaltic prism under whose protecting shadow first clustered the few rude huts which the toil and taste of her citizens have expanded into the stately streets and squares of modern Athens? And turning to a higher, less material product, is not the thought of the nation, its intellectual life, born of the soil, fed and nourished by the land in which we live? Is not the free exuberant poetry of Burns the genuine product of the banks and braes of Bonny Doon? Does not the romantic chivalry of Scott ever reflect Tweed's silver streams and Yarrow's dowie dens? And the dreamy ghost-like strains of Ossian, if they grew not up amid the grey rocks and mist-shrouded glens of Morven, were they not at least nursed under the gloomy shades of the pine-forests of Strath-Spey?

"There is not a more striking feature in the history of Scotland than the tenacity and success with which she maintained her national independence. Driven into a corner by her more powerful neighbour—cut off from retreat by barren hills and a stormy ocean, with much to lose by resistance, much to gain by yielding, she fought on for long centuries, and at length gave her king to her rival, and formed a free alliance with the freest nation in the world. How this was possible, a glance at the physical structure of the country will at once tell. But that structure is only the outward expression of internal geological phenomena. In the geological map the different formations are shown by colours. You will see how they run in lines across the country from shore to shore. Each band of colour marks a distinct formation. Some are igneous, others stratified. Some, hard and tenacious, naturally form mountains; others, softer and more yielding, valleys. Thus each geological formation became a true line of fortification. Every mountain-ridge was a wall; every valley a broad ditch, across which the southern invaders had to force their way. Usually they turned the flank of the first line of the Cheviots—came in by the east or west marches. But the second line of wall—the Southern Highlands, stretching from shore to shore, from St. Abb's Head to Stranraer—could not be so turned. Then, beyond, comes the wide ditch of the Firth of Forth, which no engineer had then ventured to bridge. North of it lies the third wall, of the Ochills, and the third river and Firth of the Tay. Deeper still rose the frowning barrier of the Grampians, backed by an interminable labyrinth of hills and glens, of winding straths, and fordless sea-lochs. No wonder the Roman eagles retreated from this region, and the conquerors of the ancient world fenced off its fierce tribes by walls and towers. Its peculiar character shutting out this mountain-land from all intercourse with other portions of the kingdom, gave it a people of its own, with special habits, traditions, and history."

MISCELLANEOUS.

Greyhounds run Wild.

In May 1814 I saw, in the Jardin des Plantes, at Paris, two, or perhaps three, animals, which I should have declared, on my oath, to the best of my knowledge and belief, to be neither more nor less than wire-haired Scotch greyhounds, which were labelled "Loups des Pyrénées." Now I know, of my own knowledge, that the roads in the seat of war were at that time so encumbered with dead baggage-animals, that the sporting dogs of the English officers took the opportunity of being independent of their masters for food, to turn wild and live upon the country. I remember riding towards half a dozen of them feasting on a dead mule, when they with one accord formed line between me and their prey, and advanced against me with one disciplined howl; insomuch that I retired, lest they should proceed to try to add me and my horse to their larder.

It has within these few days occurred to me as possible that some ingenious Frenchman, between joke and earnest, may have seized on a portion of these dogs, and sent them to Paris with a "Voilà les véritables loups des Pyrénées." I am sure what I saw were Scotch greyhounds, and nothing else. I remember that one or more of them was savage and ill-tempered, as dogs are given to be when shut up in cages. I remember seeing two Cuban bloodhounds in a cage at the Zoological Gardens, one of which was as savage as any hyæna. I have a notion that dogs at large would have no difficulty in returning to the wild state if exposed to temptation.

I have written to my son, who is at Pau, to ask him if he can throw any light on the point. He reports seeing young wolves brought in to Pau as a show.—T. P. T.

On the Perforating Bryozoa of the Family Terebriporidæ. By P. Fischer.

The existence of perforating animals has been ascertained in nearly all the classes of Invertebrata—Mollusca, Annelida, Echinodermata, Spongiaria, &c.; the vegetable kingdom likewise presents us with examples of Protophyta hollowing out their residence in shells and stones. Perforation and, consequently, the destruction of the perforated bodies are therefore the effects of a great law of nature. By the side of the creatures which accumulate masses of calcareous polyparies, and of those of which the shells strew our shores and cover the bottom of the sea, nature has placed other organisms, smaller but not less powerful in their effects, which restore to the ocean the elements which have been drawn from it.

Among the Bryozoa the existence of terebrant cells is almost a new fact. It was known that some *Lepraliæ* and *Celleporæ* slightly alter the surface of the shells to which they attach themselves; but before the discovery of Alcide d'Orbigny, no one had ever seen them lodged in the very interior of the shells.

The agents by which the perforation is effected are still unknown to us; we have been unable to detect siliceous corpuscles in the excavations of the *Terebriporæ*—a circumstance which of itself would suffice to distinguish them from the terebrant Sponges (*Cliona*, *Thoosa*), even if their organization were not infinitely superior. Until we acquire fuller information, therefore, we shall assume that the perforation is due to a chemical action.

In the commencement of this memoir we shall indicate a serious gap. We have been unable to study the animals whose habitations are described. In excuse we may say that the existence of their excavations is tolerably evident, and that the cells of the living *Terebripora* of the French coasts are scarcely 0·09 millim. in length.

The systematic arrangement of our Bryozoa is consequently founded upon the form of their cells, their grouping, and development—characters which are sufficient for their identification.

The genus *Terebripora* was established by A. d'Orbigny for two Bryozoans collected during his voyage in South America—one on the coast of Peru, the other at the Falkland Islands. D'Orbigny indicates that this genus differs from all others in its class by its cells hollowed out in the very substance of shells, their arrangement being identical with, and their mode of production similar to, those of *Hippothoa*. Since the publication just referred to, no author has made mention of the *Terebriporæ*.

The investigations which I have undertaken upon the terebrant Sponges in a fossil state led me incidentally to ascertain how widely the *Terebriporæ* are diffused in the Secondary and Tertiary beds. I have detected four or five species in the former, and as many in the latter. Their presence in the middle Tertiary beds of Touraine and the Astésan led me to expect that this genus was perhaps not yet extinct in the European seas, when, in September 1865, I collected in the harbour of Arcachon (Gironde) an oyster perforated by a colony of *Terebriporæ*. The same species occurs in the Mediterranean.

From the examination of this specimen it is easy to rectify some incorrect statements made by D'Orbigny, who represented the apertures of the cells as round, whereas they are furnished with a notch of greater or less extent—a character of great importance in the classification of the Bryozoa.

Besides *Terebripora*, I have found, on the coasts of the Gironde and the Charente-Inférieure a Bryozoan belonging to the same family and having the same habits, but differing in having its cells alternate and borne upon alternate axes. It leaves upon the shells elegant impressions resembling the ramifications of the *Sertulariæ*. I propose to name it *Spathipora*.

The living *Spathiporæ* are not numerous. I know only two species—one from the coasts of France and of the Mediterranean, the other from the Pacific; but the former does not differ notably from a Bryozoan which has perforated with its colonies the shells of the Faluns of Touraine.

To sum up. The *Terebriporæ* and *Spathiporæ* constitute a very natural group, of which the species are probably very numerous. The interest which it presents is increased by the evidence of its existence during the whole series of secondary and tertiary deposits. I arrange the family *Terebriporidæ* in the order of Cheilostomatous Bryozoa, side by side with the *Hippothoidæ*. The latter family is composed of the true *Hippothoæ* (*H. divaricata*, *patagonica*, &c.) and the new genus *Cercaripora*, Fischer, established for the reception of *Œtea truncata*, *ligulata*, *argillacea*, &c.—*Comptes Rendus*, April 30, 1866, pp. 985–987.

On the Systematic Position of the Lepidosirens. By Professor W. Peters.

The author recapitulated the external and internal characters which he considers to prove the piscine nature of the genera *Lepidosiren* and *Protopterus*, and then indicated the circumstances which appear to be opposed to the union of these animals with the Ganoids, as recommended some years ago by Gill (Proc. Acad. Nat. Sci. Philad. 1861, pp. 13 *et seq.*) and more recently by Brandt (Bull. Acad. St. Pétersb. 1865, p. 139). He remarked that the distinctions of the six subclasses of fishes established by J. Müller were to be sought chiefly in the central organs of the circulation and respiration, and that, according to this view, the Lepidosirens differ essentially from the *Ganoidei* (without taking into consideration the structure of the auricle and the valves of the aorta) by the absence of a muscular coat in the base of the aorta, and by the form of the laminar branchiæ, united to each other as far as the middle and destitute of cartilaginous supports.

In opposition to the opinion put forward by Dr. Steindachner, that the external branchiæ of *Protopterus* are of importance only during the embryonal and earliest periods of life, it was shown that these organs increase in size even after the animals have attained a reproductive age (at less than $\frac{1}{3}$ mètre in length), and that, if they are found quite aborted in very old individuals, this cannot be regarded as a normal, but only as an individual occurrence. This is the more probable, as the branchiæ are wanting on the left side of a specimen only $\frac{1}{2}$ mètre in length in the Berlin Museum. The author further indicated that, even if external branchiæ similar to those of *Protopterus* were to be discovered on *Lepidosiren*, the composite structure of the paired fins of *Rhinocryptis* (*Protopterus*) would remain as an essential difference between the genera.—*Monatsber. Berl. Akad. Wiss.* January 11, 1866, pp. 12, 13.

Remarks on some Bones of the Dodo (Didus ineptus) *recently collected in the Mauritius.* By Alph. Milne-Edwards.

Some months since, in draining a small marsh called the *Mare aux Songes*, Mr. George Clark, of Mahébourg, discovered therein a considerable number of bones of the Dodo. These bones were sent to London, where many of them were sold by auction, which has enabled me to procure an important series of specimens, by means of which the skeleton could be almost entirely restored; and I now request permission to bring before the Academy the results furnished by the study of these objects.

The differences of opinion which exist among zoologists with regard to the natural affinities of the Dodo, sufficiently indicate the difficulties they have met with in studying the remains of this bird. Linné and Latham thought that it should be placed along with the Ostriches; Cuvier approximated it to the Penguins; De Blainville believed that it should be classed in the order Raptores, beside the Vultures; Brandt regarded it as having more affinity to the Plovers; and, finally, Reinhardt discovered characters of great resemblance to the Pigeons. So long as only the external form was taken into consideration, the questions thus raised could not be solved. But in 1847 Messrs. Strickland and Melville had the opportunity of studying the bony parts contained in the fragments of feet and in the head of the Dodo preserved at Oxford, and from this examination they concluded that the bird, notwithstanding its singular form, belonged to the family of the Columbidæ—an opinion which was shared by most ornithologists, and which Professor Owen has recently adopted in consequence of his examination of the bones lately discovered in the Mauritius. According to this illustrious anatomist, the Dodo would belong to the group of Columbidæ, and the peculiarities of structure observed in it, although very considerable, would be of the rank of those which may be regarded as dependent on the adaptation of a bird of this type to an essentially terrestrial mode of life and to a special diet. One of the most remarkable portions of the skeleton of the Dodo is the pelvis; and if Linné, Cuvier, Blainville, and Brandt had been acquainted with this part of the skeleton, they certainly would not have expressed the opinions which I have indicated above. The pelvic apparatus of this bird, although in some respects resembling that of the Columbidæ, is distinguished therefrom by anatomical characters of great importance; and these differences are not of the kind observed in the terrestrial species when compared with the best fliers among the Pigeons. The pelvis is not constructed in the same manner in any bird now living.

Nor are the peculiarities in the structure of the sternal apparatus any better explained by the hypothesis of the adaptation of the organic type of the Columbidæ to an essentially terrestrial mode of life. At the first glance one is struck by the slightness of its resemblance to that of the Pigeons, and by its general form, which reminds us of the sternum of the *Rhea* more than that of any other bird—although it cannot be assimilated to the sternum of a Struthious bird, on account of the existence of a keel.

The modifications of the sternum which correspond with essentially terrestrial habits, or even with a complete incapability of flight, are of two kinds: sometimes the median keel for the insertion of the great pectoral muscles is diminished and disappears completely without any atrophy of the lateral portions of the sternal shield, as is seen to be the case in the Struthionidæ; in other cases the keel is developed in a normal fashion, but the lateral plates are very imperfectly ossified and reduced to mere narrow rods. This arrangement occurs in the ordinary Gallinaceous birds, and is carried to a great extent in the Tinamous.

If the Dodo were a Columbide merely modified to live upon the ground, we ought to expect to find a sternum constructed like that of the Pigeons, except a greater or less atrophy of the sternal keel, a narrowness of the hinder part of the entosternal, or an absence of ossification in a portion of the lateral plates; but this is not the character of the sternum in the Dodo. This pectoral buckler, which is remarkably thick and much arched, presents on each side of the keel a very broad and solid surface for the insertion of the thoracic muscles. The structure of the anterior portion is likewise different from that which occurs in the Columbidæ; and here everything seems to me to indicate a peculiar ornithological type. The femur, the tibia, the fibula, and the tarso-metatarsal present much resemblance to the bones of the foot in the Pigeons, but also differ in various anatomical characters.

To sum up, we see that the Dodo, as was shown by Reinhardt and other authors cited above, presents incontestable affinities with the Pigeons, but that the resemblances, although striking when we confine ourselves to the comparison of the feet, disappear to a great extent when we take into consideration the other parts of the skeleton, especially the pelvis and the sternum. Now the conformation of these osseous parts is so intimately bound up with that of the economy in general, that it seems to me impossible not to lay great stress upon them when we have to appreciate the zoological affinities of birds. We also see that the modifications which among the Columbidæ coincide with an adaptation of the organization more and more to a terrestrial mode of life, do not lead towards those which we have indicated in the Dodo. I think, therefore, that, in a natural ornithological classification, this bird, although occupying a place beside the Columbidæ, cannot be regarded as a walking Pigeon, that it cannot enter into the same family, and that it must be classed in a separate division of equal value.—*Comptes Rendus*, April 23, 1866, pp. 929–932.

INDEX TO VOL. XVII.

END OF THE SEVENTEENTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

Fig. 3.

Fig. 2.

Fig 1.

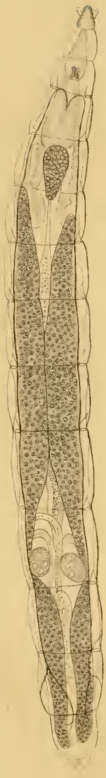


Fig. 4.

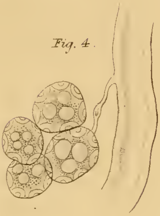


Fig. 5.

Fig. 8.

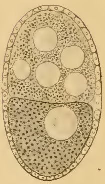


Fig. 6.

Fig. 7.

Fig 10.

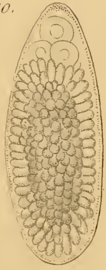
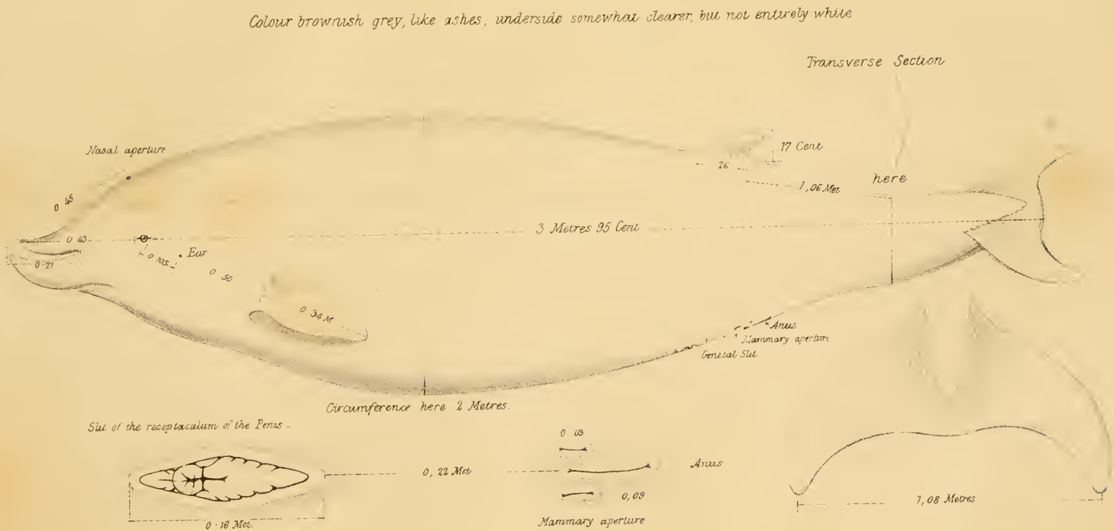


Fig. 9.

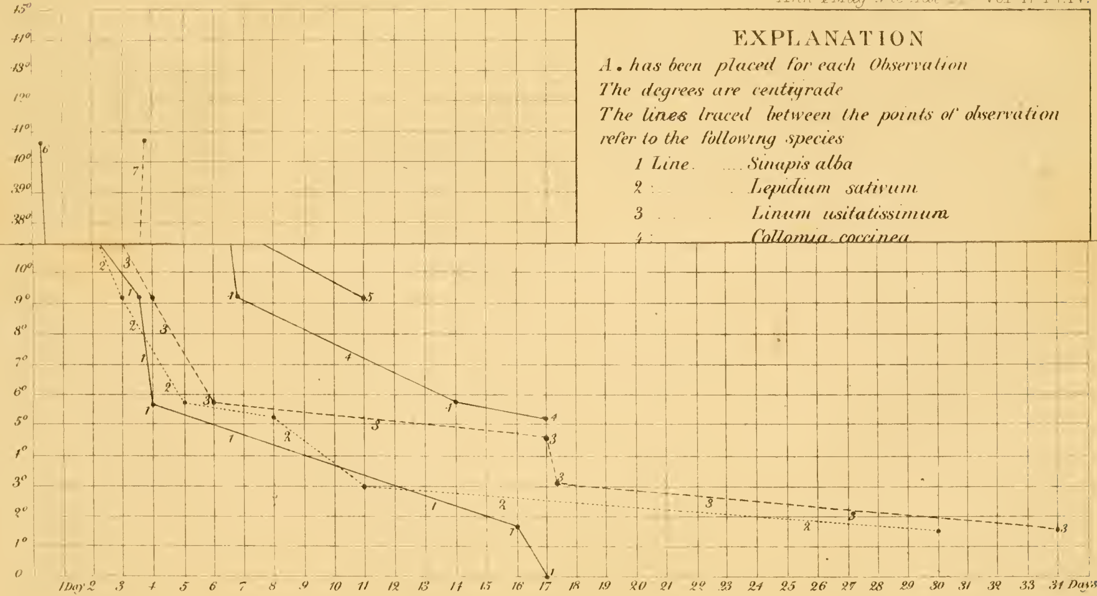
J. Basire sc.

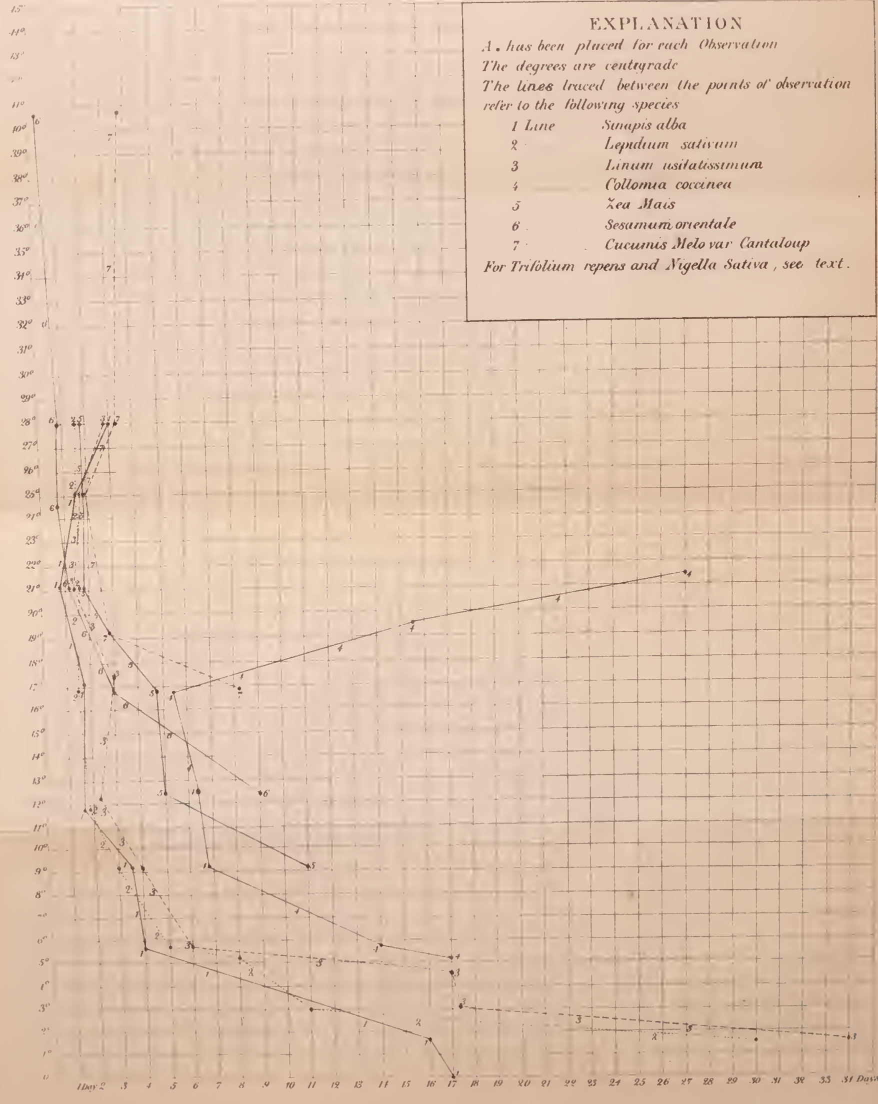
E.M.B. lith

W West imp

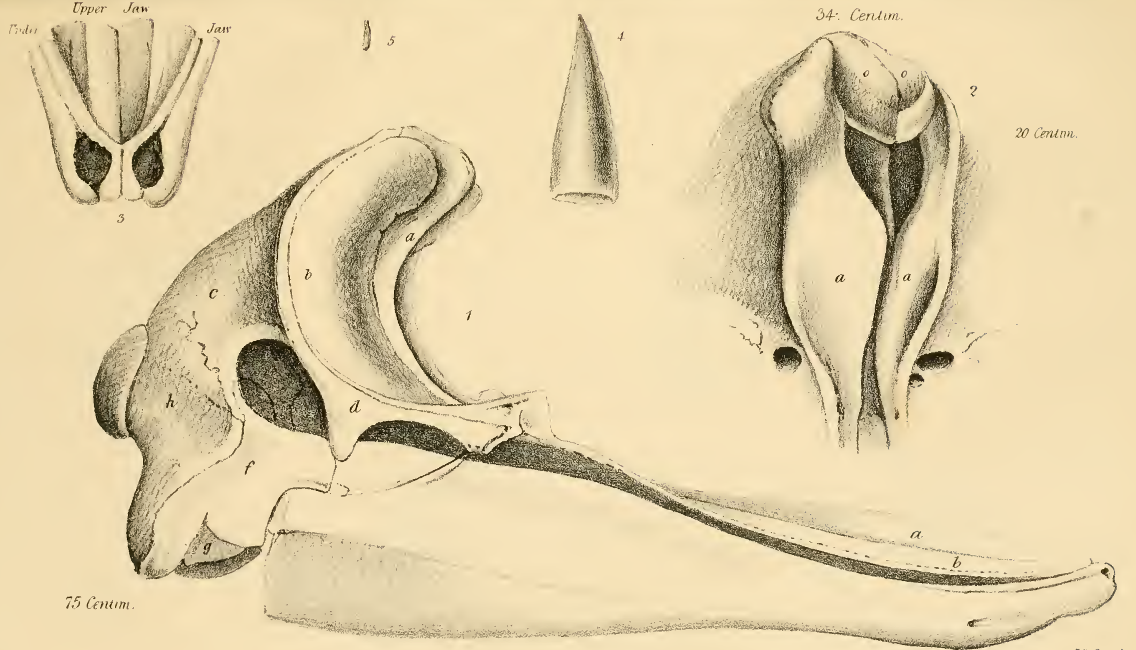


Colour brownish grey, like ashes, underside somewhat clearer, but not entirely white
Transverse Section
Nasal aperture
0 45
0 43
0 21
Ear
0 50
0 34 M
3 Metres 95 Cent
17 Cent
26
1,06 Met
here
Anus
Mammary aperture
Genital Slit
Circumference here 2 Metres.
Slit of the receptaculum of the Penis
0, 22 Met
0 · 16 Met.
0 03
Anus
0,09
Mammary aperture
1,08 Metres


EXPLANATION
A • has been placed for each Observation
The degrees are centigrade
The lines traced between the points of observation
refer to the following species
1 Line. .... Sinapis alba
2 ... Lepidium sativum
3 ... Linum usitatissimum
4 ... Collomia coccinea
1 Day 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 Days


EXPLANATION
A • has been placed for each Observation
The degrees are centigrade
The lines traced between the points of observation refer to the following species
1 Line Sinapis alba
2 Lepidium sativum
3 Linum usitatissimum
4 Collomia coccinea
5 Zea Mais
6 Sesamum orientale
7 Cucumis Melo var Cantaloup
For Trifolium repens and Nigella Sativa, see text.
1 Day 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 Days

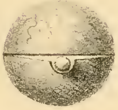

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


Upper Jaw
Under
Jaw
3
5
4
34. Centim.
o
o
2
20 Centim.
a
a
1
a
b
c
d
h
f
g
a
b
75 Centim.
59 Centim.

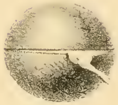
EYE OF MACKAREL

Lateral Aspect

Lineal Slit

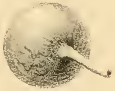


Posterior Aspect

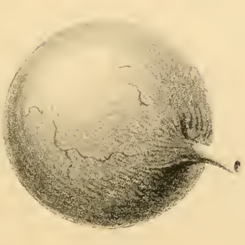


HADDOCK

WHITING.

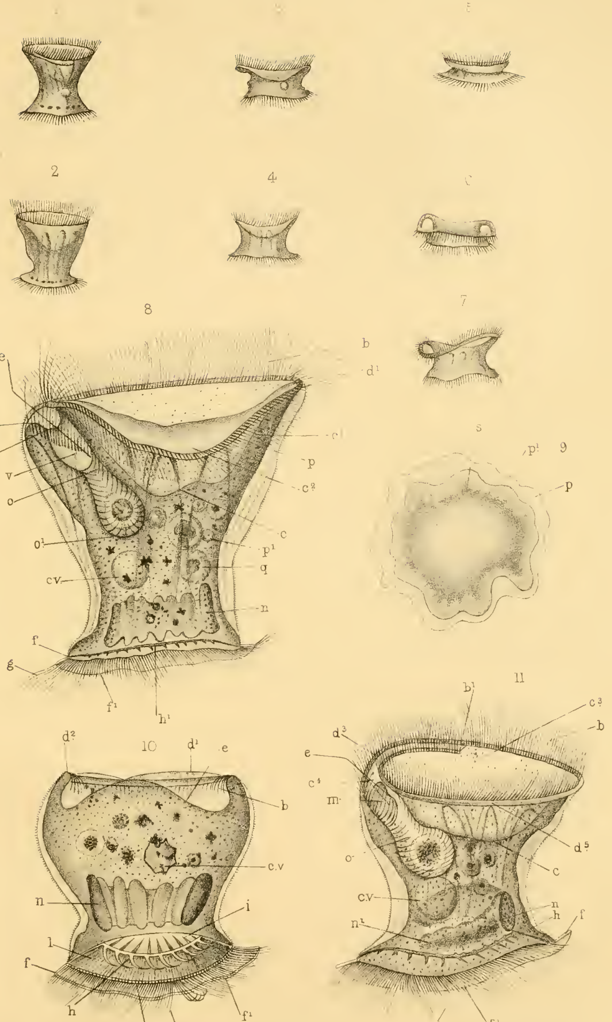


COD.



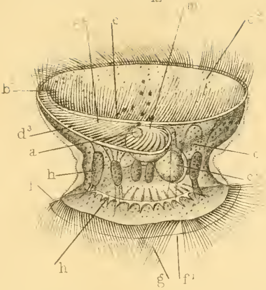
J.Basire lith

POSTERIOR ASPECT IN ALL TO CONTRAST WITH MACKAREL

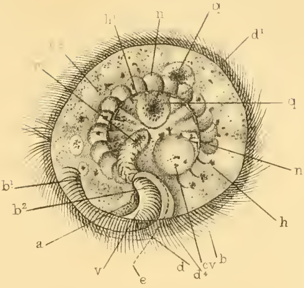

2
4
7
8
e
d
m
v
o
o1
cv
f
g
f1
h1
b
d1
c1
p
c2
c
p1
q
n
9
p1
p
10
d2
d1
e
b
c.v
n
i
l
f
h
l1
g
f1
11
b1
c3
b
d3
e
c4
m
o
cv
n1
d5
c
n
h
f
g
f1

lith

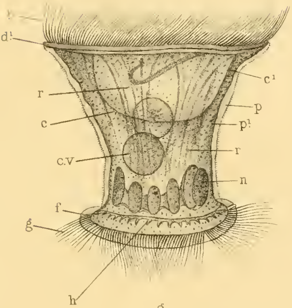
12



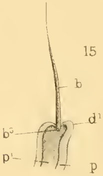
13



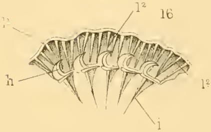
14



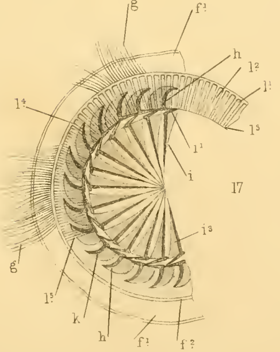
15



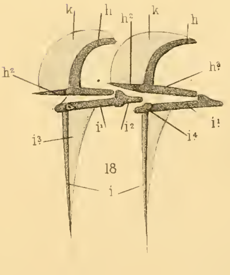
16



17



18



J. Basire lith.