

THE ANNALS
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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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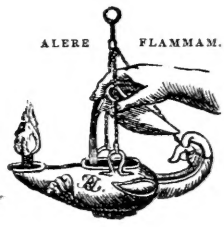
“Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper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

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

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

J. TAYLOR, *Norwich*, 1818.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

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

No. 97. JANUARY 1876.

I.—*On the Classification of Scorpions.*
By Prof. T. THORELL.

AFTER Peters, by his important work, “Ueber eine neue Eintheilung der Skorpione” &c.*, had carried out a thorough reform in the classification of Scorpions, it might have been expected that this interesting and neglected group of animals would become the subject of numerous and exhaustive researches, and that not only some among the many unknown species that lie preserved in public and private collections would be described, but also that their classification would be more fully developed on the principles laid down by Peters. Very little of this, however, has yet taken place; and under these circumstances the contribution to the knowledge of these animals which constitutes the substance of the following attempt at a systematical arrangement of the order of Scorpions, although based on the examination of a rather limited number (about 90) of species, may perhaps be considered not altogether superfluous, since it points out some

* Monatsbericht d. königl. Akad. d. Wissensch. zu Berlin, 1861, pp. 507–516.

features in their organization, the importance of which for the purpose of systematization seems not to have been sufficiently appreciated.

The principal material on which this essay is based consists of the collections in the National Museum at Stockholm and the Gottenburg Museum of Natural History; and I avail myself of this opportunity to express my thankfulness to the keepers of those institutions, Prof. C. Stål and Mr. A. W. Malm, whose obligingness enabled me to study the scorpions committed to their care.

De Geer was, as is well known, the first who divided the genus *Scorpio*, Linn., into smaller groups. He chose as the basis for his classification the differences in the number of the *eyes*. Most subsequent writers who have treated of the classification of scorpions (*e.g.* Leach, Hemprich and Ehrenberg, as also C. L. Koch) have either exclusively or principally adopted the same principle of division. C. L. Koch's arrangement is still employed by many naturalists, notwithstanding that Gervais and, subsequently, Peters have clearly shown the comparatively trifling importance and the often variable and unsatisfactory nature of the characteristics afforded by the eyes. The merit of having first disengaged himself from the ordinary view relative to the classification of scorpions belongs without doubt to Gervais*, although even he appears to attribute too much importance to the characteristics derived from the number of the eyes. The "groups," however, into which he collects the "subgenera" of his genus *Scorpio* are almost all perfectly natural, and agree in part with those proposed by Peters. His first group, containing the subgenera *Androctonus*, *Centrurus*, and *Isometrus* or *Atreus*, corresponds with Peters's *Androctonini* and *Centrurini* (which I unite in one under the denomination *Androctonoidæ*); his second group, *Tétégonés*, is identical with Peters's *Telegonini*. The four following subgenera (*Buthus*, *Chaectas*, *Scorpius*, and *Ischnurus*) he does not, however, like Peters, unite in *one* similar group, but considers each of them as forming a separate group. (The genera *Vejovis* and *Dacurus* = *Centrurus*, C. L. Koch, which appear to have been unknown to him, were erroneously placed in his first group.)

But if Gervais's division is, on the whole, quite natural and far better than C. L. Koch's, it nevertheless leaves much to be desired as regards the sharp and sure limitation of the groups; and it is principally in this respect that the system

* Gervais, "Remarques sur la fam. d. Scorpions," in the Archives du Mus. d'Hist. Nat. iv. pp. 201-240; Walckenaer et Gervais, Hist. Nat. d. Ins. Apt. iii. pp. 32-74.

of Peters distinguishes itself before all previous attempts, in that he has called attention to characteristics, overlooked by all his predecessors, which have the advantage of being eminently constant and trustworthy. It is especially the form of the *sternum* and the different tooth armature of the *mandibles* that afford the distinctive characteristics of the four "groups" into which Peters arranges the scorpions. In his first group, *Telegonini*, the sternum is extremely short, transverse, almost forming a mere line, and *both* fingers of the mandibles are armed with a *single* row of teeth. In the second group, *Scorpionini*, the sternum is large, almost pentagonal, with parallel lateral margins, and the mandibles are similar to those of the preceding group. In the third group, *Centrurini*, the sternum is small, triangular, narrowing in front, and the movable finger of the mandible armed with *two*, the immovable with *one* row of teeth. Lastly, in the fourth group, *Androctonini*, the sternum has the same form as in the *Centrurini*, but *both* fingers of the mandibles are provided with *two* rows of teeth. These four groups are further divided into several (in great part new) genera, distinguished by differences in the form of the cephalothorax and the tail, the armature and sculpture of the latter, the number and position of the eyes, the form of the hands, &c. With regard to the lateral eyes, a distinction is made between the usually larger and in number and position almost uniformly constant "principal" lateral eyes and the more variable "accessory" eyes.

The modifications of Peters's system which I have thought proper to adopt are not of any especially great consequence. I have, however, found that similitude in the form of the sternum is not accompanied by similitude in the dental armature of the mandibles quite so often as Peters supposes; and I cannot, therefore, attribute to the characteristics derived from the mandibles the same importance that he does. One consequence of this is, that I find myself led to combine *Centrurini* and *Androctonini* in one and the same principal group. Moreover I think I have found in the form of the *pectoral combs* two separate types, which in a systematic point of view are probably quite as important as the different forms under which the sternum presents itself. The "combs" are, as is known, a sort of oblong laminæ, each made up of more or less numerous longitudinally arranged lamellæ, and bearing in its posterior margin a row of long, narrow, closely set parallel processes, the so-called *teeth* of the comb. The first (front) row of lamellæ is composed of *three* large plates, which may be called *lamellæ dorsuales*; the hindmost row consists of a number of very small rounded lamellæ, one behind the base of each tooth

(with the exception of the last), which I call *lamellæ fulciantes*, or *fulcra dentium*. Between these rows lies a variable number of rows of lamellæ, the *lamellæ intermediæ*. In Peters's *Androctonini*, *Centrurini*, and *Scorpionini*, with the exception of *Vejovis*, these intermediate lamellæ are few in number, most, if not all, of them *angular* and *large* (larger than the fulcra), and always arranged in a single row. In his *Telegonini*, on the contrary, as also in *Vejovis*, the intermediate lamellæ are *numerous*, mostly *rounded* (at least towards the apex of the comb), and very *small* (little, if at all, larger than the fulcra), and arranged sometimes in one, sometimes in more rows. Such is at least the case with the few species of the two last-named groups that I have had the opportunity of examining. I have therefore detached *Vejovis* from Peters's *Scorpionini*, from the rest of which it differs also by several other peculiarities, and have formed of it a separate principal group. As the characteristics on which the four principal groups, *Androctonoidæ*, *Telegonoidæ*, *Vejovoidæ*, and *Pandinoidæ**, recognized by me were founded, are at least as important as those whereby the *families* included in the order of Spiders, for example, are distinguished from each other, I call these groups also *families*.

For determining the limits of the smaller subdivisions, the subfamilies and genera, I have partly made use of the cha-

* The name is formed from the new generic name *Pandinus*. As *Scorpiones* (or *Scorpii*) is the name of the whole order, the name *Scorpio* or *Scorpius* can no more be retained as a "nomen genericum" than *Araneus* or *Aranea* when we call the order of Spiders *Araneæ*. Together with the generic names *Scorpio* and *Scorpius* the denomination *Scorpionini* must of course be discarded.

As long as it was customary to unite the *Pseudoscorpiones* in the same "family" as the Scorpions, it was right to call that family *Scorpionides* (-*idea* &c.); but since the Scorpions have been formed into a separate order, or at least suborder, this group ought as assuredly to be called *Scorpiones*, as the class of fishes *Pisces*, and that of birds *Aves*. When we have the good fortune to possess a universally known "nomen appellativum" which accurately suits a class, order, or suborder, nothing can surely be gained by rejecting it for a newly manufactured denomination, or by appending to the end of it -*ides* or -*idea*, a termination which implies an *extension* of the notion to which it is applied, and therefore, in the present instance, *falsifies* it, and is, moreover, in zoology generally applied as an ending to *family* names, rarely to those of higher groups. Neither is this our view invalidated by an appeal to the "law of priority;" for that law holds only for the names of genera and species, not for groups of higher rank, and is moreover not so absolute as not to admit of exception—for instance, for the sake of avoiding a *false* denomination. Thus the name *Scorpio europæus* certainly could not be retained for a species never found in Europe, but only in America; and the older name *Tarentula*, Fabr., has been universally abandoned for *Phrynus*, Oliv., because it would be quite as wrong to call those animals *Tarentula* as *Scorpio* or *Musca*.

characteristics employed by Peters and others, partly of certain new ones, among which I desire to call special attention to the tooth armature of the *palp-fingers* (which often seems to me to offer particularly good and trustworthy marks of distinction), as also to the position, with regard to the upper and underside of the hand, of what I call the *hand-back* (*manus aversa*). By hand-back I mean that surface of the hand which (in the family Pandinoidæ) is turned outwards, and which is bounded by the two strongest costæ of the hand. I have retained Peters's division of the lateral eyes into principal and accessory lateral eyes, although it may sometimes be difficult to say under which of these categories an eye comes. I have also, after him, allowed the presence or absence of "keels" on the tail to serve as a distinctive mark of genera, although I am by no means sure that this characteristic is always entitled to so much credit. Those also of Peters's genera which are to me unknown, I have endeavoured, as far as possible, to accommodate with places in my scheme (they are here marked with an asterisk), but, I have no doubt, in some instances failed to assign them their proper place.

Many may probably entertain the opinion that I have broken up the families into too many genera, whereas I am convinced that the number of these groups will hereafter be considerably increased. If there is ever to be an end of the confusion in which our knowledge of the *species* of scorpions is involved (a confusion which has probably contributed more than any thing else to deter zoologists from the study of this group of animals), the first necessary step will assuredly be its division into numerous and well-distinguished *genera*.

That I have corrected the faultily written names *Brotheas* and *Væjovis* to *Broteas* and *Vejovis* (as on a former occasion I corrected, for instance, *Marpissa* to *Marpessa*), will probably be disapproved by no others than those who look upon every letter of a once published name as holy and intangible. I ought to mention that I do not allow myself to make such a correction without its having been first approved by a philologist *ex professo*. As regards my views on the subject of zoological nomenclature in general, I beg to refer to my work 'On European Spiders,' pp. 3-14.

Scorpions form so compact and uniform a group that it is extremely difficult, perhaps impossible, to say with certainty which of them are the highest and which the lowest. Those who consider Spiders as ranking above Scorpions will no doubt assign the highest place to those forms (*Ischnurus* for instance) in which the tail is least developed, and which thus

appear to form a transition, though a very indistinct one, to *Thelyphonus* and *Phrynus*. For my part I am more inclined, with Gervais, to consider the *Androctonini* the most highly developed scorpions, in virtue of their more numerous eyes, more developed pectoral combs, and richer tooth armature of the fingers both of the mandibles and the palpi, their powerful tail, &c. At least the *Androctonini* are the most *typical* of scorpions; and with them therefore I begin my arrangement. The *Pandinini*, which differ most from the *Androctonini*, have on that account received the lowest place*.

Ordo SCORPIONES (sive SCORPII).

Fam. I. *Androctonoidæ*.

Sternum narrowing forwards, subtriangular. Intermediate lamellæ of the pectoral combs rather few in number, most of them angular and larger than the fulcra, and forming only one series. The movable finger of the mandibles (which always forms a perfect furca) has two rows of teeth; their immovable finger has two teeth in the superior margin, 2-0 in the inferior. The fingers of the palpi are, along the middle of their edge, provided with a number of oblique rows of fine teeth, and on either side of these with other, generally coarser teeth, arranged in one or more rows. Three principal lateral eyes and 2-0 accessory eyes on each side of the cephalothorax.

Subfam. 1. *ANDROCTONINI*.

Not only the upper but also the under margin of the immovable mandibular finger armed with *two* strong teeth. Lateral teeth of the palp-fingers, which are coarser than the median teeth, form along the inner side a single simple row;

* The place that I consider the order of Scorpions to occupy in the class of Arachnoidea will appear by the following scheme:—

Class ARACHNOIDEA.

Subcl. 1. THORACOPODA, nob.

Ordo 1. Scorpiones.

2. Pedipalpi.

6. Pseudoscorpiones.

7. Acari.

8. Linguatulina (=fam. *Pentastomoidæ*).

Ordo 3. Araneæ.

4. Opiliones.

Ordo 5. Solifugæ.

Subcl. 2. (Ordo 9) CORMOPODA, nob. (=fam. *Arctiscoidæ*).

[The usual name of the last order, "Tardigrada," belongs to a group of Mammals. The order Pantopoda (fam. *Pycnogonoidæ*) appears to be more nearly allied to the Crustacea than to the Arachnoidea.]

but along the outer side they are arranged in a series of teeth placed two and two obliquely and transversely near to each other. No tooth or spine under the base of the sting. Generally two accessory eyes, besides the three principal eyes, on each side of the cephalothorax.

1. The fifth joint of the tail broadly excavated above, its superior margins forming an elevated denticulate or granulate keel. Tail generally increasing in breadth from the base to the fifth joint.

ANDROCTONUS, (Hempr. et Ehr.), 1829.

Type *A. australis*, (Linn.), 1758¹.

2. The upper margins of the fifth caudal segment rounded, not compressed into an elevated keel BUTHUS, (Leach), 1815.

Type *B. europæus*, (Linn.), 1754².

Subfam. 2. CENTRURINI.

The immovable finger of the mandibles has no tooth, or only one, in the inferior margin. Lateral teeth of the palp-fingers arranged in a single series, or forming several short transverse rows. The sixth caudal joint generally provided with a spine or tooth under the sting. Accessory lateral eyes often wanting, sometimes one or two on each side.

- A. "Joints of the tail destitute of keels" (*Pet.*)

*UROPLECTES, *Pet.*, 1861³.

Type *U. ornatus*, *Pet.*, 1861.

- B. At least a few of the joints of the tail evidently keeled.

- a. Inferior margin of the immovable mandibular finger toothless.

1. Lateral teeth of the palp-fingers form on the inner side a single simple row; on the outer side they are arranged in a row which partly consists of teeth placed two and two transversely near to each other. (A tooth under the sting is often wanting.)

LEPREUS, n.⁴

Type *L. pilosus*, n.⁵

¹ = *A. funestus*, Hempr. et Ehr. The *Scorpio australis* of Linnæus, which was quite erroneously by DeGeer referred to an American species, by Herbst to a scorpion which is perhaps identical with a species called by me *Buthus craturus*, by Savigny and Audouin to *Andr. crassicauda*, (Oliv.), or *A. bicolor*, Hempr. et Ehr., is probably the same species as *A. funestus*, iid., which is, I believe, the *Androctonus* most generally met with in European collections, and of which a very old specimen in the National Museum of Stockholm is labelled "*Scorpio australis*, Linn."

² = *Scorpio occitanus*, Amour. 1789, or *S. tuncitanus*, Herbst, 1800. (Not = *S. europæus*, Linn. 1758!)

³ Of his *U. flavoviridis*, however, Peters says (*l. c.* p. 516), "Obere Schwanzkämme deutlich." *Uroplectes* is perhaps not different from *Tityus* (C. L. Koch) nob.

⁴ Nom. propr. mythol.

⁵

Lepreus pilosus, n.

Densius pilosus, pallidus vel subcinereo-testaceus, oculis nigris, cauda apice

2. Lateral teeth of the palp-fingers form, both on the inner and outer side, a row of teeth placed two and two transversely near to each other. (The tooth under the sting is sometimes wanting.)

TITYUS, (C. L. Koch), 1836.

Type *T. lineatus*, C. L. Koch, 1845.

- b. Inferior margin of the immovable mandibular finger armed with one (very small) tooth. (A tooth or spine under the sting is rarely wanting.)

- * Both the inner and the outer lateral teeth of the palp-fingers arranged in a single row.

1. The fifth caudal joint broadly excavated above, its upper margins forming an elevated keel. (The tail gradually somewhat incrossated from the vicinity of the base to the fifth joint.)

PHASSUS, n.¹

Type *P. columbianus*, n.²

2. Upper margins of the fifth caudal joint rounded, not forming an elevated keel ISOMETRUS, (Hempr. et Ehr.), 1829.

Type *I. maculatus*, (DeGeer), 1778³.

plus minus infuscata; segmentis abdominalibus costis trinis versus medium, postice, munitis; cauda gracili, segmentis 1^o-4^m subcylindratis et carinis inferioribus mediis carentibus, carinis reliquis debilissimis, subtiliter denticulatis; segmento 5^o carinis superioribus carente, saltem duplo et dimidio longiore quam latiore; vesica sub aculeo mutica; digito manus mobili manu postica non vel vix longiore, ordinibus dentium secundum mediam aciem ejus 9; dentibus pectinum 29-31. Long. circa 47 millim. Africa, Caffraria.

¹ Nom. propr. mythol.

²

Phassus columbianus, n.

Cephalothorace sat crasse granuloso, nigro et fusco-testaceo variato, abdomine nigricante, ordinibus 5 longitudinalibus macularum fusco-testacearum; cauda basi fuso-testacea, apice late nigricante, ibique sat fortiter angustata, vesica parva, oblonga, crasse granulosa, sub aculeo dente forti compresso supra bidenticulato armata; manibus brachia latitudine fere æquantibus, evidentissime granuloso-costatis; digito manus mobili manu postica duplo longiore, ordinibus denticulorum secundum mediam aciem ejus circa 8; dentibus pectinum fere 12. Long. circa 32 millim. America merid., Columbia.

³ = *Scorpio americanus*, Linn., 1758. I suppose we cannot well retain the Linnean name of this scorpion, as Linnæus had already in 1754 (in his 'Museum Adolphi Friderici,' where the binominal nomenclature is consistently and constantly employed) given the name *S. americanus* to another species of *Isometrus*. In his 'Syst. Nat.' ed. 10 (1758) and in 'Mus. Ludov. Ulricæ' (1764), Linnæus changed the name of that scorpion, erroneously considering it identical with a European species, into *S. europæus*, although the specimen which he had described was from America. This *S. americanus*, Linn. 1754, or *S. europæus*, ejusd. 1758, in which, according to Linnæus (Mus. Ludov. Ulricæ, p. 429), the hands are "supra angulatæ, admodum angustæ," is no doubt identical with *S. europæus*, DeGeer (of which I have seen the type specimen), or *S. obscurus*, Gerv., which species I therefore call *Isometrus americanus*, (Linn.).

** Both the inner and outer lateral teeth of the palp-fingers arranged in a number of short oblique rows, with at least three teeth in each row.

1. The fifth caudal joint broadly excavated above, its upper margins forming an elevated keel. (The tail gradually broader from its base towards the fifth joint.) RHOPALURUS, n.¹
Type *R. laticauda*, n.²
2. The upper margins of the fifth caudal joint rounded, not forming an elevated keel. CENTRURUS, (Hempr. et Ehr.), 1829³.
Type *C. biaculeatus*, (Lucas), 1839.

Fam. II. Telegonoidæ.

Sternum very short, forming a transverse falciform band or line curved backwards between the coxæ of the second pair and the genital plates. The intermediate lamellæ of the combs generally (always?) numerous, most of them rounded and small (little or not larger than the fulcra), and arranged in 1-3 longitudinal rows. Both fingers of the mandibles provided with a single row of teeth. Lateral eyes three or two (?) on each side, small. No tooth or spine under the sting.

A. Tail without keels on the underside.

1. The fifth caudal joint provided on the underside, near the apex, with a large, depressed, almost semielliptical area, rounded in front, and limited by a row of small teeth or granules.

BOTHRIURUS, (Pet.), 1861⁴.

Type *B. vittatus*, (Guér.), 1830.

¹ ῥόπαλον, club; οὐρά, tail.

² *Rhopalurus laticauda*, n.

Subtestaceus, cauda a basi ad segmentum quintum dilatata, tum fortiter angustata, apice late infuscata, manibus subtiliter granulosus, plus minus evidenter costatis, brachio circiter dimidio latioribus, digito manuum mobili manu postica paullo plus dimidio longiore, ordinibus denticulorum secundum mediam aciem circa 8; dentibus pectinum fere 19-23. Long. circa 44-50 millim. America merid., Columbia.

³ Hemprich and Ehrenberg formed the genus *Centrurus* for those scorpions which had "10 eyes," without giving any species as its type. Peters says (*l. c.* p. 508) that it is founded on a Brazilian species, and that there can be no doubt of that species belonging to the genus *Tityus* of C. L. Koch. I have therefore as type of the genus taken a species, *C. biaculeatus*, (Luc.), which Peters expressly names as belonging to *Centrurus*, Hempr. et Ehr. In this genus the eyes do not appear to me to be in³ general more than 8; but there certainly are species with 10 (for instance, *C. testaceus*, (DeGeer), which has an accessory eye either on both sides or only on one of the sides), and even with 12 eyes. It is therefore impossible to take the number of eyes into account in characterizing this genus.

⁴ I have altered the characteristics of Peters's genus *Bothriurus* so as to make it also comprehend *Brotheas erythroductylus*, C. L. Koch, which probably is the female of *B. bonariensis*, ejusd.; *Scorpio vittatus*, Guér., is, I believe, the same species.

2. The fifth caudal segment smooth below, without a depressed semi-elliptical area TELEGONUS, (C. L. Koch), 1836.
Type *T. versicolor*, C. L. Koch, 1836.

- B. Tail keeled at least on the underside of the fifth joint.
CERCOPHONIUS, (Pet.), 1861.
Type *C. squama*, (Gerv.), 1844¹.

Fam. III. Vejovoidæ.

Sternum with parallel sides, subpentagonal, rather small, about double as broad as long. Intermediate lamellæ of the combs generally (always?) numerous, most of them rounded and small (little or not larger than the fulcra), and arranged in 1-3 longitudinal rows. The movable mandibular finger armed with one or two rows, the immovable with a single row of teeth. The hands subfusiform or ovate, their height or thickness in general greater than their least breadth. Three (or four) lateral eyes on each side, forming a row curved inwards². No spine or tooth under the sting.

1. The movable mandibular finger provided with a single row of teeth in the upper margin. Dorsal eyes placed rather far in front of cephalothorax. The tail keeled VEJOVIS, C. L. Koch, 1836³.
Type *V. intrepidus*, n.⁴

¹ The genus **Acanthochirus*, Pet., which appears to differ from *Cercophonius* almost only by the hands being armed with a spine on the inner side, is probably, as has already been suggested by Gerstäcker ("Bericht über die wissensch. Leist. im Gebiete d. Entom. 1861"), founded on the male of *Cercoph. squama*. I have myself seen a species of *Tityus* in which the male is provided with a similar spine, whereas in the female this spine is represented only by a low tubercle.

² According to Peters, these scorpions have two principal lateral eyes and one or two accessory eyes.

³ Not being acquainted with any of C. L. Koch's *Vejovis*-species, I have been obliged to give an apparently new species as the type of the genus.

⁴ *Vejovis intrepidus*, n.

Ferrugineo-fuscus, vesica ferrugineo-testacea, manibus pallidius ferrugineis, costis obscurioribus; cephalothorace crasse granuloso, segmenta caudæ 1^m et 2^m longitudine æquante, segmentis abdominalibus antice lævibus, nitidis; cauda cephalothorace circiter quadruplo et dimidio longiore, latiore quam altiore, carinis superioribus in segmentis 1^o-4^m denticulatis, dente apicali fortiore, carinis inferioribus granulosis, mediis segmentorum anticorum lævibus tamen, segmento 5^o in marginibus superioribus tenuius granuloso, carinis inferioribus subtiliter dentatis; palporum humero supra plano, granulis tantum minutissimis sparso; manibus crassis, tumidis, costis 8 longitudinalibus granulosis, digito mobili manu postica circiter dimidio longiore; pectinum dentibus circa 22. Long. circa 84 millim. America, Mexico.

2. The movable mandibular finger not only provided with a row of teeth in the upper margin, but also with a tooth in the under margin. Dorsal eyes not far removed from the centre of cephalothorax. Tail keeled HADRURUS, n.¹
Type *H. hirsutus*, (Wood), 1863.

Fam. IV. Pandinoidæ.

Sternum with parallel sides, subpentagonal, generally large. Intermediate lamellæ of the combs rather few in number, angular, and (at least most of them) larger than the fulcra, and arranged in a single row. The movable mandibular finger provided with one or two rows, the immovable with a single row of teeth. Hands broader than high, in general large and depressed. The principal lateral eyes three or two, the accessory eyes in general wanting, rarely one on each side. The sixth caudal segment nearly always destitute of a tooth or spine under the sting.

Subfam. 1. IURINI.

The movable mandibular finger not only provided with a row of teeth in the upper, but also with one or more teeth in the under margin. (Cephalothorax emarginate in front; dorsal eyes situated far in front of the centre of cephalothorax; lateral eyes three, removed from the lateral margin of cephalothorax. Sternum as broad as the labial lobes of the second pair together. Hands rather large, thick; the hand-back forming an obtuse angle with the upper surface of the hand. Tail evidently keeled, its sixth joint long, not grooved on the underside.)

1. The inferior margin of the movable mandibular finger armed with one strong tooth. The fine teeth along the middle of the edge of the palp-fingers forming many short oblique rows IURUS, n.²
Type *I. granulatus*, (C. L. Koch), 1838.
2. The inferior margin of the movable mandibular finger provided with a row of (5) teeth. The teeth along the middle of the edge of the palp-fingers forming a single continuous row UROCTONUS, n.³
Type *U. mordax*, n.⁴

¹ ἄδρως, strong; οὐρά, tail.

² ἰός, poison; οὐρά, tail.

³ οὐρά, tail; κτείνω, kill.

⁴

Uroctonus mordax, n.

Saturate fuscus, costis palporum nigris, abdomine supra plerumque dilutiore, pedibus pallidioribus, vesica testaceo-fusca; cephalothorace subtiliter granuloso, segmentis duobus primis caudæ conjunctim paullo longiore; digito manus mobili manum posticam longitudine æquante; dentibus pectinum 8-10. Long. circa 50 millim. America septentr., California.

Subfam. 2. *PANDININI*.

The movable mandibular finger provided with a single row of teeth, situated in its upper margin.

A. Three principal lateral eyes on each side.

- A. "Joints of the tail rounded, without keels. Dorsal eyes behind the centre of cephalothorax"¹ *DACURUS, Pet., 1861.
Type *D. galbineus*, (C. L. Koch), 1838.

B. Tail evidently keeled.

- a. "A spine under the base of the sting. Dorsal eyes situated just behind the first third of cephalothorax. Body, palpi, and tail as in *Heterometrus*, Hempr. et Ehr." (*Pet.*).

*DIPLOCENTRUS, Pet., 1861.

Type *D. mexicanus*, Pet., 1861.

b. No tooth or spine under the sting.

- a. Lateral eyes removed from the lateral margin of cephalothorax. Hand-back forming an acute angle with the upperside of the hand.

† Dorsal eyes not very far removed from the centre of cephalothorax. Underside of tail provided with three longitudinal grooves, and with granules arranged in at least four longitudinal rows. Labial lobes of the second pair together from half as broad again to double as broad as sternum.

- § Cubitus rounded off anteriorly; its anterior side not separated by a strong margin or ridge from the upper and under surfaces. (Dorsal eyes situated nearly in the centre of cephalothorax. The infero-lateral keels of the fifth caudal joint are, towards the apex, diverging and curved rather strongly upwards. Hands not much compressed on the inner side. Anterior margin of cephalothorax rather broadly emarginate.)

HETEROMETRUS, (Hempr. et Ehr.), 1829.

Type *H. maurus* (Linn.), 1758².

- §§ Cubitus subprismatic, with the anterior and superior sides plain; anterior side subrectangular, limited both above and below by a very distinct dentate or granulate margin.

- * Anterior margin of cephalothorax rather broadly and deeply emarginate, its frontal lobes rounded.

1. Inner margin of the hands strongly compressed, thin. (Dorsal eyes situated a little behind the centre of cephalothorax³). PANDINUS, n.⁴

Type *P. africanus*, (Linn.), 1754.

¹ According to Peters; C. L. Koch, however, says of his *Centrurus galbineus* (*Die Arachn.* iv. p. 111):—"Die Seitenkiele und die unteren Kiele zwar vorhanden, aber in nicht sehr starkem Ausdrucke." The hands are said to be "schmal, an der Aussenseite uneben, ohne deutliche Kiele." Koch gives this species ten eyes (?).

² = *H. palmatus*, Hempr. et Ehr.

³ The measures are taken from the eyes to a straight line tangent to the anterior margins of the frontal lobes, and to the middle of the posterior margin of the cephalothorax.

⁴ *πάνδεινος*, quite terrible.

2. Inner margin of the hands very thick, not compressed. (Dorsal eyes situated a little in front of the centre of cephalothorax.) PALAMNÆUS, n.¹
Type *P. Petersii*, n.²

- ** Anterior margin of cephalothorax rather slightly emarginate in the middle; frontal lobes broadly truncate; dorsal eyes situated behind the centre of cephalothorax. MLEPHONUS, n.³
Type *M. Wahlbergii*, n.⁴

- †† Dorsal eyes situated about double as far from the anterior margin of cephalothorax (which is but little or not emarginate) as from its posterior margin. Labial lobes of second pair of legs together a little broader than (not more than half as broad again as) sternum. The sixth caudal joint destitute of rows of granules and of distinct grooves on the underside.

OPISTHOPHTHALMUS, C. L. Koch, 1837.
Type *O. capensis*, (Herbst), 1800.

- β. Lateral eyes, at least the anterior one, situated very near to or on the lateral margin of cephalothorax. Hand-back forming an obtuse or nearly right angle with the upper surface of the hand. (Cephalothorax emarginate in front. Dorsal eyes not far removed from its centre. Sternum not, or only a little, narrower than the labial lobes of the second pair together. Tail rather slender, its sixth joint long and narrow, destitute of grooves and rows of granules on the underside. Body and hands in general flattened.)

- † Tail not much compressed; its superior margins rounded, not keeled.

1. The elevated lateral margin of cephalothorax visible under the lateral eyes; these eyes, therefore, separated from the margin by a slight interval. Hands not much flattened OPISTHACANTHUS, (Pet.), 1861⁵.
Type *O. elatus*, (Gerv.), 1844.

¹ παλαμναῖος, murderer. ² = *Heterometrus megacephalus*, Sim.

³ μαιφόνος, stained with blood, murderer.

⁴ *Miephonus Wahlbergii*, n.

Supra fusco-testaceus, segmentis abdominalibus basi late nigricantibus, cauda versus apicem plus minus late infuscata; subter cum pedibus testaceus; cephalothorace segmenta caudæ primum et secundum cum dimidio tertii longitudine superante; cauda leviter carinata; manibus latis, intus fortiter rotundatis, supra pæne lævibus; dentibus pectinum circa 18. Long. circa 78 millim. Africa, Caffraria.

⁵ In this genus the hind lateral eye is sometimes (as in *O. elatus*) placed a little nearer to the middle eye than this to the anterior, as also a little more inwards than the other lateral eyes. Peters has based the genus on this character, which, however, appears to me to be of less importance than that here given.

2. Lateral eyes situated on the very margin of cephalothorax.
 Hands very flat *HORMURUS*, n.¹
 Type *H. caudicula*, (L. Koch), 1867.
- †† Tail rather strongly compressed, with keels both on the
 upper and underside .. *ISCHNURUS*, (C. L. Koch), 1837.²
 Type *I. trichiurus*, (Gerv.), 1844.
- B. Two principal lateral eyes on each side.**
- a.** "Tail with only three keels on the underside, thick, its keels strong.
 Frontal margin arcuato-emarginate. Sternum broader than long,
 as broad as the labial lobes of the second pair. Hands broader
 than high, strongly keeled. Two large principal eyes on each
 side." (*Pet.*) **URODACUS*, *Pet.*, 1861.
 Type *U. novæ hollandiæ*, *Pet.*, 1861.
- b.** The first four caudal joints with four keels on the underside.
- a.** Sternum narrower than the labial lobes of the second pair to-
 gether. Dorsal eyes situated far in front of the centre of cepha-
 lothorax; the tubercle on which they are placed not grooved
 longitudinally. Hands thick, convex, the hand-back turned
 rather more downwards than upwards. Tail keeled on all sides.
 Besides the two principal eyes, there is sometimes an accessory
 eye on one or both sides of cephalothorax.
BROTEAS, (C. L. Koch), 1837.
 Type *Broteas Herbstii*, n.³
- β.** Sternum as broad as the labial lobes of the second pair together.
- † "Sternum longer than broad. Hind margin of cephalothorax
 angulato-emarginate. Hands flat, angular. The hind lateral
 eye sometimes divided into two." (*Pet.*)
 **SCORPIOPS*, *Pet.* 1861.
 Type *Scorpiops Hardwickii*, (Gerv.), 1844.
- †† Sternum broader than long. Hand-back forming, with the
 upperside of the hand, a right or obtuse angle. Only two
 lateral eyes on each side.
1. Dorsal eyes situated nearly in the middle of cephalothorax,
 which is emarginate in front; dorsal eye-tubercle divided
 by a longitudinal middle groove. Hands rather thick. Tail
 somewhat strong, with strongly marked keels on all sides.
IOCTONUS, n.⁴
 Type *I. manicatus*, n.⁵

¹ ὄφρυς, necklace; οὐρά, tail.

² The place of **Hemiscorpius*, *Pet.*, is probably in the vicinity of this genus. It is characterized by Peters in the following words:—"Sternum as broad as the labial lobes of the second pair. Frontal margin scarcely emarginate. Body and extremities flattened. Tail slender, long, higher than broad, keeled, its sixth joint with two lateral tubercles (in the males) behind the base of the short sting. The hind lateral eye somewhat smaller, placed more inwards."

If the tubercles mentioned by Peters also exist in the females, *Hemiscorpius* is without doubt a good genus.

³ = *Scorpio* (*Broteas*, *Chactas*) *maurus*, De Geer, script. recent. (non Linn.).

⁴ ἴδς, poison; κτείνω, kill.

⁵ *Ioctonus manicatus*, n.

Fuscus, palporum costis nigris, vesica fusco-testaceo lineata, pedibus apice

2. Dorsal eyes far in front of the centre of cephalothorax; frontal margin not, or but little, emarginate; dorsal eye-tubercle destitute of a longitudinal middle groove. Hands flattened. Tail slender EUSCORPIUS, n.*
Type *E. carpathicus*, (Linn.), 1767.

II.—On some Species of Terebratulina, Waldheimia, and Terebratella from the Upper Tertiary Deposits of Mount Gambier and the Murray-River Cliffs, South Australia.
By R. ETHERIDGE, jun., F.G.S.

[Plates I. & II.]

I AM indebted to the kindness of the President and Council of the Geological Society of London, through the Assistant Secretary, Mr. W. S. Dallas, F.L.S., and to Mr. T. Davidson, F.R.S., for the opportunity of describing four of the following species from the Tertiary beds of Mount Gambier. The remaining specimen I have been permitted to borrow from the small foreign collection of the Museum of Practical Geology; it is from similar beds at the Murray-River Cliffs, near the Great Bend, South Australia. Had it not been for Mr. Davidson's considerate help, both in information and the loan of specimens, I should have been unable to complete these notes; I therefore take this opportunity of thanking him for his kind assistance.

Bibliography.—So far as known to me, the following is a brief digest of previous writings in connexion with Australian Tertiary Brachiopoda.

Capt. Sturt, during his memorable exploration of the river Murray, collected a few fossils from the Murray Cliffs, which are figured in the account of his exploration †. The only Brachiopod there represented ‡ was afterwards described and figured from another locality by Mr. G. B. Sowerby, in Count

late flavo-testaceis; cephalothorace subtilissime granuloso, segmenta duo prima caudæ conjunctim longitudine paullo superante; cauda cephalothorace quadruplo longiore, segmentis anterioribus desuperne visis in lateribus leviter rotundatis; dentibus pectinum circa 13. Long. circa 54 millim. Nova Hollandia.

* εὖ-, well, true; σκορπίος, scorpion. I have preferred the termination *us* to *o* or *on* in names composed of σκορπίος (-ίων) and another Greek word, a scorpion being in Greek called σκορπίος; σκορπίων signifies the shooting-engine called by the Romans *scorpio* or *scorpius*.

† Two Expeditions into the Interior of S. Australia, 1832. 2 vols. 8vo.

‡ T. 3. f. 15.

Strzelecki's work on New South Wales*, as *Terebratula compta*. The Rev. Julian E. Woods has frequently alluded to the occurrence of this little shell in the Tertiary deposits of Southern Australia, in various papers communicated to the Geological Society of London† and the Royal Society of Victoria‡, and again in his work on the geology of South Australia, where it is also figured§. Mr. C. S. Wilkinson informs us that *T. compta* occurs in the upper part of the Spring-Creek section, about fourteen miles south of Geelong||, in beds which were regarded by Mr. R. Daintree as probably the equivalent of the Mount-Gambier series¶. In 1862 Mr. Davidson described**, under the name of *Waldheimia Gari-baldiana*, a species supposed to be from the Tertiary beds of Malta, but which he now believes to be from South Australia. Prof. McCoy has named two new species of Brachiopoda from Victorian Tertiary beds, viz. *Terebratula corioensis* and *Waldheimia macropora* (but, so far as I am aware, he has not yet described or figured them), and has recorded the occurrence of *Rhynchonella lucida*, Gould††.

Description of the Species.

Genus TEREBRATULA, Llwyd.

Subgenus TEREBRATULINA, D'Orbigny.

Terebratulina? Davidsoni, sp. nov. (Pl. I. fig. 1, a, b, c.)

Sp. char. Shell small, oval, flattened, tapering towards the beak, rounded towards the front; lateral margins in one plane, not sinuous. Ventral valve slightly convex, with the beak but little produced, truncated by a slightly oblique foramen more or less below the apex of the beak, excavated out of its substance, and completed by the two small deltidial plates and the umbo of the dorsal valve. Imperforate or dorsal valve almost flat, with the slightest indication of a mesial sinus in the front; hinge-line a little arched. Surface of both valves ornamented with a large number of fine radiating ribs, occasionally bifurcating, and a few concentric lines of growth;

* Physical Description of New South Wales and Van Diemen's Land &c., 1845, p. 296, t. 19. f. 4.

† Quart. Journ. Geol. Soc. 1860, xvi. p. 255; *ibid.* 1865, xxi. p. 393, &c.

‡ Transactions Roy. Soc. Vict. vi. p. 6 &c.

§ Geological Observations in S. Australia, 1862, 8vo, p. 74, woodcut.

|| "Report on Cape Otway District," Geol. Surv. Vict. 1865, p. 23.

¶ Geol. Surv. Vict. ¼ sheet 28 S.E., note.

** Geologist, 1862, v. p. 446.

†† Smyth's Progress Report, Geol. Surv. Vict. 1874, p. 36.

margins crenulate. In the dorsal valve there is no indication of a mesial septum; the socket-ridges are strong and well developed. Length $3\frac{1}{4}$ lines, width $2\frac{3}{4}$ lines, depth $1\frac{1}{4}$ line.

Obs. I beg to name this beautiful little shell after Mr. T. Davidson, to whom, as previously stated, I am under many obligations. Although all the internal portions of the dorsal valve are not preserved, the entire absence of the mesial septum, with the characters of the beak in the ventral valve, appear to indicate this as a species of *Terebratulina*.

Loc. and Horizon. Coralline Limestone of Mount Gambier, S. A. *Coll. Geol. Soc. Lond.*, presented by the Rev. J. E. Woods.

Subgenus WALDHEIMIA, King.

Waldheimia Garibaldiana, Davidson. (Pl. I. figs. 2 a & b.)

W. Garibaldiana, Dav., *The Geologist*, 1862, v. p. 446, t. 24. f. 9.

Sp. char. Shell obscurely pentagonal, with the lateral margins flexuous, and the ventral valve the more convex of the two. Ventral valve convex and rather deep, divided into three portions by two diverging ridges or ribs, which commence close to the extremity of the beak, and extend to the front, leaving between them a slightly concave or flattened space resembling a broad and depressed keel, in which three or four longitudinal ribs are to be seen; the lateral portions of the valve become gradually and gently concave as they approach the margins, and are obscurely wrinkled by a few longitudinal or, more properly speaking, curved ribs; beak produced, incurved, and truncated by a slightly oblique foramen, separated to some extent from the hinge-line by a deltidium. The dorsal valve is also divided into three portions, the central space being flattened and furrowed by three or four longitudinal obtusely rounded ribs, while the lateral portions become more elevated as the front is approached, and are ornamented by six or seven curved ribs, which become somewhat obscured as they approach the margin of the shell. Interior unknown. Length 1 inch 7 lines, width 1 inch 3 lines, depth 10 lines.

Obs. The above is Mr. Davidson's excellent description of this handsome shell almost in his own words. When originally described, *W. Garibaldiana* was supposed to have come from the Tertiary beds of Malta; but Mr. Davidson afterwards satisfied himself that it in reality came from Mount Gambier. The nature of the matrix filling the valves bears out this view, if matrix can be accepted as a test; for it agrees exactly in lithological character with that adhering to authenticated specimens from the same locality. Mr. Davidson

states that *W. Garibaldiana* bears a close resemblance to *W. flavescens*, Lamarck, now living in Port Jackson, Sydney, but it is less ovate, the beak is less elongated, and it has a smaller foramen.

Loc. and Horizon. Coralline Limestone of Mount Gambier, S. A. Cabinet of Mr. T. Davidson, F.R.S.

Waldheimia Taylori, sp. nov. (Pl. I. figs. 3 a, b, c.)

Sp. char. Shell large, elongato-ovate, very inequivalve, longer than wide, greatest width near the middle. Ventral valve exceedingly convex, attenuated towards the beak, with two slightly diverging obtusely rounded ridges proceeding from the latter towards the front, where they become lost, and enclosing between them a narrow space, which in its upper part is rounded, but becomes flattened or a little concave towards the front of the shell; the lateral portions of the valve are also flattened but not concave; beak produced, incurved, and truncated by an oblique circular foramen, contiguous to the umbo of the dorsal valve, but separated from it by a small deltidium. Dorsal valve as wide as the ventral, slightly convex in the umbonal region, becoming almost flat towards the front, but presenting in its longitudinal outline a gentle continuous convexity. Lateral margins a little flexuous. Surface marked by a few concentric lines of growth; shell distinctly punctate. The position of the mesial septum is traceable on the surface of the dorsal valve as a fine impressed line; interior otherwise unknown. Length 2 inches $3\frac{1}{2}$ lines, width 1 inch 10 lines, depth 1 inch 5 lines.

Obs. Although, in the partial tripartite division of the ventral valve, *W. Taylori* approaches *W. Garibaldiana*, it may be at once distinguished, irrespective of size, by the total absence of all ribbing of the valves, and by the gently convex outline of the dorsal valve, as compared with the tripartitely divided similar valve of *W. Garibaldiana*. *Terebratella compta*, G. B. Sowerby, is to be distinguished from the new species by the following external characters—its much smaller size, more triangular form of the dorsal valve, much larger deltidial area, and consequent separation of the foramen and umbo, more pointed outline of the front margin of the shell, more flattened outline of the dorsal valve, especially in the umbonal region, and a less incurved, but more obliquely truncated beak. Some forms of *Terebratula ovata*, Sowerby, from the Cretaceous series, are at first sight not unlike *W. Taylori*, but there is no trace of the longitudinal depression of the dorsal valve of that species or of the irregular surface-rugæ.

As we are at present unacquainted with the interior of this

shell beyond the impressed line on the surface of the dorsal valve representing the mesial septum, its exact generic affinity must remain an open question, although it is in all probability a *Waldheimia* or *Terebratella*. The specimen was forwarded to Mr. Davidson, who was kind enough to suggest its reference to the former subgenus. I name the species after my friend and former colleague Mr. Norman Taylor, of the Victorian Geological Survey and Mining Department.

Loc. and Horizon. Coralline Limestone of the Murray-River Cliffs, near the Great Bend, S. A. Blanford Collection, *Mus. Pract. Geology*, London.

Waldheimia gambierensis, sp. nov. (Pl. II. figs. 4 a-d.)

Sp. char. Shell elongate, much longer than wide, somewhat fig-shaped, notched in front, valves convex. Ventral valve the larger and more convex of the two, obtusely bicipitated towards the front, with a short shallow sulcus between the plaits, and two similar lateral ones corresponding to two ill-defined lobes in the dorsal valve; beak moderately produced, truncated by an oblique large circular foramen, encircled by the apex of the beak and the delitidium. Dorsal valve convex in the median and umbonal regions, produced more or less towards the front, with a broad median longitudinal plait, only apparent near the front margin, bounded by two short lateral sulci, corresponding to the two previously mentioned plaits of the ventral valve. Lateral margins curved; front margin sinuated. Surface of the shell marked with concentric lines of growth. An impressed line, showing the position of the mesial septum, extends for six lines along the surface of the dorsal valve from the umbo, and can be traced still further as a dark line under the shell. Length 2 inches, width 1 inch $3\frac{3}{4}$ lines, depth 1 inch 1 line.

Obs. With the exception of the median septum, as previously indicated, we are not acquainted with the internal characters of this species; the position of the mesial septum is shown, as in *W. Taylora*, by an impressed line on the dorsal valve from the umbo forwards.

Loc. and Horizon. Coralline Limestone of Mount Gambier. Cabinet of Mr. T. Davidson, F.R.S.

Genus TEREBRATELLA, D'Orbigny.

Terebratella compta, G. B. Sowerby. (Pl. II. figs. 5 a-d.)

Terebratula, sp., Sturt, Two Expds. Int. S. Austr. 1832, ii. t. 3. f. 15.

Terebratula compta, G. B. Sow. Strzelecki's Phys. Deser. N. S. Wales and V. D. Land, 1845, p. 297, t. 19. f. 4; Woods, Geol. Obs. S. Austr. 1862, p. 74, woodcut.

Sp. char. Shell trapeziform, slightly longer than wide;

valves unequally convex. Ventral valve longitudinally and obtusely carinate, convex, and tapering towards the beak, which is a little incurved, truncated by a slightly oblique circular foramen; beak-ridges sharply defined, enclosing between them and the hinge-margin a wide triangular area, flat or a little concave. Dorsal valve depressed, with a gentle curve from the umbo to the front; but in some specimens a slight longitudinal depression or sulcus exists towards the centre of the valve, extending to the front; hinge-line in some individuals a little curved, in others almost straight, giving to the valve a somewhat triangular form. Surface with a few concentric lines of growth. Shell-substance thin, punctate. Length 8 lines, width $6\frac{1}{2}$ lines, depth 4 lines.

Obs. Fig 5, *d*, representing the interior of the dorsal valve, exhibits some of the characters on which the reference of this species to the genus *Terebratella* is based. At the end of the median septum may be seen the broken horizontal process to which the loop would be attached in the perfect specimen. The oral processes, instead of being directed inwards towards the septum, are pointing forwards directly parallel to it. The above are the measurements of the largest specimen I have seen.

Loc. and Horizon. Coralline Limestone of Mount Gambier, S. A. *Coll. Geol. Soc. London.*

T. compta was originally figured by Capt. Sturt from a specimen obtained from the Coralline Limestone of the Murray-River Cliffs, near the Great Bend, S. A. Count Strzelecki's example, upon which Mr. G. B. Sowerby's description is founded, was obtained from a raised beach at Port Fairy. The Rev. Mr. Woods has recorded it from Mount Gambier*, S. A.; whilst Mr. C. S. Wilkinson has obtained it in considerable numbers from the Spring-Creek † section near Geelong, Victoria.

The following brief description of the appearance and extent of the Mount-Gambier Coralline Limestone is abstracted from the Rev. J. E. Woods's excellent work, 'Geological Observations in South Australia' ‡ :—

Immediately under the surface of the country in the Mount-Gambier district is usually found a brittle white limestone, much decomposed and without fossils, which gradually passes downwards into a hard and close perfectly white rock, horizontal, and distinctly stratified in layers or beds about

* Quart. Journ. Geol. Soc. 1860, xvi. p. 255 &c.

† Cape-Otway Report, 1865, p. 23.

‡ Pp. 58-125.

fourteen feet in thickness, with great regularity. The whole formation has much the appearance of chalk, containing both "sand-pipes" and layers of black and white flints, and in places is literally crammed with organic remains (Foraminifera, Entomostraca, Polyzoa, Echinoderms, and Mollusca), some of the species of which are identical with existing forms, whilst the whole bears a general resemblance to the fauna at present living on the neighbouring coast. The Foraminifera have been examined by Prof. T. Rupert Jones, F.R.S., and Mr. W. K. Parker, F.R.S., who consider them to be probably of Pliocene age and indicative of deep water*. The Polyzoa have also received attention at the hands of Prof. G. Busk, F.R.S. †, who considers it "probable that the formation in which they are found corresponds in point of relation to the existing state of things with the Lower Crag of England." The general appearance of the strata indicates that the particles of which they are formed were deposited in a tranquil sea, and derived from the destruction of coral reefs. This coralline limestone, or, as it is termed by Mr. Woods, the "Crag," is estimated by the latter to occupy probably at least one sixth of the whole of Australia, but to attain its chief development in that part of South Australia which extends from the coast on the south northwards to the Murray River, westward to the base of the Cape-Jervis range, whilst on the east a ridge of trap-rocks, corresponding to the 141st meridian of east longitude, along the limit of the colonies of Victoria and South Australia, serves as a boundary in that direction. This district, wholly occupied, with one or two trifling exceptions, by the coralline limestone or "Crag," contains an area of 22,000 square miles. Near the Great Bend of the Murray River the latter has cut its course through this formation, forming cliffs 150 feet high, from which Capt. Sturt, the great explorer, collected fossils in about 140° E. longitude, the majority of which are specifically identical, according to Mr. Woods, with the Mount-Gambier fauna, whilst the remainder are not found at the latter locality. Capt. Sturt states that in 1845 he found similar fossils in a limestone cropping out on both sides of Lake Torrens, whilst Mr. Woods believes that the greater portion of Central Australia is occupied by this deposit. In Victoria it is found still further eastward at Portland, underlying volcanic rocks, and extends along the coast to between Port Fairy and Cape Otway. Finally, in Tasmania beds have been described bearing a strong resemblance to the Mount-Gambier Coralline Limestone.

* Quart. Journ. Geol. Soc. 1860, xvi. p. 261.

† Ibid. p. 260.

EXPLANATION OF PLATES I. & II.

- Fig. 1.* *Terebratulina? Davidsoni*, R. Etheridge, jun., natural size. Tertiary Coralline Limestone, Mount Gambier, S. Australia. *a*, view of ventral valve; *b*, view of dorsal valve and foramen of ventral valve; *c*, interior of dorsal valve.
- Fig. 2.* *Waldheimia Garibaldiana*, Davidson, natural size. Tertiary Coralline Limestone, Mount Gambier, S. A. *a*, ventral valve; *b*, dorsal valve and foramen of ventral valve.
- Fig. 3.* *W. Taylori*, R. Etheridge, jun., natural size. Tertiary Coralline Limestone of the Murray-River Cliffs, S. A. *a*, ventral valve; *b*, dorsal valve, with the groove indicating the position of the septum, and the foramen of the ventral valve; *c*, lateral view of both valves.
- Fig. 4.* *W. gambierensis*, R. Etheridge, jun., natural size. Tertiary Coralline Limestone of Mount Gambier, S. A. *a*, view of ventral valve; *b*, dorsal valve and foramen of ventral valve; *c*, lateral view of both valves; *d*, view of sinuate front margin. (The figure 4 *a* is partially restored on the left-hand side, the shelly matter being there broken away.)
- Fig. 5.* *Terebratella compta*, G. B. Sowerby. Tertiary Coralline Limestone of Mount Gambier, S. A. *a*, view of ventral valve; *b*, view of dorsal valve and foramen of ventral valve, both enlarged one and a half times; *c*, interior of ventral valve; *d*, interior of dorsal valve, showing the dilated portion of the mesial septum: the two latter figures are of the natural size.

Figs. 3 *a, b, c* are from drawings kindly made for me by the late Mr. C. R. Bone, of the Museum of Practical Geology, shortly before his death; for the remainder I am indebted to the artistic skill of my friend Mr. B. N. Peach (of the Geological Survey of Scotland).

III.—*Critical Notes on the New-Zealand Hydroida, Suborder Thecaphora.* By MILLEN COUGHTREY, M.B., C.M. Edinb. Univ., Hon. Fellow Historic Soc. Lanc. & Ches., President of the Dunedin Naturalists Field-Club, N.Z., &c. &c.

[Plate III.]

To the last volume (no. vii.) of the 'Transactions of the New-Zealand Institute I contributed a paper on the New-Zealand Hydroida*, in which I gave the results of an examination of the type specimens of Capt. F. W. Hutton's paper on the New-Zealand Sertularians†, and of several new specimens I obtained on the New-Zealand coasts. Contrary to my usual practice, and with many misgivings on my part, these notes were rather prematurely published; and I regret now that I did not hold them back until I had more works of

* Vol. vii. pp. 281-293, plate xx.

† Trans. N.Z. Inst. vol. v. 1872.

reference at my command, and a greater supply of specimens from other parts of the world with which to compare the New-Zealand ones.

Workers residing in "an out-of-the-way" part of the earth labour under many disadvantages when contrasted with the facilities afforded to home students. It is true they have got almost a virgin soil; but unless they are to become mere collectors for home cabinet students, they require for almost every branch of science a very great profusion of works of reference. Many of the drawbacks they at present suffer from are probably capable of removal by the aid of patience and an improved intercommunication with the parent country; but other difficulties would lessen were the societies at home unanimously to agree to centralize their publications, remitting zoological papers to purely zoological societies, and botanical to purely botanical. At the present time we find in the department of Hydrozoa, *e. g.*, one paper among the proceedings of a botanical society, another within the covers of a medical review, a third in one of the microscopical journals, others in the various transactions of local societies, and, lastly, as custom has long established, in the present Journal. This decentralization not only proves very expensive to the student, but often involves a large amount of unnecessary labour, though the latter has certainly been much lightened by that inestimable boon, 'The Record of Zoological Literature.' Still a difficulty remains; and that difficulty may be best expressed by an example: take that valuable publication, the 'Transactions of the Royal Society of Edinburgh;' let persons search through the chief provincial towns of Great Britain, and see in how very few the above publication may be found, and they will then understand the scarcity that may exist in a place like New Zealand. On account of the limited means at my disposal, I therefore desire that these remarks may be considered as purely provisional, since I do not possess by me all the works I desire to make them complete.

The classification I have adopted is that used by Mr. Hincks in his 'British Hydroid Zoophytes;' and the order will therefore be found different from that adopted in my previous paper to the New-Zealand Institute. Since those notes were written, I have been able in some cases to verify, in others to correct my former observations, and I have had the means of comparing the New-Zealand specimens with the British species*.

Regarding the Athecate Hydroids and the general history and reproduction of Hydroida here, I prefer to hold back my

* I have to thank my friend Mr. T. J. Moore, of the Free Public Museum, Liverpool, for a packet of these.

notes for further observations, though the New-Zealand fauna presents many peculiarities in this respect. Indeed to-day (September 24, 1875) I discovered a pretty freshwater *Hydra*, in some pond-water, attached to one of the leaves of the plant *Natella ucra*. This *Hydra* in general form is like *H. viridis*, Linn., in colour pale brown, and has seven tentacula, which are peculiar in this respect, that they are distinctly annulated and each ring is fringed.

Suborder THECAPHORA, Hincks.

Family Campanulariidae.

Genus OBELIA:

Obelia geniculata, Linnæus ; Hincks, *loc. cit.* p. 149. (*Vide* Coughtrey, *Trans. N.Z. Inst.* vol. vii. p. 290, pl. xx. fig. 42.)

This widely distributed species is present in New Zealand. It differs from the British specimens in the following particulars: it is more robust in habit, its hydrothecæ are larger, and its gonothecæ present some peculiarities. In many specimens these are decidedly urceolate, as figured by me; but occasionally on the same colony there may be observed one or two reproductive capsules that have a similar form to the nutritive calyces, only that they are quite as large as the other gonothecæ.

The habitat of this species will enable me to present one or two points of interest in connexion with those masses of floating seaweed in which Prof. Agardh, of Lund, has exhibited an interest. There grows most luxuriantly in the southern harbours of the New-Zealand and Australian coasts, within and a little below ordinary tidal limits, a fucus which seems to me to be "*Macrocystis pyrifera*" of Decaisne. Wherever I have found fronds of this seaweed in the neighbourhood of land, I have got *O. geniculata* upon it. And I have found it in the following localities:—east and south coasts of Middle Island, New Zealand; King George's Sound and Glenelg, Australia; also in Port-Philip Harbour and Bass Strait (loose and floating).

When *O. geniculata* attaches itself to a virgin frond, it spreads in a peculiar manner: there is one parent or primary shoot, which runs generally obliquely across the frond; and this gives off from one side several shoots, which run in the long direction of the frond quite parallel to one another, and but rarely communicating with one another by lateral shoots. From the longitudinal stoloniferous shoots there are sent up at regular

intervals the stems of each subcolony ; but those nearest the parent stolon are most abundant in calyces.

The same fucus (*M. pyrifera*) on which *O. geniculata* is so frequently found forms the chief part of those islands of seaweed so abundant in the Southern Ocean between latitudes 45° and 50°, especially in the vicinity of the Crozet Isles and of Kerguelen's Land ; and it has been my good fortune during two separate voyages to secure by appropriate tackle detached masses of this seaweed. I have examined them on all occasions with great care, and have been surprised to find a total absence of animal life ; while other specimens of this seaweed, bearing every appearance of having been floating on the surface for days, and that had been washed ashore, had numerous clusters of Hydroida, Polyzoans, and Cirripeds in great profusion.

Obelia pygmæa (?), sp. nov. provisionally referred to this genus.
Pl. III. fig. 3.

Shoots very profuse where the sponge-patches are on stems of *Boltenia pedunculata*, Milne-Edwards. It arises from a creeping filamentous hydrorhiza, grows to the height of $\frac{3}{4}$ of an inch, extremely delicate and transparent. Hydrocaulus branched ; branches ringed just above their origin ; hydrocaulus strongly ringed beyond where branches arise. Internodes between pedicels of hydrothecæ irregularly ringed (from six to twenty rings). Hydrothecæ broadly campanulate, rim entire, alternate ; extremity of each branchlet divided into two hydrothecæ ; pedicels annulated (ten to fifteen rings).

Gonothecæ — ?

Genus CAMPANULARIA.

Campanularia bilabiata, mihi, *loc. cit.* p. 291, pl. xx.
figs. 46 & 49.

I have nothing fresh to add to my previous description of this species.

Campanularia integra (?), Hutton, fig. 45 (my paper).

In describing this species, which I figured, I mentioned that it did not agree with *C. integra* of Johnston. Further observation has confirmed this opinion, and I now believe it to be *C. caliculata*, Hincks, and to agree specially with the variety, fig. 2*b* of plate xxxi. 'British Hydroid Zoophytes.' The annulation of the pedicel is a little too strongly marked in my figure*.

* On the smaller seaweeds just beneath low-water mark, Port Chalmers, I got a small species in general habit and size very like *C. caliculata*.

Family **Haleciidæ**.

Genus **HALECIUM**, Oken ; Hincks, Brit. Hydr. Zooph.

Halecium delicatulum, sp. nov. (Pl. III. figs. 4 & 5),

is the name I propose for a very delicate species of *Halecium*, whose general appearance resembles somewhat a minute specimen of *H. Beanii*.

Hydrophyton slender, 0·5–1·0 inch in height, pale and transparent.

Hydrocaulus pinnately branched, simple in character, slightly tumid where branches are given off. Internodes between the calicular pedicels jointed in lower half just above origin of pedicels ; joints from two to three rings. Hydrothecæ alternate, pedicellated ; lower ones oldest of three generations of polypites, upper ones sessile ; in the oldest, where the calicular tubes fit into one another, there is a small joint.

Gonothecæ —?

Hab. On sponges, deep water, Dunedin Upper Harbour.

Family **Sertulariidæ**.

Genus **SERTULARELLA**.

Sertularella Johnstonii, Gray, Dieff. N. Z. vol. ii. p. 294 ;
Hutton, *loc. cit.* ; Coughtrey, *loc. cit.*

Mr. Hincks remarks of this species that it makes a near approach to *S. tricuspidata*, British species. I have carefully compared it with the latter, and I agree with Mr. Hincks, its chief points of difference being that the mouths of the hydrothecæ are contracted, rendering the calyces subconical in form, as in *S. polyzonias*. Many of the gonothecæ are very like that figured at p. 240 of 'British Hydr. Zooph.' In habit it attains a greater height than *S. tricuspidata* ; and I have deposited a very handsome specimen of *S. Johnstonii*, which shows this, in the Liverpool Free Public Museum.

The hydrothecæ have the inverted hand-bell appearance, but are of the ovato-conic form, the chitine suddenly tapering off near the rim, which is deeply crenulated. The greater part of the pedicel is spiral ; but it is peculiarly jointed to the calyces. At base of calycle is a distinct ring of chitine ; there are two other rings, which are longer, the proximal one being at least twice the length of the intermediate one, and three times that of the most distal one. I am inclined to place them in the genus *Campanulina* (Van Beneden). *Vide* Pl. III. figs. 1 & 2.

Sertularella subpinnata and *Sertularella delicatula*, Hutton,
loc. cit.

I still believe these two species to be varieties of *S. Johnstonii*; and I have made fresh examinations of them.

Sertularella simplex, Hutton, *loc. cit.*; Coughtrey, *loc. cit.*
p. 283, pl. xx.

In my paper to the New-Zealand Institute I expressed an opinion that *S. simplex* of Hutton was the New-Zealand representative of *S. polyzonias* of Linnæus; and I grouped along with Hutton's species several pygmy varieties in which the hydrothecæ were transversely wrinkled. In this I was wrong; and I would now regard Capt. Hutton's species as a distinct one, approaching nearest to *Sertularella fusiformis* of Hincks; while the transversely wrinkled variety (pl. xx. fig. 9, *loc. cit.*) is an intermediate form between *S. rugosa* and *S. tenella*, British species, but approaching nearest to the latter; and the large one with the denticles (fig. 10, *loc. cit.*), together with the form figured in the present paper, I believe to present other and distinct characters to form a separate species, for which I would propose the name of *Sertularella robusta* (Pl. III. figs. 6 a, b, c).

In habit *S. robusta* resembles *S. geniculata*, Hincks (Ann. & Mag. Nat. Hist. ser. 4, vol. xiii. p. 152), or, again, the specimen of *S. polyzonias* obtained by Sars from the North Cape ('British Zoophytes'). The two most robust specimens I have gathered were both from the southern coasts,—one from the shell of *Imperator imperialis*, got in the Foreaux-Straits oyster-bank; the other from the rootlets of a large Laminarian that had been washed ashore on the Ocean Beach, Dunedin. I think it right to mention that of all the specimens I have gathered belonging to the *S. polyzonias* group, those from the east coast are considerably smaller than those got on the southern coast. This difference in size accords well with what is seen in the same type in the northern hemisphere.

Genus SERTULARIA, Linnæus (in part), Hincks, Brit. Hydr.
Zooph.

Sertularia bispinosa, Hutton, *loc. cit.*, and Coughtrey, *loc. cit.*
p. 284, pl. xx. fig. 17.

Dynamene bispinosa, Gray.

Mr. Busk, when reporting on the Sertularian Zoophytes

and Polyzoa from Natal, South Africa[‡], remarked the resemblance between this species and *S. operculata*, British. The likeness only holds good with one of the varieties of *S. bispinosa* of New Zealand; and that is the extremely delicate and slender variety. The other variety is so very much more robust and coarse than the British specimen, that, independently of the peculiar differences in the form of the gonothecæ, a difference must be said to exist.

Sertularia ramulosa, mihi.

I have lately met with delicate and coarse varieties of this species, and have observed in some specimens that the hydrothecæ are directed chiefly towards the outside of each little fascicle or branch, the gonosomic elements lying only on the inside. I have got this species at the Bluff.

Sertularia trispinosa, mihi, *loc. cit.*

The relation this species bears in habitat and minute characters to the above two species has been preserved in all specimens I have recently gathered.

Sertularia abietinoides, Hutton, *loc. cit.*; Coughtrey, *loc. cit.*
p. 285.

Dynamene abietinoides, Gray, Dieffenbach's N. Z. vol. ii.

In general habit the chief variety of this species bears a close resemblance to *S. filicula* (British species); while the characters of the hydrothecæ and of the gonothecæ at once proclaim a vast difference not only from the above species, but also from the more robust British ally *S. abietina*.

Sertularia fusiformis, Hutton, *loc. cit.*; Coughtrey, *loc. cit.*
p. 285.

In consequence of there being a likelihood of this species being confused with *Sertularella fusiformis*, Hincks, I would suggest for it the name of *Sertularia longicosta* (from the crest along one side of the gonotheca). Its ovarian capsules approach somewhat the form of those described by Mr. Busk on the South-African variety of *Plumularia cristata* (Brit. Assoc. Report, 1850, p. 120); again, the apex of the capsule

* Brit. Assoc. Report, 1850, p. 118.

has an appearance not unlike the crest of *Camp. calceolifera*, Hincks (Ann. & Mag. Nat. Hist. ser. 4, vol. viii. p. 78). It never attains a greater height than 2 inches.

Sertularia pumila (sp. nov. to N. Z.) = *Syntheceium gracilis*, mihi, *loc. cit.* p. 286, pl. xx. figs. 26-31.

I am now perfectly satisfied that I was in error when I placed this species under Allman's genus *Syntheceium*. I have carefully compared it with varieties of *S. pumila* from the Mersey (Britain) and elsewhere, and cannot detect sufficient specific characters for a new species.

The differences I observed in the New-Zealand specimens (as shown in *loc. cit.* pl. xx. figs. 26 & 27, both magnified to same extent) are present in British specimens; and one character has been observed by Dr. M'Intosh in St.-Andrews specimens, namely presence or absence of joint in the stem (Ann. & Mag. Nat. Hist. ser. 4, vol. xiii. p. 212).

Sertularia elegans.

Syntheceium elegans, Allman (Gymnoblastic Hydroids).

Another small specimen has enabled me to confirm my previous identification of this species. It is equally pygmy in size with my first one, and in one of the calyces has the lower three fourths of the peculiar ovarian capsule described by Prof. Allman. *Vide* Trans. N.Z. Inst. vol. vii. pl. xx. fig. 25*.

Genus HYDRALLMANIA.

Hydrallmania? bicalycula, sp. nov. Pl. III. figs. 8, 8', 8''', 9.

I place this specimen provisionally under the above genus; but the generic characters would have to be remodelled to admit it. I do not think it can be the *Sertularia unilateralis*

* *Sertularia* —? I lately obtained from the Bluff Harbour, just below low-water mark, a little specimen resembling in many points *S. pumila*, but which I am undecided where to place. The shoots spring from a filiform hydrorhiza. Stems straight, very much thicker than pinnæ; pinnately branched, pinnæ subopposite. Pinnæ arise by a peculiar joint from stem, like as in Pl. III. figs. 7, 7', 7'', & 7'''. Hydrothecæ opposite, crowded, ensheathing the axis, so that scarcely any interspace is observed between those on the pinnæ, while a large interspace is observable between those on the stems; hydrothecæ short and stout, toothed and operculated; a small joint between each pair of hydrothecæ. *Vide* Pl. III. fig. 7.

of Quoy and Gaimard; but I have forwarded by this mail a small specimen to my old teacher Prof. Allman, with the request that he would compare it with the above species.

The zoophyte is large and lax, of a dark brownish colour where it arises from the hydrorhiza, and very strong at that part, becoming lighter in its ultimate branches, so that its pinnæ are quite light and transparent. It attains a height of 12 inches. Stem arises from a filamentous hydrorhiza, is made up of several tubes twisted, all of them bearing calyces, and gives off close to its origin from eight to twenty branches, which bifurcate within an inch of their origin into long, loose, flexuous branchlets, some of these being nearly 7 inches in length. These branchlets are pinnate. Pinnæ arise from margins of one side of rachis (sometimes opposite, sometimes alternately) by a thin, narrow, twisted pedicle; length of pinnæ 0·1-0·5 of an inch, most commonly 0·25 of an inch.

Hydrothecæ on stem, branches, branchlets, and pinnæ, unilateral and opposite, in pairs, and springing from a thickened portion of rachis. Adjacent surfaces of the hydrothecæ of one pair are quite close to one another. Hydrothecæ most crowded on pinnæ, less so on branches, least so on parent stem, where they are distant, and the pairs are occasionally separated by an oblique irregular joint. Calyces large, distal end bent and free. Mouth rounded, lateral parts of lips sinuous.

Gonothecæ abundant on pinnæ, large, length 0·13 inch, width 0·08 inch; urceolate, with a small mouth, which is round, entire, and supported on a short simple neck. At the widest part of the capsule, at a distance of one fourth of its (capsule's) entire length from the mouth, there is a faint rim. Capsule subpedicellated.

Hab. On shells and stones, 1 to 2 fathoms, Bluff Harbour; also Wickliff Bay, Otago peninsula.

Sertularia monilifera, Hutton; Coughtrey, *loc. cit.* p. 282.

I am very doubtful of the generic relations of this species; and I am now inclined to regard it as allied to the genus *Diphasia*.

Genus THUIARIA.

Thuiaria subarticulata, mihi, *loc. cit.* p. 287, pl. xx.
figs. 32 & 33.

I have lately had several opportunities of examining this species, and of comparing it with many specimens of the British species *T. articulata*; and I am satisfied the two are distinct.

The British species is much the finer and slenderer of the two; the pinnæ are longer, the hydrothecæ more evenly tubular and free from dentations, while the absence of transverse wrinkles over the whole of the ovarian capsules is marked, though I have gathered British specimens in which the proximal three fourths of these capsules was strongly and deeply wrinkled.

I notice that the southern specimens bear the same relation to the east-coast ones as Mr. Norman's Shetland variety does to the ordinary British species.

Family Plumulariida, Hincks, Brit. Hydr. Zooph.

I intend to be very brief regarding the specimens under this head at present, and only to give workers a few items of importance about them, until I have the opportunity of making more observations.

Genus ANTENNULARIA.

Antennularia antennina of New Zealand is identical with the British species.

Genus AGLAOPHENIA.

Aglaophenia pennatula.

I have recently got several fresh specimens of this, and I am satisfied it is different from *A. pennatula* (Hincks). In my sketch fig. 37, pl. xx. *loc. cit.*, the calyces are not as tubular as in nature.

Aglaophenia Huttoni and *A. incisa*, mihi, *loc. cit.* pp. 289, 290.

I have not yet obtained fresh specimens of these.

Plumularia simplex, mihi, ought to be discarded and placed among the Sertulariida. I was misled in my first specimen by distorted appearances; but fresh specimens proved to me that I had been wrong. I think it fair to acknowledge mistakes as freely and as early as possible. I will place this species in its proper position in a future paper.

In conclusion, allow me to state that I should be obliged if authors in this department would exchange with me their papers for specimens.

EXPLANATION OF PLATE III.

[All objects that are magnified are to 80 diameters.]

- Fig. 1.* Distal half of pedicel and a calycle of a Campanularian allied to *C. caliculata* (Hincks).
- Fig. 2.* The same (to show natural size and habit), growing from part of the stem of a *Boltenia* (p. 25, note).
- Fig. 3.* *Obelia pygmaea*?, portion of stem and one branch (p. 25).
- Fig. 4.* *Halecium delicatulum*, older part of hydrophyton.
- Fig. 5.* The same, to show younger part of hydrophyton.
- Fig. 6 a.* *Sertularella robusta*, southern species, $\times 80$ diam. *b.* A specimen from east coast, to show difference in size of calyces, $\times 80$ diam. *c.* *S. simplex*, intermediate between *S. rugosa* and *S. tenella* (vide p. 27), $\times 80$ diam.
- Fig. 7.* *Sertularia* — — —?, from the Bluff, New Zealand. 7'. Portion of pinnæ, magnified. 7". Part of stem, magnified.
- Fig. 8.* *Hydrallmania* (?) *bicalycula*, from the Bluff, New Zealand. 8'. Shows a branchlet, mode of origin of pinnæ, the relative distance of the calicular pairs on pinnæ and stem respectively, also the attachment of gonothecal pedicel. 8". A gonothecal capsule.
- Fig. 9.* Exhibits a profile view of a branchlet of *H. bicalycula*, showing the unilateral position of the hydrothecæ.

IV.—*Description of a supposed new Suthora from the Daffa Hills, and a Minla from the Nágá Hills, with Remarks on Pictorhis (Chrysomma) altirostre, Jerdon.* By Major H. H. GODWIN-AUSTEN, F.R.G.S., F.Z.S., &c., Deputy Superintendent, Topographical Survey of India.

I HAVE to publish another interesting bird from the Daffa hills, Assam, of the genus *Suthora*, closely allied to *S. muni-purensis*, Wald. & G.-Aust., described in the 'Ibis' for 1875, p. 250. The difference between them is most marked on the underside, the chin being grey in the Daffa bird, paling on the upper breast and belly to dull yellowish white; while in the Muni-púr and Nágá species the chin and throat are deep black, fading to grey on the breast, into the white of the lower tail-coverts. There is also a marked difference in size, this new form being the smallest of the genus now known.

Suthora daflaensis, n. sp.

Above—crown of head chrome-brown, back and rump rusty olivaceous brown; tail very rich rusty brown, particularly near the base; frontal band, passing over the eye to the nape, black; a white circle round eye, with a moustachial streak passing

down the side of the neck of the same colour; ear-coverts grey, surmounted by a small streak of golden yellow. Chin grey; breast and belly dull sordid white; under tail-coverts white; flanks grey. Shoulder of wing olivaceous; primaries black, rufous at the base, forming a band, the outermost edged white; their coverts black: secondaries grey, edged rich rufous on the outer web, with a narrow white edging to the inner. Irides dark brown; legs and feet pale grey; bill neutral grey.

Length 3·25 inches, wing 1·75, tail 2·10, tarsus 0·62, bill at front 0·25.

Hab. The bamboo underwood of the forests at 5000–7000 feet, Daffa hills, and first obtained on the slopes of Torúpútú Peak in January.

These curious little birds associate together in large flocks, making an incessant sharp twitter. They are most active, flitting rapidly about the foliage of the bamboos, of which the underwood is principally composed. They were the most fearless birds I ever met with, perching on twigs within a couple of yards of one's head, so close that it was some time before I could fire at one without the certainty of blowing it all to pieces, and two specimens obtained I had to throw away. The bright-coloured top of the head, set off with its black coronal edging, is conspicuous as they fly and hop about the branches.

Minla Mandellii, n. sp.

Above dark olivaceous, tail brown; forehead rufous, merging into the olivaceous brown of the top of the head; a white supercilium commences from above the eye, and extends to the neck, merging into some streaky buff and black feathers behind the ear-coverts; a black band surmounts the white one, but does not meet the black lores; ear-coverts sooty. Chin, throat, and upper breast buffy white; sullied white on abdomen; flanks olivaceous. Irides dark red-brown; legs and feet pale fleshy; bill grey-brown. Feathers of the head scaly.

Length 5·55 inches, wing 2·2, tail 2·5, tarsus 0·95, bill at front 0·45 (measured in the flesh).

Hab. Nágá hills, in forest, at about 6000 feet.

I have named this bird after Mr. L. Mandelli, who has so successfully worked the ornithology of the Sikkim hills, and who described in 'Stray Feathers,' July 1873, a very near ally of this species, viz. *Minla rufogularis* (= *collaris*, Walden), of which I obtained several specimens in the Daffa hills last winter.

Dr. Jerdon, in a paper on some birds from Upper Burmah, in the 'Ibis' for 1862, p. 19, describes, under the title *Chryssomma*, a bird he obtained at Thyatmyo, which I do not think has since been got there. Among the collection from the Daffa hills there are several skins of what can be no other than this species. Dr. Jerdon's description and the size agree very well. To Lord Walden is due the credit of identification. It is curious to say, Dr. Jerdon in the above paper twice (probably writing fast, and using the term "chur") writes "Bar-rampootra" instead of Irrawaddy, the above word being applied to the sandy islands of the former river; but there is just this possibility, that the specimen really came from Assam, where I found it quite common in the grassy country of the Bishnath plain up to the base of the Daffa hills. It is very close to *Pictorhis sinensis*, Gmelin, as mentioned by Dr. Jerdon in the 'Birds of India,' vol. ii. p. 16, and approximates in its higher and shorter bill to the *Paradoxornis* group. It is, however, not so gregarious, being only found two or three together. I found it a very hard bird to shoot, from its rapid dodgy flight in the grass, and the quick way in which it would hide at once; this is probably the cause of its not having been oftener noticed and collected. I have failed to discover where Dr. Jerdon's original type of this interesting bird can now be.

I take the earliest opportunity in this paper to suppress the species (*Garrulax albosuperciliaris*) figured in the 'Journ. Asiat. Soc. Bengal,' 1874, and described by me in the 'Proc. Zool. Soc.' for 1874. It is, I find, the same as *G. sannio*, Swinhoe. The only variation I noticed in the single specimen with which I have compared it was a slight difference in the shade of coloration of the upper surface; this is one often seen in birds taken on the extreme limits of their range.

V.—*Diagnoses of new Species of Asteriidae and Linkiidae in the British Museum.* By M. EDMOND PERRIER*.

Asterias Rodolphi.

Very like *A. glacialis*, L., from which it differs chiefly in the number of rays, which is seven, and the position of the ventral spines near the ambulacral spines, which form a triple and not a double series as in the European species.

Hab. Raoul Island, Kermadec Islands. Presented by the Lords of the Admiralty, and collected by J. Macgillivray during the voyage of H.M.S. 'Herald.'

* Translated by Mr. Edgar A. Smith, Zoological Department.

Asterias rarispina.

It differs from *A. africana*, M. & T., by the total absence of spines between the median line of the rays and the lateral spines.

Hab. Cape of Good Hope (*J. MacGillivray, voyage of H.M.S. 'Herald'*).

Asterias Vancouveri.

A species with six or seven rays, the ambulacral spines forming two rows, after which come, first, a double row of ventral spines, then seven rows of groups of dorsal spines, each group consisting of three or four spines. A single madreporic plate.

Hab. Esquimalt Harbour, Vancouver Island. Collected and presented to the British Museum by J. K. Lord, Esq.

Asterias nuda.

A species with five short rays, with the ossicles of the skeleton robust, forming an irregular network covered by a thick naked skin. Ambulacral spines in two regular series; three incomplete rows of ventral spines—a median row on the back of each ray, two lateral rows, one on each side; some scattered spines on the middle region of the rays; all the spines are short, obtuse, and few in number.

Hab. Torres Straits, Port Lincoln.

There are two specimens of this species, presented by J. B. Harvey, Esq.

Asterias capensis.

A small species, with five or six rays; ambulacral spines in two series; a band of ventral spines placed in a double or triple row, then follow seven rows of groups of two or three short and blunt spines; madreporic plates three.

Hab. South Africa. Presented by Dr. Andrew Smith.

Asterias sinusoida.

Rays five. Ambulacral spines in two rows; three simple series of blunt ventral spines; rows of lateral spines, two or three spines on each plate; a central row of spines on the rays, of which the other spines form an irregularly sinuous line alternately touching the median and lateral lines of spines; all the spines are blunt, almost truncate.

Hab. Van Diemen's Land, Sandy Bay, Hobart Town. Presented by Dr. Sinclair, R.N.

Asterias Cunninghamsi.

Five convex rays, thick at the base; ambulacral spines in a single row; a double or triple series of ventral spines; the marginal dorsal rows of spines simple, the dorsal ones irregularly distributed.

Hab. Straits of Magellan, Sandy Point. Collected by Dr. R. O. Cunningham, and presented by the Lords of the Admiralty.

Asterias meridionalis.

Very like the preceding (*A. Cunninghamsi*), but with six rays and the ambulacral spines disposed in two series.

Hab. —? (*Antarctic Expedition*). Presented by the Lords of the Admiralty, and collected during the voyage of the 'Erebus' and 'Terror.'

Scytaster gomophia.

Much resembling *Gomophia ægyptiaca*, Gray, but with the rays a little shorter, and with the dorsal tubercles entirely granulous.

Hab. New Caledonia.

Scytaster obtusus.

A species near to *S. variolatus*, but distinguished from it by the obtuse form of the rays, the less elevation of the dorsal ossicles, and the less depth of the poriferous areas.

Hab. Philippine Islands.

OBSERVATIONS.

Asterias Douglasi.

I have designated with this name a species which, in the British Museum, bears the name of *A. Katherinæ*, in the handwriting of Dr. Gray, but which is quite distinct from the veritable types of the latter species. *A. Douglasi* exists also in the Jardin des Plantes; but among a certain number of examples of *A. polaris* which Dr. Lütken sent to me, I found a specimen scarcely distinguishable from the species in question. I am therefore inclined to consider that *A. Douglasi* really is only a form (with more numerous spines, truncated and crowded in groups one against another) of *A. polaris* from Greenland—which must be a very polymorphous species if a specimen must also be assigned to it which was sent under this name by the Museum of Comparative Zoology of Cambridge, Massachusetts, and which I shall describe in a subsequent work under the name of *A. borealis*.

VI.—On the Foraminifera of the River Dee.

By J. D. SIDDALL.

THE Microzoa inhabiting brackish water have formed the subject of much careful study—the Ostracoda especially at the hands of Mr. G. S. Brady and Mr. Robertson, the Foraminifera at those of Mr. H. B. Brady and the latter gentleman. The interest which attaches to an intermediate fauna depends very greatly on the completeness of its ascertained facts even to minute particulars; and it is with this view that the following paper is offered as a contribution to the general store of knowledge. As the observations of which it is the record refer entirely to the Foraminifera, it may be well at the outset to note what has already been done in connexion with the subject.

In his Catalogue of the Foraminifera of the north-eastern portion of the English coast*, Mr. H. B. Brady draws attention to the Rhizopoda inhabiting the brackish pools of one or two river-estuaries, commenting on the apparent alteration in the material of the test in some well-known species as dependent on their altered external conditions of life.

The subject was resumed and entered upon at much greater length by the same author in a paper which appeared in the 'Annals' for October 1870†. This memoir is founded on the examination of material collected from upwards of thirty localities, principally river-estuaries, round Great Britain. In the preliminary observations the question of the chemical and physical characters of the test is further dwelt upon, and the general conclusion drawn that in proportion to the decreased salinity of the water the investment of the testaceous Rhizopoda becomes less and less calcareous, till at last in certain species, which tolerate this process of dilution better than others, the test ceases to be calcareous at all, and consists only of a thin, brown, chitinous membrane, which is not dissolved by either acids or alkalies. The species in which these phenomena were especially noticed were *Trochammina macrescens* and *Quinqueloculina fusca*, the origin of both of which could be traced to well-known marine forms. The sarcode, in like manner, was shown often to acquire a green colour in brackish specimens, apparently from the formation of chlorophyl.

* "Catalogue of the Recent Foraminifera of Northumberland and Durham," Nat.-Hist. Trans. North. & Durham (1866), vol. i. p. 86.

† "The Ostracoda and Foraminifera of Tidal Rivers," by Geo. S. Brady, C.M.Z.S., and David Robertson, F.G.S.; with an Analysis and Descriptions of the Foraminifera by Henry B. Brady, F.L.S. (Part II.) Ann. & Mag. Nat. Hist. ser. 4, vol. vi. pp. 273-306, pls. xi. & xii.

Out of the forty-four genera constituting the British marine fauna, representatives of thirty-two were observed and recorded from these gatherings: some types were conspicuous by their absence, whilst others, especially the *Milioline* genera, with *Truncatulina*, *Rotalia*, *Polystomella*, and *Nonionina*, appeared to adapt themselves to brackish water perfectly. After tracing the relation of the existing brackish-water Foraminiferous fauna of the "Fen area" with that of the Post-tertiary Fen-clays, Mr. Brady proceeds to give a geographical account of the stations from which the material had been collected, and also of the various species found, concluding a valuable and comprehensive paper with a table showing the genera and species found in each locality.

More recently* Mr. David Robertson, F.G.S., of Glasgow, has worked out, with great care and patience, the Foraminifera of the Firth of Clyde; and his results yield a list of eighty-five species in all. His gatherings were made at no less than forty stations, and embrace depths of all degrees from four to thirty fathoms. Between these extremes there must be a wide range of variation in the conditions of life, depending on the depth and on the relative volume of fresh and salt water; and fuller particulars on such points would have conferred additional interest upon Mr. Robertson's valuable paper.

The results proposed to be offered in the following pages have been attained from the examination of the Microzoa of the estuary of the Dee, the observations having extended over a period of about three years—great assistance having been given in this by my kind friend Mrs. Shone, who has worked most indefatigably, and discovered several species of great interest. The list is even a longer one than Mr. Robertson's, comprising no less than one hundred species and varieties, an increase of fifteen per cent. in number. Of the thirty-two genera included in Mr. Brady's list, three have not yet been observed in the Dee, viz. *Glandulina*, *Vaginulina*, and *Gaudryina*; but three others have taken their place, and so made the number equal, viz. *Bigenerina*, *Spirillina*, and *Cassidulina*; but the specimens of each are very small and of rare occurrence.

The estuary of the Dee from Chester down to Burton Point, a distance of about 9 miles, has within the past two hundred years undergone very considerable changes in outline. Many thousands of acres of sand which the tide formerly flowed over have been reclaimed; and this work of reclamation is still

* "Notes on the Ostracoda and Foraminifera of the Firth of Clyde, with some Remarks on the Distribution of Mollusca," by David Robertson, F.G.S., Trans. Geol. Soc. Glasgow, 1874, vol. v. part 1, p. 112.

going on; and as the amount of tidal water which reaches Chester and Saltney must of necessity be very much lessened by reason of the narrowing of the channel through which it flows, the character of the fauna of this part of the river will doubtless be greatly altered. An opportunity of verifying this deduction, by comparing the Foraminifera which are very plentiful in the reclaimed sands with specimens collected fresh from the river, has been afforded by some excavations that have been going on during the past year; and these comparisons show that in the "sands" there is an almost total absence of the thin-shelled "chitinous" forms now so common in the river at the same distance from the sea. There can be no doubt that the degree of salinity of the water has a marked effect upon these lowly organisms; and it is to be regretted that a series of careful observations was not made to ascertain this at the different points from which collections of Foraminifera have been made. The importance of this was not then fully realized; but it is hoped that the omission will be rectified during the ensuing summer, when it is proposed that the Entomostraca shall be worked out.

The Dee, with its wide estuary, might reasonably be expected to be very rich in Rhizopoda; and such proves to be the case, the annexed List showing how very numerous its Foraminifera are. Living specimens have as yet been obtained only from the lower parts of the river, near to the sea; but the richest deposits of dead shells are found near to Chester and Saltney, about 18 miles from the sea, where they are brought and deposited by the tide. Material for examination has been collected from all parts of the river, but more particularly from the following:—

No. 1. Chester (18 miles from the sea; water not perceptibly saline, except at high water). A sand bank left bare at low water; sand collected at high- and low-water marks. During spring tides very rich.

No. 2. Saltney (16 miles from the sea; water as in last). A sand bank completely covered each tide; sand collected from between the ripple-marks at extreme low water. The richest collecting-ground yet found in the whole river. This and no. 1 seem to owe their peculiar richness to their position, being situated in each case at a bend in the river. Dredgings between these points yielded very little.

No. 3. Queen's Ferry (11 miles from the sea; water slightly brackish). Sand collected from sheltered spots at low-water mark; also dredged. Not very productive.

No. 4. Connah's Quay (9 miles from the sea; water decidedly brackish). Shore-sand from here not very rich, but

dredgings yield a considerable number of arenaceous specimens.

No. 5. Burton Marsh (8 miles from the sea ; estuary widening rapidly ; water rather salt). The material examined from here was scraped from the channels and pools left by the receding tide. It contained Foraminifera, but nothing requiring special comment.

No. 6. Parkgate (estuary 2 miles wide ; water salt). Sand scraped from low-water mark on the shore, also dredged. Not very good.

No. 7. Holywell (estuary 4 miles wide). Collections made by scraping and skimming the "grassy" pools on the muddy shore near high-water mark, and also the sandy mud at low-water mark. In a very rich gathering of Rhizopoda made here on the 19th of April, 1875, *Gromia oviformis* and *Diffugia pyriformis* and *aculeata* were very plentiful; and some very fine living specimens of *Polystomella striato-punctata* then obtained were afterwards kept under observation for several days. They were for a few days particularly active, and crawled about the cells in which they were placed for examination. After two or three days, however, the pseudopodia of some became finally retracted, and the sarcode showed a tendency to become granulated and condensed into an oval mass in the centre of each chamber of the shell; the following note, having reference to this aggregation of the sarcode, was made at the time:—" . . . Twelve chambers of shell visible externally. The granular oval contents of chambers nos. 2, 4, and 9 (from the aperture) were furnished with cilia, distinctly visible with a power of 400 diameters, and swam freely about in the chambers; on the contents of the other chambers no cilia were visible, and the form assumed by the contracted sarcode was not so definite. Colour of sarcode brownish yellow ; moving bodies rather more dense, and therefore very slightly darker in colour." The cilia were very plain ; and the writer was corroborated in his observation by the Rev. J. L. Bedford, F.L.S., who was present at the time.

No. 8. Hilbre Island (estuary 5 miles wide). The material collected here from among the rocks between the "Little Eye" and "Middle Island," at dead low water, and also that from no. 7, were very good gatherings, and especially rich in arenaceous forms. The difference in the appearance of the shells obtained from these "salt-water" localities and of those from nearer Chester, where the water is scarcely "brackish," was very marked—the specimens from the former having fine well-developed shells, while those from the latter sources are generally small and delicate, and often destitute of any calcareous matter

in the "test," especially in the representatives of the Milioline genera, its place being supplied by the "chitinous" or reddish-brown horny-looking substance which seems to form the base of the shell in all the *Miliolinæ*.

It is interesting to compare the Rhizopodal fauna of these two western estuaries, the Clyde and the Dee. Of the total number of forms met with, sixty-nine are common to both rivers; seventeen species are found in the Clyde which have not been found in the Dee, and, on the other hand, thirty-two have been found in the last-mentioned river which do not appear in Mr. Robertson's catalogue, as follows:—

Foraminifera found in the Firth of Clyde not occurring in the estuary of the Dee.

Cornuspira foliacea.
Triloculina Brongniartii.

Spiroloculina excavata.
Lituola nauiloidea.
Valvulina austriaca.
Lagena distoma.
— *lagenoides.*
— *hexagona.*
— *Jeffreysii.*
— *striato-punctata.*
Nodosaria pyrula.
Dentalina pauperata.
Vaginulina legumen.

Polymorphina tubulosa.

Bulimina aculeata.

Tinoporos lucidus.

Polystomella arctica.

Foraminifera found in the estuary of the Dee not occurring in the Firth of Clyde.

Cornuspira involvens.

Quinqueloculina Candaina.
— *pulchella.*

Lituola fusiformis.

Lagena striata, var. *gracilis.*
— *ornata.*
— *lucida.*
— *aspera.*

Nodosaria radícula.
Dentalina guttiferá.

Marginulina raphanus.
— *glabra.*
Polymorphina oblonga.
— *Thouini.*
— *fusiformis.*
— *concava.*
— *gibba*, var. *æqualis.*

Uvigerina angulosa.

— *pygmæa.*
Textularia pygmæa.
— *difformis.*
— *agglutinans.*

Verneuilina spinulosa.
Bulimina elegantissima.
Bigenerina digitata.
Spirillina margaritifera.
— *vivipara.*

Cassidulina lævigata.

Truncatulina refulgens.
Pulvinulina aurícula.
— *repanda.*

Nonionina umbilicatula.

Of the Foraminifera in the Dee catalogue, three forms are new to the British fauna, and deserve a moment's notice; and attention may just be called to the fact of the appearance of *Verneuilina spinulosa*, which is an interesting confirmation of its previous record by Mr. Brady.

Cornuspira involvens, Reuss.

Operculina involvens, Reuss, 1849, Denkschr. Akad. Wien, vol. i. p. 370, pl. xlv. fig. 20.

Cornuspira involvens, Jones, Parker, and Brady, 1865, Monog. Crag Forum. p. 3, pl. iii. figs. 52-54.

Messrs. Jones, Parker, and Brady (*loc. cit.*) admit Professor Reuss's name for the thicker *Cornuspira* with rounded tube, as distinct from the outspread flattened contour of *C. foliacea*. Probably the real zoological significance of the character is not great; but it seems quite worth recognizing.

Lagena aspera, Reuss.

Lagena aspera, Reuss, 1861, Sitzungsab. d. k. Akad. Wiss. Wien, vol. xl. p. 305, pl. i. fig. 5.

A rare species, with superficial rugosity caused by small, short, blunt spines. Well figured by Professor Reuss from fossil Tertiary specimens, but not figured in any English work.

Polymorphina Thouini, D'Orbigny.

Polymorphina Thouini, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 265. no. 8, Modèle no. 23; Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond. vol. xxvii. p. 232, pl. xl. fig. 17.

An interesting and exceedingly well-marked variety, of which one very beautiful specimen was obtained. It has an attenuated subcylindrical contour, with long, upright, compactly fitting segments.

Great interest was constantly manifested in the prosecution of these researches by the late Rev. Canon Kingsley, the founder and President of our Chester Society of Natural Science. Those whose privilege it was to know him will best appreciate the weight and value of his encouragement in such a work.

In conclusion, it remains only to state that all doubtful forms, and in fact the whole series of mountings, have with characteristic kindness been carefully examined by Mr. H. B. Brady, F.R.S., whose revision is an assurance of uniformity of nomenclature with previously published researches on the same subject, a matter of some importance in so variable a group of organisms.

FORAMINIFERA OF THE RIVER DEE.

Tabulated List, showing the Distribution and Relative Abundance of each Species between Chester and Hilbre Island.

Types.	Genera and Species.	Locality.	Remarks.
Suborder IMPERFORATA.			
Family MILIOLIDA.			
Cornuspira foliaceae, Phil.	Cornuspira, <i>Schultze</i> .		
	<i>involvens</i> , <i>Reuss</i>	Chester to Hilbre.	Rather rare.
	Biloculina, <i>D'Orb.</i>		
	<i>ringens</i> , <i>Lamk.</i>	Chester to Hilbre.	Very rare.
	<i>elongata</i> , <i>D'Orb.</i>	"	Frequent.
	<i>depressa</i> , <i>D'Orb.</i>	"	Common.
	Triloculina, <i>D'Orb.</i>		
	<i>oblonga</i> , <i>Montagu</i>	Chester to Hilbre.	Common.
	<i>tricarinata</i> , <i>D'Orb.</i>	Saltney.	A single specimen only.
	<i>trigonula</i> , <i>D'Orb.</i>	Chester to Hilbre.	Frequent.
	<i>Quinqueloculina</i> , <i>D'Orb.</i>		
	<i>agglutinans</i> , <i>D'Orb.</i>	Holywell and Hilbre.	Rare.
	<i>seminulum</i> , <i>Lin.</i>	Chester to Hilbre.	Rather rare.
Miliola seminulum, <i>Lin.</i>	<i>pulchella</i> , <i>D'Orb.</i>	Saltney.	A single specimen only.
	<i>bicornis</i> , <i>W. & J.</i>	Chester to Hilbre.	Frequent, especially young shells.
	<i>secans</i> , <i>D'Orb.</i>	"	Frequent.
	<i>subrotunda</i> , <i>Montagu</i>	"	Abundant. Shell sometimes merely <i>chitinous</i> .
	<i>Ferussacii</i> , <i>D'Orb.</i>	Saltney.	A single specimen only.
	<i>Candeina</i> , <i>D'Orb.</i>	"	A single specimen only.
	<i>fuscæ</i> , <i>Brady</i>	Holywell.	A single specimen only.
	<i>Spiroloculina</i> , <i>D'Orb.</i>		Rather rare.
	<i>planulata</i> , <i>Lamk.</i>	Chester to Hilbre.	Rather rare.
	<i>canaliculata</i> , <i>D'Orb.</i>	"	Very rare.
	<i>limbata</i> , <i>D'Orb.</i>	Hilbre.	A single specimen only.

Types.	Genera and Species.	Locality.	Remarks.
Family LITUOLIDA. Trochammina squamata, <i>P. & J.</i> Lituola nautiloidea, <i>Lamb.</i>	Trochammina, <i>P. & J.</i> <i>incerta, D'Orb.</i> <i>gordialis, P. & J.</i> <i>squamata, P. & J.</i> <i>macrescens, Brady</i> <i>inflata, Montagu</i> <i>Lituola, Lamb.</i> <i>canariensis, D'Orb.</i> <i>scorpiurus, Montf.</i> <i>fusiformis, Will.</i>	Hilbre. Holywell. " " Chester to Hilbre. Hilbre. Holywell and Hilbre.	Very rare. One good specimen only. Very rare. Rare. Not common. Common. Common. Very rare. Very rare.
Suborder PERFORATA. Family LAGENIDA. Lagena, <i>Walker.</i> <i>sulcata, W. & J.</i> <i>Lyelli, Seguenza</i> <i>laevis, Montagu</i> <i>gracillima, Seguenza</i> <i>striata, D'Orb.</i> var. <i>gracilis, Will.</i> .. <i>semistriata, Will.</i> <i>globosa, Montagu</i> <i>marginata, W. & J.</i> <i>ornata, Will.</i> <i>pulchella, Brady</i>	Chester to Hilbre. " " " Holywell. Chester to Hilbre. " " " Hilbre.	Rather common. Very rare. Rather common. Rather rare. Frequent. Very rare. Frequent. Rather common. Frequent. Rare. Very rare.	

<i>lucida</i> , Will.	Chester to Hilbre.	Frequent.
<i>aspera</i> , Reuss.	"	Very rare.
<i>caudata</i> , D'Orb.	"	Not common.
<i>melo</i> , D'Orb.	"	Frequent.
<i>squamosa</i> , Montagu	"	Frequent.
<i>Nodosaria</i> , Lamk.		
<i>scalaris</i> , Batsch.	Chester to Hilbre.	Rare. Very variable in form.
<i>radicula</i> , Linn.	Holywell and Hilbre.	Very rare.
<i>Dentalina</i> , D'Orb.		
<i>guttifera</i> , D'Orb.	Chester to Hilbre.	Rather rare. Perfect specimens at Hilbre.
<i>communis</i> , D'Orb.	"	Frequent.
<i>Marginulina</i> , D'Orb.		
<i>raphanus</i> , D'Orb.	Saltney.	A single specimen only.
<i>glabra</i> , D'Orb.	"	A single specimen only.
<i>Cristellaria</i> , Lamk.		
<i>rotulata</i> , Lamk.	Chester to Hilbre.	Rare. Generally small.
<i>crepidula</i> , F. & M.	"	Frequent.
<i>Polymorphina</i> , D'Orb.		
<i>communis</i> , D'Orb.	Chester to Hilbre.	Frequent.
<i>compressa</i> , D'Orb.	"	Frequent.
<i>oblonga</i> , Will.	"	Rather common.
<i>Thouini</i> , D'Orb.	Hilbre.	A single specimen only.
<i>fusiformis</i> , Roemer	"	A single specimen only.
<i>lactea</i> , W. & J.	Chester to Hilbre.	Not common.
<i>concava</i> , Will.	"	Rare.
<i>gibba</i> , D'Orb.	"	Frequent.
<i>var. aequalis</i> , D'Orb.	"	Frequent.
<i>Uvigerina</i> , D'Orb.		
<i>angulosa</i> , Will.	Chester to Hilbre.	Small and rare.
<i>pygmaea</i> , D'Orb.	"	Small and rare.
<i>Nodosaria raphanus</i> , Linn.		
<i>Polymorphina lactea</i> , W. & J.		
<i>Uvigerina pygmaea</i> , D'Orb.		

Types.	Genera and Species.	Locality.	Remarks.
Family GLOBIGERINIDA.			
Orbulina universa, <i>D'Orb.</i>	Orbulina, <i>D'Orb.</i> universa, <i>D'Orb.</i>	Chester to Hilbre.	Rare. Test generally brown.
Globigerina bulloides, <i>D'Orb.</i>	Globigerina, <i>D'Orb.</i> bulloides, <i>D'Orb.</i>	Chester to Hilbre.	Not common.
Textularia agglutinans, <i>D'Orb.</i>	Textularia, <i>Defrance.</i> sagittula, <i>Defrance</i> variabilis, <i>Will.</i>	Holywell and Hilbre. Chester to Hilbre.	Very rare. Frequent.
	pygmaea, <i>D'Orb.</i>	" Hilbre.	Very rare. Specimens very small.
	difformis, <i>Will.</i>	Holywell and Hilbre.	Very rare. Specimens very small.
	agglutinans, <i>D'Orb.</i>		
	Verneuillina, <i>D'Orb.</i> spinulosa, <i>Reuss</i>	Saltney.	A single specimen only.
	polystropha, <i>Reuss</i>	Connah's Quay to Hilbre.	Rare.
	Bulimina, <i>D'Orb.</i> pupoides, <i>D'Orb.</i>	Chester to Hilbre.	Rather rare.
	marginata, <i>D'Orb.</i>	"	Rather rare.
	ovata, <i>D'Orb.</i>	"	Frequent.
	elegantissima, <i>D'Orb.</i> ..	"	Rather rare.
Bulimina Presli, <i>Reuss</i> ..	Virgulina, <i>D'Orb.</i> Schreibersii, <i>Cyzeak</i>	Chester to Hilbre.	Very rare. Good specimen.
	Bolivina, <i>D'Orb.</i> punctata, <i>D'Orb.</i>	Chester to Hilbre.	Rare.
	plicata, <i>D'Orb.</i>	"	Not common.
	Bigenerina, <i>D'Orb.</i> digitata, <i>D'Orb.</i>	Hilbre and Holywell.	Rare, and always broken.
Spirillina vivipara, <i>Ehrenb.</i>	Spirillina, <i>Ehrenberg.</i> margaritifera, <i>Will.</i>	Chester.	A single specimen only.
	vivipara, <i>Ehrenb.</i>	Chester to Hilbre.	Very rare.

Cassidulina laevigata, <i>D'Orb.</i>	Cassidulina, <i>D'Orb.</i> laevigata, <i>D'Orb.</i>	Saltney.	Very rare and small.
Discorbina turbo, <i>D'Orb.</i>	Discorbina, <i>F. & J.</i> rosacea, <i>D'Orb.</i> globularis, <i>D'Orb.</i> ochracea, <i>Will.</i>	Chester to Hilbre. " Holywell.	Not common. Frequent. Very fine. Very rare. Specimens very small.
Planorbulina fureta, <i>F. & M.</i>	Planorbulina, <i>D'Orb.</i> mediterraneensis, <i>D'Orb.</i> Truncatulina, <i>D'Orb.</i> lobatula, <i>Walker</i> refulgens, <i>Montfort</i>	Chester to Hilbre. Chester to Hilbre. Holywell.	Frequent. Occasionally " <i>Acerrulina</i> ." Common. Very fine. A single specimen only.
Pulvinulina repanda, <i>F. & M.</i>	Pulvinulina, <i>F. & J.</i> auricula, <i>F. & M.</i> repanda, <i>F. & M.</i>	Saltney. Hilbre.	Very rare. Very rare.
Rotalia Beccarii, <i>Linna.</i>	Rotalia, <i>Lamk.</i> Beccarii, <i>Linna.</i> nitida, <i>Will.</i>	Chester to Hilbre. "	Common. Very fine. Not common. Generally small.
Patellina concava, <i>Lamk.</i>	Patellina, <i>Will.</i> corrugata, <i>Will.</i>	Chester to Hilbre.	Rare. Good specimens.
Family NUMMULINIDA.			
Polystomella crispa, <i>Linna.</i>	Polystomella, <i>Lamk.</i> crispa, <i>Linna.</i> striato-punctata, <i>F. & M.</i>	Holywell and Hilbre. Chester to Hilbre.	Very rare. Poor specimens. Abundant. Very fine.
	Nonionina, <i>D'Orb.</i> scapha, <i>F. & M.</i> depressula, <i>W. & J.</i> umbilicatulata, <i>Montf.</i> turgida, <i>Will.</i> asterizans, <i>F. & M.</i>	Chester to Hilbre. " Hilbre. Chester to Hilbre. "	Very rare. Good specimens. Abundant and fine. Very rare. Generally broken. Rather rare.

VII.—*Descriptions of new Genera and Species of New-Zealand Coleoptera.*—Part II. By FRANCIS P. PASCÖE, F.L.S. &c.

SCAPHIDIIDÆ.
Scaphisoma tenellum.

CUCUJIDÆ.
Dendrophagus capito.

ELATERIDÆ.
Amychus, n. g.
— Candezel.
Limonium collaris.

CLERIDÆ.
Phymatophæa, n. g.
— electa.
Eumede, n. g.
— æraria.
Eleale opiloides.

TENEBRIONIDÆ.
Ectomida, n. g.
— lacerata.
Adelium bullatum.

PYTHONIDÆ.
Salpingus bilunatus.

CEDEMERIDÆ.
Sessinia pauperata.

MORDELLIDÆ.
Mordella funerea.
— detracta.

CURCULIONIDÆ.
Irenimus, n. g.
— parilis.
Lyperobius, n. g.
— Huttoni.
Pædaretus, n. g.
— hispidus.
Eirrhinus acalyptoides.
Aneuma, n. g.
— fulvipes.
Stephanorhynchus purus.
— brevipennis.
Hoplocneme punctatissima.
Pactola, n. g.
— variabilis.
Idotasia egena.

ANTHRIBIDÆ.
Aræocerus pardalis.

CERAMBYCIDÆ.
Ochrocydus, n. g.
— Huttoni.

LAMIIDÆ.
Agapanthida scutellaris.

EROTYLIDÆ.
Triplax Brounii.

Scaphisoma tenellum.

S. nitidum, nigrum, pygidio pedibusque piceis; antennis pallidis, articulis quinque ultimis, basi apiceque exceptis, fuscis; capite prothoraceque impunctatis, hoc lobo scutellari scutellum obtigente; elytris impunctatis, stria suturali distincta; pygidio conico; corpore infra nigro; abdomine segmentis sex. Long. $1\frac{3}{4}$ lin.

Hab. Auckland (Tairoa).

Longer than our *S. Boleti*, and the elytra, except in the sutural stria, impunctate; in my specimen the eighth joint of the antennæ is much narrower than the seventh or following joints. This character is found in other members of the genus, but it does not seem to be invariable even in the same species.

Dendrophagus capito.

D. parallelus, depressus, fulvus, parcim pilosus; capite prothoraci latitudine æquali, inter oculos plicato-rugoso; antennis corpori longitudine fere æqualibus, articulis secundo tertioque simul quarto paulo brevioribus, prothorace antice utrinque tuberculato producto, lateribus dentibus tribus parvis instructis; elytris pallidioribus, confertim fortiter lineatim punctatis, plagis fuscis obscuris notatis; pedibus pallidis, tarsis anticis articulo basali cordato-ampliatis, secundo minore, tarsis intermediis et posticis elongatis, linearibus. Long. $2\frac{1}{2}$ –3 lin.

Hab. Otago; Lake Guyon.

Dendrophagus brevicornis, Wh., is a *Cryptomorpha*, a genus first discovered in Madeira by Mr. Wollaston (Ins. Mad. p. 156). *D. suturalis* and *D. umbrinus*, also from New Zealand, and each represented by a single specimen in bad condition in the British Museum, appear to me to be scarcely more than varieties. A species of the nearly allied genus *Prostomis* from New Zealand was sent to me many years ago by the late Dr. Howitt; but, excepting its larger size, I am unable to separate it from the European *P. mandibularis*.

AMYCHUS.

Caput parvum, inter oculos planatum. *Antennæ* breves, articulo primo valido, secundo quam tertio paulo brevior, cæteris, ultimo elliptico excepto, triangularibus, quam secundo haud longioribus. *Sulci* pectorales obsoleti. *Characteres* alii fere ut in *Lacone*.

The habit of the species described below is unmistakably that of *Lacon*; but it has only a very slight trace of the lateral prosternal groove destined for the reception of the antenna in repose. It was discovered in the Chatham Islands by Mr. Travers. I have dedicated it to Dr. Candèze, who has so elaborately monographed the insects of the family.

Amychus Candèzei.

A. validus, modice convexus, fusco-tomentosus, pilis aurulentis parce adpersus; antennis fuscis, extus magis pubescentibus; prothorace amplo, subtransverso, basi fortiter trisinuato, angulis posticis productis; scutello scutiformi; elytris striatis, lateribus valde rotundatis, griseo subfasciatis vel plagiatis, punctis nitidis adpersis; corpore infra indumento fusco, verisimiliter sæpe detrito, induto. Long. 7–9 lin.

Hab. Pitt's Island.

Limonius collaris.

L. gracilis, nitide fuscus, prothorace pedibusque fulvescentibus; antennis luteis, corporis dimidia longitudine, articulis secundo

tertioque breviusculis, cæteris longiusculis, serratis; capite prothoraceque sat vage punctatis; elytris elongato-cuneiformibus, striato-punctatis; meso- metathoraceque nitide fuscis.

Hab. Auckland.

An elegant species, not agreeing well with *Limonius*, and probably belonging to a new genus.

PHYMATOPHÆA.

Caput antice modice productum. *Oculi* reniformes, transversi. *Antennæ* articulo basali elongato, valido, tertio ad octavum gradatim brevioribus; *clava* magna, laxè triarticulata, articulis duobus basilibus triangularibus, ultimo rotundato. *Palpi* articulo ultimo triangulari. *Prothorax* utrinque tuberculato-productus. *Elytra* supra inæqualia, basi prothoracis duplo latiora. *Pedes* modice elongati; *femora* fusiformia, anteriora crassiora; *tarsi* articulo basali obtecto; *unguiculi* basi dente instructi.

There is nothing in the sterna or abdomen different from *Scrobiger*, Spin., near which this genus may be placed. Its distinctive peculiarity is the large, loosely three-jointed club; but there is much to remind us of the West-African genus *Erymanthus*.

Phymatophæa electa.

P. modice elongata, fusca, subnitida, plagis succineis ornata, pilis concoloribus adspersa; capite inter oculos nudo, bituberculato; prothorace antice tuberculis duobus succineis instructo; elytris inæqualiter rude impresso-punctatis, humeris tuberculisque succineis sex, scil. duobus subbasilibus, duobus ante medium, duobus sub apice positis, pone medium fascia obliqua elevata notatis; pedibus fusco variegatis; corpore infra nitide fusco. Long. 4-4½ lin.

Hab. Auckland.

EUMEDE.

Caput antice brevissimum. *Oculi* magni, leviter emarginati, tenuiter granulati. *Antennæ* breviusculæ, 11-articulatæ, articulis tribus ultimis clavam formantibus. *Palpi* maxillares articulo ultimo ovoideo, labiales securiformi. *Prothorax* capite angustior, basi modice latus. *Elytra* oblonga. *Pedes* graciles; *tarsi* articulo primo brevissimo.

The only exponent of this genus has somewhat the habit of *Lemidia*, from which it differs, *inter alia*, in its emarginate eye; while *Aulicus*, to which it slightly approximates, has all the palpi securiform.

Eumede æraria.

E. fusco-ænea, nitida, antennis, palpis pedibusque, femoribus exceptis, testaceis, pilis volitantibus aliisque albis subadpressis vestita;

antennis prothorace vix longioribus, articulis duobus basalibus validis, secundo dimidio brevioribus; prothorace paulo longiore quam latiore, lateribus rotundatis; elytris postice paulo gradatim latioribus. Long. $2\frac{1}{2}$ lin.

Hab. Christchurch.

Eleale opiloïdes.

E. elongata, æneo-fusca, fulvo-varia, vage breviter pilosa; antennis modice elongatis, clava laxè articulata; capite prothoraceque confertim punctatis, hoc capite angustiore, basi angusto, in medio fulvo; scutello cordiformi; elytris fortiter punctatis, apicem versus paulo gradatim latioribus, fasciis duabus apiceque fulvis notatis; pedibus fulvis. Long. $2\frac{1}{4}$ lin.

Hab. Christchurch, Auckland.

Not unlike a small individual of *Opilus mollis*. The genus is somewhat doubtful.

ECTOMIDA.

Characteres generici fere ut in *Pristodero*, sed tarsis tibiisque aliis, scil. articulis duobus basalibus conjunctis triangulum breviusculum formantibus, tertio parvo, angusto; tibiis extus compressis, margine exteriori denticulatis.

Dermestes scaber, Fab. *, is congeneric with *Pristoderus antarcticus*, White; Erichson's *Ulonotus* is probably founded on one of these two (he does not describe any species); Lacordaire, indeed, suggested the identity of these genera. In *Pristoderus* the tarsi are simply linear, and the tibiæ filiform, not denticulate externally. The species here described is remarkable on account of the dilatation, deeply divided into lobes, of the sides of the prothorax; the insect varies in colour from uniform yellowish testaceous to brownish or with brownish patches.

Ectomida lacerata.

E. oblonga, depressa, subtestacea, aliquando infuscata vel fusco variegata, subtiliter tomentosa; capite tuberculis parvis instructo; antennis articulis duobus basalibus crassis, tertio ad octavum gradatim brevioribus, clava fusca, articulis duobus basalibus valde

* "*Nova Hollandia*" is given as the habitat; but the type in the British Museum is the only individual I have seen. *Dermestes limbatus*, Fab. (Ent. Syst. i. p. 234) is either my *Phycosecis discoidea* or *P. atomaria* (ante, vol. xvi. pp. 213, 214). I incline to the former; but Mr. C. O. Waterhouse, who has carefully compared them, thinks it is the latter; the two specimens in the British Museum are barely recognizable. Fabricius must have been labouring under difficulties when, in describing these two species from the Banksian collection, he referred them to *Dermestes*, with which, it is almost needless to say, they have no affinity.

transversis, ultimo rotundato; prothorace rugoso, lateribus foliaceis, trilobis, lobo anteriore tripartito, lobis duobus posticis multo minoribus; scutello parvo; elytris striato-punctatis, seriatim tuberculatis, tuberculis interioribus quatuor, quorum tribus majoribus, marginibus externis serratis, apicibus divergentibus. Long. $1\frac{1}{2}$ -2 lin.

Hab. Auckland (Tairoa).

Adelium bullatum.

A. nitide nigrum, vel subnigrum; capite prothoraceque subtiliter punctatis, hoc transverso, in medio leviter canaliculato, lateribus rotundato, basi sat lato, angulis posticis subacutis; scutello parvo, transverso; elytris elongato-cordatis, leviter irregulariter punctatis, spatiis inter puncta lævibus ovatis, plurimis oblongis vel linearibus; pedibus lævigatis, nitidis; corpore infra nitido, abdomine reticulato-punctulato. Long. 7 lin.

Hab. Otago.

Adelium is a common Australian genus; but it has not previously been found in New Zealand. This species may be placed after *A. proximum*, although it is not closely allied. The sculpture of the elytra is very distinctive (lines of fine punctures embracing oval, oblong, and a few linear spaces, all of a very irregular character). *Seirotiana*, to which *A. proximum* was referred, should, I think, be united to *Adelium*, its principal character (the "contiguity" of the prothorax to the elytra) being in some species rather difficult to determine, although Lacordaire lays great stress on it. *Amarosoma*, Redt., is the same as my *Pheloneis* (Journ. of Entom. vol. ii. p. 483); his species, *A. simulans*, is or was known to Australian entomologists as *Adelium harpaloides*, White; but White's species is much less convex, with more parallel sides, and larger. The two species should therefore stand as *P. harpaloides*, Wh., and *P. simulans*, Redt.

Salpingus bilunatus.

S. fuscus, subnitidus; antennis articulis quatuor ultimis perfoliatis, fuscis; capite prothoraceque fortiter punctatis, hoc utrinque rotundato, basin versus multo angustiore; scutello transverso; elytris confertim striato-punctatis, macula magna semilunari, ad suturam contigua, ornatis; corpore infra pedibusque fulvescentibus, vel aliquando infuscatis. Long. $1-1\frac{1}{4}$ lin.

Hab. Auckland.

This species has quite the outline of our *S. æreus*; but it is scarcely half the length (*i. e.* eight times less in bulk), and well

marked by the large semilunar patch on the elytra extending from the shoulder to near the apex and meeting its fellow at the suture.

Sessinia pauperata.

S. testacea, parce pubescens; antennis articulo tertio quam quarto paulo brevior; capite prothoraceque subtiliter et confertim punctatis; scutello majusculo, transverso; elytris brevibus, subpunctato-striatis, interstitiis alternis multo latioribus. Long. 4 lin.

Hab. Christchurch.

This very distinct species may at once be known by its short elytra. The genus *Sessinia* was published by me in January 1863 (Journ. of Entom. ii. p. 45, note). *Ananca*, Fairm. et Germ. (Ann. Soc. Ent. de Fr. 4^e sér. iii. p. 267, 1863), must have been published some months later, as a subsequent paper (p. 293) was read at the "séance" of the 10th June in the same year. *Dryops lineata*, Fab. (Ent. Syst. i. pt. 2, p. 76), and *Dryops strigipennis*, Wh. (Ereb. and Terror, p. 12), belong to *Sessinia*. The genus is differentiated from *Nacerdes* by its two-spurred tibiæ. *Selenopalpus chalybæus* and *subviridis* are probably only varieties of *S. cyaneus*, Fab. (*Dryops*).

Mordella funerea.

M. nigra, subtilissime squamulosa, elytris in medio maculis duabus fasciæque flexuosa postica, ad suturam interrupta, albo-pubescentibus, sed in certa luce evanescentibus; antennis, articulis quatuor basalibus exceptis, serratis; capitis fronte subtilissime punctata; tibiis fere ecalcaratis; tarsis quatuor anterioribus breviusculis; aculeo paulo recurvo; corpore infra nitide nigro. Long. 7 lin.

Hab. Waikato.

About the size and general appearance of the Australian *M. 10-maculata*, Fab., but, *inter alia*, minutely scaly, except the white spots and band, not pubescent, and the tibial spurs nearly obsolete.

Mordella detracta.

M. nigra, pube, in certa luce grisea, subtiliter vestita; elytris fascia flexuosa ante medium maculisque duabus posticis albis ornatis; antennis minus serratis; capite antice valde convexo; tarsis quatuor anterioribus valde elongatis; aculeo recto, breviusculo; corpore infra griseo-sericante. Long. 4 lin.

Hab. Waikato.

About the size and general appearance of our *M. fasciata*, but the elytra narrowing much more posteriorly and differently marked.

IRENIMUS.

Rostrum parum elongatum, modice robustum, versus apicem manifeste crassius, apice triangulariter emarginato; *scrobes* breves, apicales. *Antennæ* graciles; *scapus* prothoracem attingens; *funiculus* articulo primo vix incrassato; *clava* distincta. *Oculi* subtenuiter granulati. *Prothorax* subcylindricus, basi rotundatus, lobis ocularibus parum prominulis. *Elytra* elongato-cordata, basi prothorace manifeste latiora, humeris obliquis. *Femora* crassa; *tibiæ* flexuosæ, posticæ corbellis subcavernosis. *Abdomen* segmentis duobus basalibus ampliatis. *Corpus* squamosum.

Allied to the Australian genus *Perperus*, differing principally in the base of the elytra exceeding the width of the prothorax at the base. This is a character on which Lacordaire lays great stress; but in many genera it really seems to be only of specific importance.

Irenimus parilis.

I. oblongus, niger, squamis obscure cervinis omnino dense tectus, setulisque nigris adpersus; rostro capite duplo longiore, antice carinato; antennis ferrugineis; scapo squamoso; funiculo articulis tribus basalibus sensim brevioribus, cæteris obconicis; prothorace parum longiore quam latiore, lateribus rotundatis, pone medium subparallelis; scutello invisio; elytris seriatim punctatis, interstitiis vix convexis, tibiis subbisinuatis, apice subacuminatis. Long. $3\frac{1}{4}$ lin.

Hab. Christchurch.

LYPEROBIUS.

Molyti affinis. *Rostrum* validum, rotundum; *mandibulæ* lamelliformes; *scrobes* obliquæ, oculos vix attingentes; *clava* distincta. *Prothorax* lobis ocularibus paulo prominulis. *Elytra* ovalia. *Femora* incrassata; *tibiæ* apice haud laminatæ. *Abdomen* segmento secundo quam tertio paulo longiore.

With nearly all the characters of the European *Molytes*, this genus is principally distinguished by the tibiæ being without that peculiar external prolongation of the lamina which normally forms the floor of the hollow (corbel) above which the tarsus is inserted, and also by the club of the antennæ being distinctly marked off from the funicle. The fine species constituting the only exponent of the genus at present has been recently discovered by Capt. Hutton at Tardale, near the head of the river Wairau, in the Nelson province. "It lives on the spear-grass (*Aciphylla Colensois*), and sucks its turpentine juices. The plant only grows on the mountains from 2000 to 5500 feet elevation." The insect is entirely black; but some of the specimens are sprinkled with a few fine straw-coloured hairs.

Lyperobius Huttoni.

L. ovalis, niger, nitidus; capite antice convexo; rostro tenuiter punctato, basi fovea profunda impresso; oculis valde angustis; antennis piceis; scapo apice sensim incrassato; funiculo articulis duobus basalibus æqualibus, reliquis submoniliformibus; clava breviter ovata, tomentosa; prothorace inæqualiter convexo, leviter vage punctato; elytris striato-punctatis, punctis approximatis, interstitiis planatis, tertio quintoque multo latioribus; corpore infra nitido, subtiliter punctato; pedibus tenuiter vage setulosis. Long. 9–11 lin.

Hab. Tarndale.

PÆDARETUS.

Caput parvum; rostrum modice elongatum, apicem versus crassius; *scrobes* præmedianæ, obliquæ, ante medium oculorum desinentes. *Oculi* ovales, grosse granulati. *Scapus* oculum vix attingens; *funiculus* 7-articulatus, articulo primo magno, cæteris transversis. *Prothorax* amplus, utrinque rotundatus, basi leviter bisinuatus. *Scutellum* invisum. *Elytra* breviter cylindrica, basi prothoracis latiora. *Coaræ* anticæ haud contiguæ; *femora* mutica; *tibiæ* cylindricæ, unco valido armatæ; *tarsi* breves; *unguiculi* liberi. *Propectus* haud excavatum. *Abdomen* segmentis duobus basalibus ampliatis.

I can only compare this genus to the Australian *Psaldus*, from which it is at once differentiated, *inter alia*, by its normal scrobes and propectus (the latter without the slightest trace of a canal). *Syagrius* has a different rostrum and the tibiæ not armed with a hook.

Pædaretus hispidus.

P. breviter cylindricus, fuscus, squamulis erectis piliformibus, rostro incluso, vestitus; antennis nitide subferrugineis, clava ovata; prothorace latitudine longitudini æquali, lateribus valde rotundatis, supra confertim fortiter punctato; elytris fortiter striatis, striis punctis remotis impressis; corpore infra fortiter punctato; tarsis fulvis. Long. $1\frac{3}{4}$ lin.

Hab. Auckland.

Eirrhinus acalyptoides.

E. ovatus, fulvus, parce sericeo-pilosus, prothorace fusco; rostro gracili, prothoraci longitudine æquali, modice arcuato, basi striato; antennis fere in medio rostri insertis, clava majuscula, fusca; prothorace transverso, utrinque valde rotundato, sat vage punctato; scutello rotundato; elytris prothorace multo latioribus, striato-punctatis, apice rotundatis; pedibus fulvis; corpore infra infuscato. Long. $1\frac{2}{3}$ lin.

Hab. Otago.

I can see nothing to differentiate this pretty little species generically from *Eirrhinus*. It is very similar in appearance to our *Acalyptus Carpini*.

ANEUMA.

Rostrum cylindricum, tenue, arcuatum; *scrobes* antemedianæ, laterales. *Scapus* oculum attingens; *funiculus* articulo primo elongato, crasso; *clava* distincta. *Oculi* rotundati, fortiter granulati. *Prothorax* transversus, basi truncatus, lobis ocularibus nullis. *Elytra* elongato-cordata, prothorace multo latiora. *Pectus* antice emarginato-canaliculatum. *Coxæ* anticæ contiguæ, intermediæ modice approximatae; *femora* incrassata, infra dente minuto instructa; *tibiæ* breviusculæ, rectæ; *tarsi* normales. *Abdomen* segmento secundo haud ampliato, duobus sequentibus conjunctim longiore. *Corpus* pilosum.

In this genus the head is deeply inserted into the prothorax, and, although it is much bent inwards, the rostrum is not received in the pectoral canal, the latter being bounded behind by the anterior coxæ. The presence of this canal prevents the genus being associated with *Erirehinus*, to which otherwise it might have been referred.

Aneuma fulvipes.

A. ovalis, supra subtestacea, nigrescenti-nebulosa, pilis griseis sat sparse vestita; rostro prothorace brevior, basi lineis elevatis instructo; antennis subtestaceis, apicem versus infuscatis; funiculo articulis secundo, tertio quartoque gradatim brevioribus, tribus ultimis transversis; prothorace utrinque rotundato, leviter punctulato; elytris confertim striato-punctatis, interstitiis convexis; corpore infra piceo-testaceo; pedibus fulvescentibus, sparse pilosis. Long. $1\frac{1}{4}$ lin.

Hab. Christchurch.

Stephanorhynchus purus.

S. fere omnino griseo squamulosus; rostro vix compresso, antice haud cristato, fronte super oculos leviter bituberculata, tuberculis haud setosis; clava antennarum elongato-ovata, tomentosa, arcte articulata; prothorace nonnihil subquadrato, sed antice subito constricto, supra vix tuberculato; scutello parvo, transverso; elytris elongato-subcordatis, supra subplanatis, leviter tuberculatis, striatis, interstitiis alternis elevatis, lateribus subito deflexis, apicibus divergentibus; femoribus posticis dente minus prominente; abdomine segmentis tribus ultimis esquamosis, infuscatis; tarsis articulo penultimo nigro. Long. $3\frac{1}{2}$ lin.

Hab. Pitt's Island.

In *S. attelaboides*, Fab., the only species hitherto described, the upper surface is very irregular, the rostrum with a sharply raised longitudinal crest, the prothorax conical, &c. It varies in colour, being sometimes uniformly grey, as in the species before us; but its normal state is well represented in Mr. White's figure (Ereb. and Terror, tab. 3. fig. 11).

Stephanorhynchus brevipennis.

S. squamulis filiformibus brevibus fere omnino tectus; rostro capite paulo longiore, antice gibboso, fronte super oculos leviter bituberculata, tuberculis haud setosis; occipite longitudinaliter excavato; clava antennarum elongato-ovata, arcte articulata; prothorace capite minore, conico, pone apicem strangulato; elytris brevibus, leviter striatis, singulis quadrituberculatis, tuberculo juxta suturam pone medium majore, vel cristam triangularem formante, apicibus rotundatis; tibiis fulvis, posticis valde curvatis. Long. $2\frac{1}{2}$ lin.

Hab. Christchurch.

Well differentiated, *inter alia*, by its short elytra, rounded at the apices.

Hoplocneme punctatissima.

H. nigra, vel purpureo-nigra, vix nitida, femoribus apice, tibiis tarsisque subferrugineis, supra confertim punctata; capite inter oculos haud excavato, collo valde constricto; clava antennarum majuscula; prothorace subcylindrico, angulis anticis rotundatis; scutello parvo; elytris sat ampliatis, haud striatis. Long. $1\frac{3}{4}$ lin.

Hab. Otago.

Smaller than *H. Hookeri*, Wh., from which it may be at once known by the irregularly crowded punctures on the elytra without any trace of striae, instead of being in regular lines. Mr. White refers *Hoplocneme* to the neighbourhood of *Orchestes*, with which it has nothing to do; it is one of the Eirrhiniinae, and allied to the same writer's *Stephanorhynchus*. The funicle in *Hoplocneme* is six-jointed, and the club is four-jointed.

PACTOLA.

Rostrum capite brevius, cylindricum; *scrobes* obliquae, infra oculos desinentes. *Antennae* subterminales; *scapus* elongatus, pone oculos superans; *funiculus* 7-articulatus, articulo primo majusculo, quatuor ultimis transversis; *clava* magna, ovata, concreta. *Oculi* prominuli, laterales, rotundati, grosse granulati. *Prothorax* angustus. *Elytra* ampliata, supra irregularia, humeris callosis. *Pedes* quatuor anteriores mediocres, *femoribus* simplicibus, *tibiis* subrectis; *pedes* posteriores majores, *femoribus* fortiter clavatis, infra dente magno armatis, *tibiis* arcuatis, haud compressis, omnibus apice muticis; *tarsis* articulo tertio late bilobo; *unguiculi* subdentati; *coxae* anticae contiguae, intermediae et posticae late distantes. *Abdomen* segmentis duobus basalibus valde ampliatis.

It is with some doubt that I refer this genus to the Eirrhiniinae. In the form of the hind legs it approaches the two preceding genera; but the head, not constricted behind to

form a neck, would seem to indicate a different type. *Ixalma*, another anomalous genus, with somewhat similar legs, but having a free pygidium, I refer to the neighbourhood of *Tachygonus*. M. Roelofs (Ann. Soc. Ent. Belg. xvii. p. 126) places his genus *Celia**, apparently identical with *Ixalma*, among the "Eugnomides," *i. e.* with the *Eriirhiniinæ*. These are all isolated forms; but I think the pygidium offers a more important character than the separation or the contiguity of the anterior coxæ. The species described below differs considerably in coloration, some individuals being of an almost uniform dark brown, others pale brown on the disk of the elytra; some have the elytron prettily variegated—a central dark triangular spot with a light semicircular line behind, and other variations.

Pactola variabilis.

P. oblonga, fusco- vel brunneo-squamosa, aliquando variegata; antennis fulvis, apicem versus infuscatis; prothorace subcylindrico, in medio bituberculato; elytris basi prothorace fere triplo latioribus, supra tuberculatis, antice subdepressis, late striato-punctatis; corpore infra sparse punctato. Long. $1\frac{3}{4}$ lin.

Hab. Auckland.

Idotasia egena.

I. elliptica, nitide nigra; rostro pone basin fortiter arcuato, dimidio basali antice punctis magnis oblongis approximatis impresso; oculis grosse granulatis; antennis fulvo-ferrugineis; clava oblongo-ovata; prothorace sat vage punctato; elytris vage leviter punctulatis; pedibus piceis. Long. $1\frac{2}{3}$ lin.

Hab. Waikato.

This species is more nearly allied to the Batchian *I. scaphioides* than to either of the Australian members of the genus; it is, however, broader and less convex, the posterior portion of the elytra less attenuated, the intervals of the punctures on the rostrum less decidedly elevated or cariniform, &c. *Idotasia* now contains nine species—five from New Guinea and the neighbouring islands, two from Queensland, one from New Caledonia; and the above. They are very homogeneous, except the one from New Caledonia, but are differentiated by well-marked characters.

Aræocerus pardalis.

A. dense pubescens, fuscus, albido maculatus; antennis breviusculis, nitide fulvis, articulis tertio ad quartum paulo elongatis; clava

* *Celia* has long been used for a genus of Carabidæ.

infuscata, articulis perfoliatis, duobus basalibus valde transversis, ultimo rotundato; prothorace transverso, basi quam apice fere duplo latiore; scutello minuto; elytris oblique striato-punctatis, humeris paulo callosis; pedibus pallidis, tibiis apicem versus leviter incrassatis, tarsis articulo basali modice elongato. Long. $1\frac{1}{2}$ lin.

Hab. Auckland.

Probably introduced, as this species has also been found in Ceylon; but it has not, I think, been described. It is like *A. Coffeæ*, but smaller, with shorter antennæ, the club stouter and more compact, the tarsi not nearly so long, &c.

OCHIROCYDUS.

Caput breve. *Oculi* permagni, subtenuiter granulati; *epistoma* distincta; *labrum* parvum; *labium* membranaceum, bifidum; *maxillæ* lobo interiore triangulari. *Palpi* elongati, omnes fere æquales. *Antennæ* (σ) corpore longiores, 12-articulatæ, articulo basali medioeri, obconico, tertio paulo brevior, cæteris (ultimo excepto breviusculo) parum longioribus, subæqualibus, unilateraliter dilatatis; (φ) corpore breviores, 11-articulatæ. *Prothorax* transversus, depressus, muticus. *Elytra* prothorace latiora, elongata, subparallela. *Pedes* tenuati, elongati; *femora* linearia; *tibiæ*, posticæ flexuosæ exceptæ, rectæ, apice hispidosæ; *coxæ* anticæ transversæ. *Prosternum* elevatum, postice rotundatum. *Abdomen* molle, lævigatum.

The only exponent of this genus retains the name of *Aphanasium australe*, Boisd., in the British Museum*, and as such was referred by Mr. White to the Prionidæ. It is probable that Lacordaire, had he known it, would have placed it in his "Monodesmides." I do so now with some hesitation in consequence of the absence of the lateral ridges separating the pronotum from the sides of the prothorax, and the presence of the inner maxillary lobe.

Ochrocydus Huttoni.

A. fulvescens, elytris nitide testaceis; capite prothoraceque sat sparsim, pectore dense, villosis; prothorace angulo antico rotundato, lateribus subparallelis; elytris sat confertim punctatis, apicibus ad suturam spinosis; pedibus tenuiter pilosis; tarsis intermediis et posticis articulo primo quam secundo longiore; segmento ultimo abdominis in fœmina solum detecto. Long. (σ) 12 lin., (φ) 15 lin.

Hab. Waikato; Wellington.

* It was this that led me to describe the true *Aphanasium australe* as a new species under the name of *Solimnia sublineata*, a mistake which I afterwards corrected (Journ. Linn. Soc. ix. p. 134).

Agapanthida scutellaris.

A. oblonga, depressa, rufo-castanea, antennis pedibusque dilutioribus, supra confertim punctata, griseo variegata; scutello nigro, subscutiformi, in medio excavato; elytris apice paulo dehiscentibus, sutura canaliculata. Long. 4 lin.

Hab. Waikato.

Judging from Mr. White's figure of *A. pulchella* ('Voyage of the Erebus and Terror,' Entom. tab. 4. fig. 10), this species differs, it might be thought almost generically, in its shorter and much thicker femora. The derm in my unique example (apparently a female) seems to be covered with a membranous sort of integument, peeling off in patches; but, from the regularity on both sides, the variegation does not seem to be due solely to that cause. The slight intervals between the punctures on the elytra have a granulated appearance. *Agapanthida* differs from *Phlyctænodes* in its finely faceted eyes, an exceptional character in its own and allied groups.

Triplax Brounii.

T. obovata, fusco-castanea, nitida, antennis pedibusque ferrugineis, illis articulo ultimo apice obliquo, palpis maxillaribus articulo ultimo valde transverso; capite prothoraceque subtiliter, elytris fere obsolete punctatis; tibiis modice triangularibus; prosterno postice paulo bilobo. Long. $1\frac{3}{4}$ lin.

Hab. Auckland.

Rather narrower than *T. ænea*, and the elytra more cuneate. The nearly allied Australian genus *Thallis*, Er., has filiform palpi. I have named this interesting species after Captain Broun, whose numerous discoveries are adding so much to our knowledge of the insect-fauna of New Zealand.

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

[Continued from vol. xvi. p. 429.]

[Plates VI. & VII.]

Genus CYATHOPHYLLUM.

Cyathophyllum, Goldfuss (in parte), Petref. Germ. vol. i. p. 54, 1826.

Gen. char. Corallum simple or compound, with a well-developed epitheca. Tabulæ not complete, but well developed and occupying a central area, which is surrounded by a more

or less extensive zone of vesicular tissue, composed of numerous rows of minute cells. Septa with their sides and edges smooth, always symmetrically developed and regularly arranged. No true columella is present; but the septa usually extend to the centre of the visceral chamber, where they partially coalesce or are twisted together, so as to form a small spurious columella projecting into the bottom of the calice.

The form of the corallum differs very much in different species of *Cyathophyllum*. In the simple forms the corallum is more or less of a conical or cylindro-conical figure, usually more or less bent or curved towards the base, and often with well-marked accretion-ridges. Good examples of these are to be found in *C. angustum*, Lonsd., *C. Murchisoni*, E. & H., *C. Stutchburyi*, E. & H., *C. Ræmeri*, E. & H., *C. ceratites*, Goldf., and *C. obtortum*, E. & H. The compound forms of *Cyathophyllum* assume very different aspects according to their mode of growth. Some, such as *C. articulatum*, Wahl., and *C. cæspitosum*, Goldf., form fasciculate masses, in which the corallites are long and cylindrical, and remain distinct from one another. Others, such as *C. truncatum*, Linn., and *C. paracida*, M'Coy (Pl. VII. fig. 7), exhibit the purest form of compound calicular gemmation, and form inverted pyramidal masses, the bases of which are formed by the parent corallite. Others, again, such as *C. hexagonum*, Goldf., *C. boloniense*, Blainv., *C. Sedgwickii*, E. & H., and *C. regium*, Phill. (Pl. VII. fig. 9), constitute astræiform masses, in which the corallites are generally firmly united laterally, and assume a polygonal form from mutual pressure. Finally, one species at any rate, viz. *C. helianthoides*, Goldf., appears to have been sometimes simple and sometimes compound. In the compound *Cyathophylla* calicine gemmation is the predominant mode of increase, though lateral gemmation obtains in some.

As regards their internal structure, the corals which are referable to the genus *Cyathophyllum* appear to be marked out with sufficient distinctness. The epitheca is generally thin, but well developed, and marked with fine concentric striæ and more or less conspicuous annulations of growth. Very often there are vertical lines or ridges corresponding with the septa within; and these are very conspicuous in some forms, as, for example, in *C. angustum*, Lonsd., and *C. bisectum*, Lindström.

The tabulæ never extend completely across the visceral chamber, as they do in *Zaphrentis* and *Amplexus*, but are always confined to a zone or area occupying the centre of the coral. This tabulate area is sometimes very extensive, at other times more or less contracted; and within it the tabulæ are usually very closely set, often bifurcating and coalescing with their neighbours (Pl. VI. fig. 1, & Pl. VII. figs. 7 A, 9 A).

The central tabulate area of the coral is, in all forms properly referable to *Cyathophyllum*, surrounded by an exterior zone of finely vesicular tissue. This forms the periphery of the visceral chamber, and is composed of numerous layers of minute lenticular cells, which are invariably inclined upwards and outwards as regards the axis of the coral (Pl. VI. fig. 1 A, & Pl. VII. figs. 7 A, 9 A).

The septa are well developed, symmetrical, regularly arranged, and not interrupted in general by the development of any conspicuous fossula. Secondary septa may or may not be present. In the outer portion of the coral the interseptal loculi are more or less copiously filled up by dissepiments, which form the vesicular tissue above spoken of, and have their convex surfaces directed upwards. The sides of the septa are plain, and their free edges are not denticulated as they are in the genus *Heliophyllum*. At the bottom of the calice the septa generally extend inward to the centre of the visceral chambers, where they are usually twisted together so as to form a small projection or false columella. In almost all the typical forms of the genus a similar meeting of the septa in the centre of the corallum is shown in transverse sections of the coral at all heights (Pl. VII. figs. 8 & 9). In some forms, however, which are not otherwise separable from *Cyathophyllum*, and which appear properly to belong to it, transverse sections exhibit the septa stopping short at some distance from the centre, and leaving the tabulæ exposed to view over a larger or smaller median area (as in *C. paracida*, M'Coy, Pl. VII. fig. 7 B).

It will be seen from the above that the structural characters which collectively distinguish the genus *Cyathophyllum* are:— (1) the presence of a more or less extensive central tabulate area; (2) the existence of an exterior zone of vesicular tissue, formed by oblique dissepiments, the convexities of which are directed upwards; (3) the more or less completely developed, symmetrical, and plain septa; (4) the general twisting together or union of the septa in the centre of the floor of the calice, constituting a false columellar projection.

With regard to the affinities of the genus, its nearest ally appears to be *Diphyphyllum*, Lonsd. Some forms of *Cyathophyllum*, indeed, such as *C. cæspitosum*, Goldf., appear to establish an almost complete transition between the two genera. As a general rule, however, the genus *Diphyphyllum* can be readily distinguished by the fact that the septa appear never to extend quite to the centre of the visceral chamber, but invariably leave a well-defined central tabulate area into which the septa are not prolonged. There is thus no twisting to-

gether of the septa in the centre of the corallites to form a false columella. The genus *Eridophyllum*, E. & H., is similarly distinguished from the true *Cyathophylla*, with the additional character that adjacent corallites are united together by epithecal processes. In the genus *Fascicularia** of Dybowski, however, the septa are said to extend quite to the centre of the visceral chamber, where they come into contact with one another; and it is difficult to see how these can be generically separated from forms like *C. caespitosum*, Goldf. The genus *Donacophyllum* of the same author appears to be hardly separable from *Diphyphyllum*, the only difference which is stated to exist being in the size of the vesicles of the dissepimental area (Mon. der Zoanth. scleroderm. rugosa aus der Silurformation Esthlands &c., p. 80).

If, on the other hand, we take the simple forms of *Cyathophyllum*, we find few genera so closely related thereto as to afford any great difficulty in diagnosis. From *Zaphrentis* proper the simple *Cyathophylla* are at once distinguished by the incompleteness of the tabulæ, the presence of an exterior zone of vesicular tissue, and the possession by the latter of a well-marked fossula, formed by the folding and coalescence of a certain number of the septa.

The genus *Campophyllum*, E. & H. (Pl. VI. figs. 3, 4, 4 A), offers, again, a transitional form between the simple *Cyathophylla* and the genus *Amplexus*. It agrees with the former in having the tabulæ restricted to a central area, and in the presence of an exterior zone of vesicular tissue; whilst it approximates to the latter in the fact that the septa do not nearly reach the centre of the visceral chamber, but leave the tabulæ exposed over an extensive median space.

The genus *Calophyllum*, Dana (Pl. VI. figs. 5-7 A), whether valid or not, is fundamentally separated from *Cyathophyllum* by the fact that it possesses no circumferential zone of vesicular tissue, and by its complete tabulæ. Whether or not *Calophyllum* is distinct from *Amplexus*, as denied by Edwards and Haime (Pol. Foss. des Terr. Pal. p. 347), and affirmed by M'Coy (Brit. Pal. Foss. p. 91), and more recently by Dybowski (Mon. der Zoanth. scler. rugosa, p. 118), can hardly be settled except by a reference to the forms originally examined by the great American naturalist when founding the genus.

Our examination of the corals of the genus *Streptelasma*, Hall, has not yet proceeded far enough to justify us in speaking positively as to its affinities. Whatever its true position may

* This name will have to be abandoned, having been previously applied by Milne-Edwards to a well-known genus of Polyzoa.

be, however, it is clearly separated from *Cyathophyllum* by the absence of any external area of vesicular tissue.

The genus *Heliophyllum*, Hall, though in certain respects nearly allied to *Cyathophyllum*, and appearing in great part to take its place in certain formations, is nevertheless distinguished by characters of primary importance. It agrees with *Cyathophyllum* in possessing a circumscribed central tabulate area, in the extension of the septa to the centre of the visceral chamber (where they are more or less twisted and coalescent), and in the fact that the circumferential zone of the corallum is more or less minutely subdivided into cells by the development of dissepiments in the interseptal loculi. With these substantial points of agreement, there is the following striking dissimilarity of structure:—In *Cyathophyllum* the lines of dissepiments run from the theca *inwards and downwards*, so as to form a series of layers of minute vesicles having a corresponding inclination. In *Heliophyllum*, on the other hand, the interseptal loculi are divided into compartments by the intersection of two sets of dissepiments, of which the primary and far most conspicuous series is directed from the internal surface of the wall obliquely *inwards and upwards*, towards the centre, in a succession of ascending arches, the convexities of which are directed upwards. The dissepiments of this series appear on the free edges of the septa within the calice as so many short spines; and they communicate to the sides of the septa, as seen in transverse sections, a characteristic and unmistakable denticulation. They are intersected, generally nearly at right angles, by a second series of dissepiments, which are much more delicate, more disconnected, and more variable than the preceding, but which generally run *inwards and downwards* from the wall.

The genus *Omphyma*, Rafinesque and Clifford, is, again, related to *Cyathophyllum*, the central tabulate area being surrounded by an outer zone of large vesicles having an upward and outward direction. It is, however, distinguished by the fact that the septa do not coalesce centrally, but leave a small portion of the tabulæ free to view, by the presence of four shallow septal fossulæ, by the possession of root-like outgrowths of the epitheca, and by the comparatively gigantic size of the vesicles filling the outer portion of the interseptal loculi.

Finally, we may briefly consider the forms which have been at various times placed under the names *Caninia* and *Cyathopsis*. Most of the forms included under the genus *Caninia*, Mich., have been shown by Milne-Edwards and Haime to appertain in reality to *Zaphrentis*. This is the case, more

or less certainly, with *C. patula*, Mich., *C. cornu-copiæ*, Mich., *C. punctata*, D'Orb., *C. ibicina*, Lonsd., and *C. bilateralis*, Hall; whilst *C. cornu-bovis*, Mich., is apparently an *Amplexus*, and *C. sulcata*, D'Orb., is an *Aulacophyllum*. These distinguished authorities, therefore, consider that *Caninia*, Mich., is but a synonym of the previously founded *Zaphrentis* of Rafinesque and Clifford; and in this opinion they have been generally followed.

Prof. M'Coy, on the other hand, came to the conclusion that *Caninia* could be separated from *Zaphrentis* by the possession of a circumferential zone of vesicular tissue; but his conclusion was vitiated by the fact that he included under this name forms of very diverse nature. Thus his *C. turbinata* and *C. lata* are referable to *Omphyma*; whilst his *C. sub-ibicina* appears to be a *Zaphrentis*.

The genus *Cyathopsis*, D'Orb., again, was considered by Milne-Edwards and Haimé as synonymous with *Amplexus*; but it was retained as distinct by M'Coy, who placed under it *C. cornu-bovis*, Mich. (Pl. VII. figs. 6, 6A), which is probably an *Amplexus*, together with *C. cornu-copiæ*, Mich., and *C. fungites*, M'Coy, both of which belong to *Zaphrentis*. According to M'Coy's definition, *Cyathopsis*, D'Orb., is distinguished by not having the exterior zone of vesicular tissue which is present in *Caninia*; whilst it is said to differ from *Amplexus* chiefly in the more vesicular nature of the tabulæ, and the greater inward extension of the septa.

More recently Dybowski (*op. jam cit.*) has declared in favour of retaining both *Caninia* and *Cyathopsis*. He places *Caninia* in the immediate neighbourhood of *Omphyma*, from which it is separated, in his opinion, solely by the fact that it possesses but a single septal fossula, whilst four such exist in the latter. He also retains *Cyathopsis*, D'Orb. (as distinct from *Amplexus*), and places it next to *Zaphrentis*, from which he separates it simply by the smaller development of the septa. According to his views, *Zaphrentis* and *Cyathopsis* agree with one another in having septa of unequal lengths and of irregular arrangement; whereas he places *Amplexus* in a different family, as having equal and regularly arranged septa. We, however, do not think that any difference in the extent to which the septa are developed should, of itself, be regarded as of such high value in classification; nor can we admit, as a matter of fact, that the septa in the genus *Amplexus* are always equally developed.

Upon the whole * there can be little hesitation about con-

* Whether *Cyathopsis*, D'Orb., can be retained as a distinct genus or not depends, of course, upon the characters possessed by the form which
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sidering *Cyathopsis* a synonym of *Amplexus*, as insisted on by Edwards and Haime. The same authorities can equally be followed in referring most of the species of *Caninia* to the genus *Zaphrentis*.

There is, however, one species of *Caninia*, viz. the *Caninia gigantea* of Michelin, which, in our opinion, cannot possibly be referred to *Zaphrentis* without violating its natural affinities. This species was removed from *Caninia* to *Zaphrentis* by Milne-Edwards and Haime; and its name was at the same time changed to *Z. cylindrica*, in consequence of there being already in existence the much older *Z. gigantea* of Lesueur, which is an unquestionable *Zaphrentis*. We are, however, satisfied that the coral known under the names of *C. gigantea*, Mich., or *Z. cylindrica*, E. & H., possesses a structure which removes it out of *Zaphrentis* proper, as will at once be evident from the following brief summary of its leading characters:—

Corallum (Pl. VI. figs. 1-1 r) tall, cylindrical or cylindro-conical, more or less curved, with distinct accretion-swings. Epitheca thin, with fine encircling lines of growth. Calice circular and shallow. The central area of the coral is occupied exclusively by the tabulæ, which are close-set and numerous, and bend down slightly at the margins of the area. Circumferentially there is a large, distinct, and well-developed zone of vesicular tissue, formed by dissepiments filling the interseptal loculi, and constituting a series of minute lenticular cells arranged in rows which have a direction upwards and outwards. The septa are well developed, but do not appear to extend to the centre of the visceral chamber, a portion of the central tabulate area being left exposed to view. The primary septa are numerous, apparently always over sixty in number towards the summit of the corallum, and they alternate with much shorter secondary septa. A single well-marked septal fossette is present, placed on one side, formed by a depression of the tabulæ, and occupied by a single short septum.

D'Orbigny selected as the type of the genus, viz. *Cyathopsis (Amplexus) cornu-bovis*, Mich. This coral differs from typical species of the older genus *Amplexus* (such as *A. coralloides*, Sow.) chiefly in the fact that the septa extend further inwards towards the centre of the visceral chamber. The distinction relied upon by D'Orbigny is that *A. cornu-bovis* possesses a septal fossette formed by an inflection of the tabulæ on one side; but a similar, though less pronounced, fossette is present in *A. coralloides*; so that this distinction falls to the ground. The development of the septa in *A. cornu-bovis*, though greater than in *A. coralloides*, is not sufficient to constitute a ground of generic distinction, since in both forms a large central area of the tabulæ is left exposed to view. We have not seen the original specimens of *A. cornu-bovis*, Mich.; but we figure an example, apparently belonging to this species (Pl. VII. figs. 6, 6A), which shows the characters of the septa, and can be compared with the figures we have previously given of *Amplexus*.

When we consider the above-mentioned characters as displayed by longitudinal and transverse sections of this coral (Pl. VI. figs. 1-1 I), we are led to the conclusion that it is fundamentally distinguished from all the forms of *Zaphrentis* proper (1) by the fact that the tabulæ do not extend completely across the visceral chamber, (2) by its possession of an exterior vesicular zone, formed by very numerous dissepiments filling the interseptal loculi, and (3) by the fact that the septal fossula is not formed by the bending round and coalescence of a certain number of the septa, but is constituted by a funnel-shaped depression of each successive tabula (whence the name of *Siphonophyllia* applied by Scouler to forms presenting this peculiarity).

On the other hand, it agrees with the genus *Cyathophyllum*, as we have defined it, (1) in the fact that the tabulæ are restricted to a central area, and (2) in the possession of a well-marked circumferential zone of lenticular cells, which are arranged in layers inclined upwards and outwards. In the possession of a well-marked fossula, on the contrary, it certainly differs from the more typical simple *Cyathophylla*, though some of these do actually possess a small or rudimentary fossette. A more serious difference, however, is found in the fact that the septa do not appear to reach the centre of the visceral chamber, but fall short of this point, and leave the tabulæ exposed. This, at any rate, is what is shown by transverse sections (Pl. VI. figs. 1 B-1 I), though, according to Edwards and Haime, the septa are continued in the form of striæ nearly to the centre of the highest of the tabulæ*.

So far as the evidence in our possession goes, we have no doubt as to the propriety of removing *Z. cylindrica* from the genus *Zaphrentis*; and we are inclined to think that it should be placed in *Cyathophyllum*, in spite of the minor differences above noted. In that case the original specific name will have to be restored, and it will stand as *Cyathophyllum giganteum*, Mich. If the above-mentioned differences should be considered of sufficient weight to separate it generically from *Cyathophyllum*, then the genus *Caninia* will have to be resuscitated for its reception, and it will revert to its original title of *Caninia gigantea*, Mich.

The genus *Cyathophyllum* has a wide range in time, ex-

* Much stress cannot perhaps be laid upon the fact that the septa fall short of the centre. It is true that in the most typical *Cyathophylla* they extend to the centre of the visceral chamber; but there is at least one marked exception to this rule, viz. *C. paracida*, M'Coy (Pl. VII. figs. 7 B, 7 C), in which the septa fall short of the centre, and leave the tabulæ exposed to view in the centre.

tending from the Upper Silurian (Wenlock Limestone) to the top of the Lower Carboniferous. It appears to have attained its maximum of development in the Devonian period.

Genus CAMPOPHYLLUM.

Campophyllum, Milne-Edwards and Haime, Brit. Foss. Cor., Intr. p. lxxviii. (1850).

Gen. char. Corallum simple, conical or cylindro-conical, with an epitheca. Calice deep. Tabulæ well developed, extending over a large central area, but not quite reaching the inner surface of the theca. Outside the tabulate area is a zone of vesicular tissue; but this is mostly of inconsiderable thickness. The septa are short, and do not nearly extend to the centre, but leave the smooth upper surfaces of the tabulæ exposed over a large median space. At the circumference of the visceral chamber the interseptal loculi are occupied by delicate dissepiments (Pl. VI. figs. 3, 4, & 4 A).

As we have remarked before, the genus *Campophyllum* may be regarded as intermediate between the simple *Cyathophylla* and *Amplexus*. The point in which the genus approaches *Cyathophyllum* is found in the fact that the interseptal loculi are filled up externally by fine dissepiments, which give rise to a peripheral zone of vesicular tissue, in which the vesicles are arranged in layers directed upwards and outwards. This vesicular zone, however, is very rarely developed to any thing like the extent which characterizes *Cyathophyllum*; and it is often filled up and almost unrecognizable. From the typical *Cyathophylla*, again, the genus is separated by the much less highly developed condition of the septa, and the exposure of the tabulæ to view over a large central area. In this latter feature, on the other hand, the genus closely approaches *Amplexus*.

The tabulæ are comparatively remote and simple; and the area which they occupy is sometimes so great as to render the distinction of examples from *Amplexus* a matter of difficulty. The septa, though short, are always longer than in most of the species of *Amplexus*, and they are united towards the circumference by a moderate number of dissepiments. The dissepimental vesicles are small and lenticular in shape. A septal fossula is present, in some instances at any rate, and is formed by a depression of the tabulæ on one side of the corallum (Pl. VI. fig. 3). Short secondary septa are developed alternately with the primary septa.

In the absence of any certainty as to the precise forms included by Prof. Dana in his genus *Calophyllum*, we are in

doubt as to whether it may not be in part conterminous with *Campophyllum* as well as with *Amplexus*. The forms recently referred to *Calophyllum* by Dybowski (Mon. der Zoanth. scler. rugosa, pp. 118-121) are partly simple and partly compound, and are certainly not referable either to *Campophyllum* or *Amplexus*. We have, however, no means of judging to what extent they can be regarded as representing the forms referred by Dana to *Calophyllum*. There exists, however, in the Carboniferous rocks of Scotland, a group of corals which stand intermediate between *Campophyllum* on the one hand and *Amplexus* on the other. They differ from the former in having no well-defined exterior zone of vesicular tissue, and from the latter in the much greater development of the septa, which only leave a small central area of the tabulæ exposed. Whether the name of *Calophyllum* can with propriety be retained for such forms we leave at present an open question; but we have figured a few examples for purposes of comparison.

As at present constituted the genus *Campophyllum* contains only simple corals. There would, however, be some reason for removing *Cyathophyllum paracida*, M'Coy, from its present genus, and referring it to *Campophyllum*, as suggested by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 395). The ground for such a change is that the septa in this species appear never to reach the centre of the visceral chamber, but always leave a portion of the tabulæ exposed; whereas in the typical *Cyathophylla* the septa meet in the centre. If this change were to be accepted, then *Campophyllum* would contain compound as well as simple forms. *Cyathophyllum giganteum* (= *Zaphrentis cylindrica*) would also have to undergo a similar transference. We do not, however, feel justified in adopting this alteration with the evidence at present in our possession.

The genus *Campophyllum* is mainly Devonian in its range; but it also extends into the Carboniferous system, where it is represented by at least one species (*Campophyllum Murchisoni*, E. & H., Pl. VI. figs. 3, 4, & 4A).

EXPLANATION OF THE PLATES.

(All the specimens are figured of the natural size.)

PLATE VI.

Fig. 1. *Cyathophyllum (Caninia) giganteum*, Mich., outline of the corallum of a large individual, from Auchenskeoch Quarry, near Dalry, Ayrshire (Lower Carboniferous); 1A, longitudinal section of the upper portion of another individual of the same, from the Lower Carboniferous of Pathgate, Linlithgowshire; 1B-1I,

transverse sections of the same, showing the structure at different stages of growth.

- Fig. 2.* Transverse section of another example of the same, Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.
- Fig. 3.* Transverse section of *Campophyllum Murchisoni*, E. & H., Lower Carboniferous, Durnish, County Limerick. (In the collection of the Geological Survey of Ireland.)
- Figs. 4, 4 A.* Longitudinal and transverse sections of another example of the same, Lower Carboniferous, near Beith, Ayrshire. In all these examples the narrow outer vesicular zone is more or less completely filled up.
- Figs. 5, 5 A, 6, 6 A, 7, 7 A.* Longitudinal and transverse sections of different examples of a coral possibly belonging to *Calophyllum*, Dana. The structure is nearly allied to that of *Campophyllum*; but there is an absence of any exterior zone of vesicular tissue. The specimens are from the Lower Carboniferous of Ayrshire.

PLATE VII.

- Figs. 1, 2, & 3.* Transverse sections of a large species of *Cyathophyllum*, closely allied to *C. giganteum*, Mich., but differing in the nature of the dissepiments, the number of the septa, and certain other particulars. The specimens exhibit a large septal fossula. Lower Carboniferous, Ireland. (In the Collection of the Geological Survey of Ireland.)
- Figs. 4 & 5.* Transverse sections of *Cyathophyllum*, sp., exhibiting fissiparous development. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.
- Figs. 6, 6 A.* *Amplexus (Cyathopsis) cornu-bovis*, Mich., showing the septa passing inwards to near the centre of the visceral chamber. Lower Carboniferous, Ayrshire.
- Fig. 7.* *Cyathophyllum paracida*, M'Coy, showing calicular gemmation; 7 A, longitudinal section of the same; 7 B-7 D, transverse sections of the same. Lower Carboniferous, Lanarkshire.
- Fig. 8.* *Cyathophyllum*, sp., transverse section. Carboniferous, Ireland. (In the collection of the Geological Survey of Ireland.)
- Fig. 9.* *Cyathophyllum regium*, Phill., transverse section of a small slab; 9 A, longitudinal section of a single corallite of the same.

[To be continued.]

IX.—*Descriptions of two new Coleopterous Insects belonging to the Families Buprestidæ and Melolonthidæ.* By CHARLES O. WATERHOUSE.

Fam. Buprestidæ.

Stigmodera Saundersii, sp. n.

Oblonga, convexa, lata, nitida, viridi-cærulea; elytris cyaneis, maculis quatuor coccineis; thorace convexo, longitudine $\frac{2}{3}$ latiori, fortiter crebre punctato; scutello parvo, nitido; elytris thorace vix latioribus, at $2\frac{1}{2}$ longioribus (apicibus rotundatis), punctato-striatis. Long. 8 lin., lat. $3\frac{1}{2}$ lin.

This species is peculiar for its broad, very convex form, and

rounded apices to the elytra. The sides of the thorax are rounded in front; the posterior angles are rather less than right angles. The elytra are deep steel-blue, strongly punctate-striate; the interstices are scarcely convex, very finely and not thickly punctured; but there are some large punctures about the shoulders. Each elytron has two bright red spots; the larger one occupies all the base except the scutellar region; the second spot is near the apex, commencing on the margin, and, extending obliquely upwards, nearly reaches the suture.

Hab. New South Wales. Brit. Mus.

This species differs considerably from all the other *Stigmodera*, but should, I think, be placed next to *S. bifasciata*, Saund., which it most nearly resembles in form.

Fam. Melolonthidæ.

CALONOTA, Hope.

I have examined many examples of *Calonota*, and am unable to detect more than eight joints to the antennæ (not nine, as given by Lacordaire). The third joint is very long, cylindrical; the fourth the same form, but shorter; the fifth very short, thickened at the internal apical angle; the sixth, seventh, and eighth form the club, elongate in the male, ovate in the female.

The name *Pyronota*, Boisd., although prior to that of Hope, is given without any proper characters for the genus; and I therefore adopt Hope's name.

I am unable to distinguish more than one species of this genus. I am even unable to find any definite characters to separate the piceous form, with pale margins and broad thorax (which at first appeared quite distinct), from the typical bright green *C. festiva*. I find intermediates both in form and colour.

PHYLLOCERUS, Hope, MS.

Antennæ nine-jointed; first joint much enlarged at the apex; second nearly globular; third, fourth, and fifth cylindrical, subequal, a little shorter than the second; sixth joint very short, but broader than the previous joint; the seventh, eighth, and ninth joints forming a club, very long in the male, elongate-ovate in the female. Clypeus somewhat deeply triangularly emarginate in the middle. Mesosternal projection long, conical. Posterior coxæ with the internal angle not produced into a spine; posterior femora with a small triangular projection on the internal lower margin. Claws simple.

This genus is founded on a well-known Australian insect, but it appears to be undescribed. It is intermediate between *Calonota* and *Colymbomorpha*.

Phyllococcus purpurascens, Hope, MS.

Ovalis, convexus, nitidus: capite thoraceque viridibus; elytris griseo-purpurascensibus; corpore subtus picco, æneo tincto, dense albo-pubescente; elytris sat fortiter striato-punctatis, interstitiis alternatim seriatim punctatis. Long. 6 lin., lat. $3\frac{1}{2}$ lin.

Form of *Colymbomorpha lineata*, but more regularly oval and more convex; very shining. Clypeus thickly and moderately strongly punctured, narrowed in front, triangularly notched in the middle. Thorax not very thickly and somewhat obscurely punctured. Scutellum green, obscurely punctured. Elytra greyish purple, somewhat strongly striate-punctate: the interstices not convex; the first irregularly and somewhat strongly punctured; the third, fifth, and seventh each with an irregular row of punctures; the second, fourth, and sixth are rather narrower. Club of the antennæ black. Anterior tibiæ slender, with an oblique incision in the middle of the outer edge, surmounted by a somewhat acute (but not projecting) tooth.

Hab. Swan River. Brit. Mus.

COLYMBOMORPHA, Blanch.

This genus is united to *Calonota* in Gemminger and Harold's Catalogue. I think it should certainly be kept distinct. It differs from both the foregoing genera in being hirsute above, and in having the mesosternal projection in the form of a blade instead of conical; from *Calonota* it differs in having no appendage to the claws. These characters have already been noted by Lacordaire; but that the males have five lamellæ to the nine-jointed antennæ seems to have been entirely overlooked.

In the British-Museum collection there are three or four specimens, which differ considerably in colour and sculpture from each other and from the type of the genus, *C. lineata*; but I cannot satisfy myself that they are more than varieties, as there appear to be intermediates.

X.—Description of a new Species of Sessile-eyed Crustacean, and other Notices. By the Rev. THOMAS R. R. STEBBING, M.A.

[Plates IV. & V.]

Microdeuteropus bidentatus, n. sp. Pl. IV. figs. 1, 1 a, 1 b.

This new species of *Microdeuteropus* was dredged at Salcombe in August of the present year (1875). It exhibits well the characters of the genus as given by Messrs. Bate and Westwood, if we except the expression "complexly subchelate," which they apply to the first gnathopods. This complexity, however, does not belong to all the species they describe, nor to the females of any of them. The genus *Autonoë* of Bruzelius was separated from *Microdeuteropus* of Costa to receive species which do not possess the complexity in either sex, and which have the rami of the last pair of pleopoda unequal. But the separation seems scarcely desirable, since there appears to be no correlation between the two characters used for the generic distinction. Thus the present species and *M. longipes*, at least as described in the 'Catalogue of Amphipodous Crustacea,' have the rami of the last pleopoda equal, but the hands not complexly chelate. On the other hand, *M. grandimanus*, also described in the Catalogue just mentioned, has the rami of the pleopoda unequal, but the posterior angle of the carpus of the first gnathopods produced into a tooth in the male—a circumstance which links it closely to the *M. gryllotalpa* of Bate and Westwood, *M. anomalus* of Rathke.

In general appearance the new species has a near resemblance to *M. Websteri*. The superior antennæ have a secondary appendage of three slender articulations, and a flagellum of fifteen. In the lower antennæ the articulations of the flagellum are comparatively stout, but only four in number. The eyes are small and black. The whole animal is slender, and, like others of the genus, when dead has a metallic lustre. The telson has a double apex, carrying two short spines and two setæ. The last pair of legs exceeds in length the preceding pair by the whole of the long thin propodos and finger; the antepenultimate pair is the shortest; the third and fourth pairs are equal in size, having the finger two thirds the length of the propodos. The thighs of all the seven pairs of legs are long; those of the second gnathopods are distinguished by a sort of curved spur projecting at the anterior distal angle; in other respects this pair of gnathopods

seems scarcely distinguishable from the corresponding limbs of *M. Websteri*: the general proportions are the same; and the wrist and hand are in like manner densely clothed with long hairs on the anterior margin, while tufts project from the other side. Close to the extremity of the palm is a slender spine, which the finger, when in a clasping position, overlaps. The first gnathopods exceed the second in size, but to no very great extent; they agree with the second in hirsute adornment, with, however, this addition, that the hinder part of the metacarpus is here clothed like the front of the wrist and hand. The wrist is rather longer than the hand, but scarcely so wide. The palm of the hand is quite unlike that of any of the other hitherto described species of *Microdeuteropus*: the defining angle is rounded off; from the interior of this curve rises a transparent spine, itself slightly curving, against the outer side of which the serrated finger impinges when clasped. Almost parallel with the spine a strong tooth shoots up from the palm, meeting the concavity of the finger, and beyond this another, smaller tooth, nearer to the wavy line which marks the hinge. The spine is capable of an independent motion backwards and forwards in the line of the finger. Under the microscope little circles or dark points in orderly arrangement mark the places of insertion of the long bright hairs, producing a very agreeable effect.

It is right to notice the remarkably close resemblance of this species to the *Microdeuteropus (Gammarus) longipes* of Lilljeborg, taken at Kullaberg in Scania. But whereas in our species the first gnathopods have the two processes on the palm of the hand, in the foreign species they are stated to be on the posterior margin. The words of Lilljeborg's description are "Manus pedum thoracicorum primi paris iisdem secundi paris majores, apud marem ovatae, ad marginem posticum, unguem propius, processibus duobus et aculeo interno mobili praeditae," which Mr. Spence Bate, in the British-Museum Catalogue, thus translates:—"First pair of gnathopoda larger than the second, having the propodos in the male ovate, furnished on the posterior margin near the dactylos with two processes and an internal movable spine."

Boeck's description of the species says, "Pedes primi paris apud marem articulo primo postice perdilatato et setoso; carpo permagno sed brevior quam manu; hac ovata, in margine inferiore dentibus validis duobus armata." It may be remarked that the first joint of these gnathopods in the Salcombe species, though broad, is not very remarkably so, and is certainly not setose; nor is the finger in the third and fourth pairs of legs

equal in length to the hand, as in Boeck's account. The Rev. A. M. Norman, to whose kindness I am indebted for the means of comparing the foreign literature on the subject of *Microdeuteropus* (*Autonoë*) *longipes*, doubts whether Boeck is really describing the same species as that which Bruzelius names *Autonoë longipes*; for, while the branches of the last pleopoda are said by Lilljeborg to be equal to one another, and by Bruzelius to be twice as long as their stem, Boeck speaks of the outer branch alone as being much longer than its peduncle. On the other hand, the *Gammarus longipes* of Lilljeborg suits the Salcombe species in all respects, if the term "margo posticus" could be understood to mean not what is commonly called the hinder margin, but the palm at right angles to it. In that case the name *bidentatus* would have to succumb to the priority of *longipes*.

It may be added that Boeck is not very consistent in his discrimination of *Microdeuteropus* from *Autonoë*. In the generic character of the former he says that the last pleopoda have the inner and outer branches almost equal in length. He then gives two species:—*M. gryllotalpa* (*grandimanus*, Bate), in which the outer is a little longer than the inner branch; and *M. anomalus*, in which, he says, the branches are equal. In the generic character of *Autonoë* he tells us that the outer branch is longer than the inner. This, it must be presumed, implies a decided inequality; otherwise it would be no mark of distinction from the genus *Microdeuteropus*. Yet of the only two species described, *A. longipes* and *A. plumosa*, it is doubtful whether the former possesses this character; and of the latter Boeck himself says, not that one of the branches is, but that the branches are, twice as long as their peduncle. So that, if things which are double of the same are equal to one another, this species ought not to be reckoned an *Autonoë*, or the generic character of *Autonoë* must itself be amended, which would be best effected by its reabsorption into *Microdeuteropus*.

Anonyx obesus, Spence Bate = *Acidostoma obesum*,
Lilljeborg.

An example of this species, not hitherto recorded from the south, was taken at Salcombe on the muddy sand, from which *Ophiura brachiata* may be dug at very low tide. The specimen was salmon-coloured with white markings, the legs and antennæ white, the eyes orange-red.

Kröyera arenaria, Spence Bate. Pl. IV. fig. 3.

The genus *Kröyera* was separated from *Monoculodes* of Stimpson only on the ground that the animals belonging to it have the eyes apart and the second pair of gnathopoda chelate. It so happened that, while the 'British Sessile-eyed Crustacea' was passing through the press, the authors became acquainted with a new species on all accounts demanding admittance into the genus, except from its having the eyes confluent. The separateness of the eyes can no longer, therefore, be reckoned among the characters of the genus; and the genus itself might well be cancelled, and the species assigned to *Monoculodes*. As far as the confluence of the eyes is concerned, it is not only *Kröyera altamarina* that possesses this Cyclops-like appearance; it belongs also to the species *Kröyera arenaria*, on which the genus was founded. At least, if specimens taken in South Devon may be trusted, the eyes, which are situated on the projection of the head, meet in the centre, being distinct, indeed, from one another, but closely united; they are magenta in colour, prettily picked out by white facets. The boundaries are determined by two concentric curves across the head, and at the sides by the shape of the projection of the head, the lines of which they follow. The white median line which divides and unites the two organs pursues a straight course.

It will often be in vain to seek for the eyes in specimens that have been long dead; the pigment invariably loses its colour, and generally becomes dispersed or invisible. As the specimens described by Messrs. Bate and Westwood appear to have reached them from a distance, it is probable that the eyes were not in a condition to admit of accurate description.

Lilljeborgia Normanni. Pl. IV. fig. 4.

This species was described in the 'Annals' for July 1874, from specimens taken at Salcombe. In those specimens the last pair of pleopoda were wanting; and as the closely allied species *Lilljeborgia shetlandica* (B. & W.) was described by Messrs. Bate and Westwood from specimens in a similar predicament, the present opportunity is taken of giving an account of these organs as seen in the female of *Lilljeborgia Normanni*. There is not likely to be much difference between the two species in this respect. The stem of the pleopoda in question is stout, widening towards the distal end, and projecting as far as the

branches of the other pleopoda; its two branches are equal in length, broad and thin, the upper one being as it were sheathed in the lower. The spines are set rather away from the edges. On the distal end of the stem three spines make themselves conspicuous, a long one followed by two short ones. The telson is in two pieces, which can move independently; the lower part is curved; the upper ends in a long point, preceded by a cavity and another sharp tooth; from this cavity spring two spines, a long one and a short one.

Melita gladiosa, Spence Bate. Pl. IV. figs. 2, 2 a-d.

This species is tolerably common in the estuary at Salcombe; but only the male has as yet been described. The female agrees in form with the male very minutely, except in regard to the second pair of gnathopods. These in the male present a short wrist, but a large and broad hand with a curiously serrated and uneven palm and a massive scimitar-like finger, all much exceeding in size the corresponding parts of the first gnathopods. In the female the two pairs are nearly equal: both pairs in this sex have the finger pointed and simply curved, the palm nearly straight and set with a row of short fine hairs. The first pair have a dense fringe of fine short hairs also on the hinder margins of the metacarpus, wrist, and hand, such as occurs in the female of *Melita obtusata*. In the first pair the wrist and hand are equal and similar, both being broadly oval; the palm of the hand is scarcely defined. In the second pair the palm is defined by a small tooth, the wrist is about as long as that in the first pair, but not so broad; the hand is equal in breadth to that of the first pair, and about one third longer.

Both in the male and female the third segment of the tail has the lower half of the hinder margin and the hinder half of the lower margin serrated, just as in *Megamæra Othonis* of Spence Bate, which the Rev. A. M. Norman has ascertained to be the female of *Mæra longimana*.

A striking characteristic of *Melita gladiosa* in both sexes is the dentation of the pleon. According to Bate and Westwood, all the segments of the pleon, except the sixth, have the dorsal surface of the posterior margin furnished with three teeth. The exception is unnecessary; for in fact the three teeth are present, though much less pronounced and rather difficult to observe, in the sixth segment. The telson is double, each branch having a spine rising from the centre, and the upper

margin concave between this spine and the pointed extremity. In the last pair of pleopoda the minute upper branch is broadest near the distal end.

A specimen of the male dredged at Salcombe has one of the second gnathopods normal, the other much smaller and almost without trace of denticulation. A specimen of *Melita palmata* taken at Torquay presents a similar inequality in the second pair of gnathopods. Another example of *M. palmata* in the same condition has been described by Mr. Spence Bate; who suggests in explanation that a limb has been lost by some injury, and then replaced by a new one imperfectly developed. These casualties would seem to argue a combative disposition in the genus *Melita*.

Proto Goodsiri, Spence Bate.

As in the 'British Sessile-eyed Crustacea' *Proto Goodsiri* is thought to be only a northern species, it may be worth while to record its capture in the Salcombe estuary during August of this year (1875). The work just mentioned affirms that "the tail is very rudimentary, and supports in the male a single pair of rudimentary propoda." In the Salcombe specimens, however, there are two pairs of these styliiform appendages, as in the closely allied species *Proto pedata*. Both species were dredged in the same part of the estuary; and the female forms, found in proximity to each among the contents of the dredge, were not distinguishable from one another.

The numerous variations in the second gnathopods of *Caprella acanthifera* make the suggestion at least plausible that *Proto pedata* and *P. Goodsiri*, mainly distinguished as they are by differences in the hands of the second pair, may be only varieties of one and the same species, with *P. Goodsiri* for the older, as it seems to be invariably the larger, form.

Tanais vittatus, Lilljeborg.

In discussing the genus *Apseudes*, Messrs. Bate and Westwood take occasion to remark that, although they had examined some hundreds of individuals of the genus *Tanais*, they had never seen one possessing the features of a female. At the same time they call attention to Rathke's figure of his *Crossurus vittatus*, with a large incubatory pouch filled with large eggs, this *Crossurus* being the *Tanais* of Lilljeborg. They mention also that Müller, Rathke, and Lilljeborg have described the females of *Tanais* as resembling the males. Additional

evidence can scarcely be needed; but it will do no harm to place on record the capture of a fine specimen of *Tanais vittatus* with eggs as described by Rathke. It was taken in August 1875 from the shore-piles on the North Sands at Salcombe, in which, as in similar piles at Torquay, this species abounds along with *Chelura terebrans* and *Linnoria lignorum*.

Aapseudes Latreillii, Bate and Westwood.

This species, hitherto recorded only from the North, was dredged this summer at Salcombe. The antennæ bear a very close resemblance to those of *Aapseudes talpa*, a fact which could scarcely be guessed from the figures of the two species in the 'British Sessile-eyed Crustacea.' There is, however, apparently no crenulation in the large basal joint of the upper antennæ, though it has the uneven outline and setæ noticeable in the other species.

Jæra albifrons, Leach. Pl. V. figs. 5, 5 a, 5 b, 6, 6 a, 7.

The generic character of *Jæra* in the 'British Sessile-eyed Crustacea' states that "the pleopoda or branchial appendages" are "covered by a large plate occupying the entire under surface of the pleon." In the remarks which follow, however, it is explained that this plate (or "grande lame operculaire," as Milne-Edwards has called it) is a sexual distinction peculiar to the females. It is necessary to bear this in mind in order to infer, what is not otherwise indicated, that the *Jæra albifrons* figured and described in the work referred to is a female form, while the *Jæra Nordmanni* of the same work is a male. One might easily jump to the conclusion that they were the sexes of a single species; nevertheless such a leap in the dark would land us in a mistake. On all the shores near Torquay *Jæra albifrons* is very common, and, at least in one spot (on Meadfoot Beach), *Jæra Nordmanni* is, or till lately was, also abundant. But though in close propinquity, the two species were not mixed, *Jæra Nordmanni* occupying a higher zone of the beach than its congener. Messrs. Bate and Westwood give the same length for each of the species, namely "about one sixth of an inch." This is probably an oversight or a printer's error, since, though the figure of *J. Nordmanni* happens to be a larger one than that of *J. albifrons*, in the lines which indicate the natural sizes these dimensions are reversed. As a matter of fact no members of the Meadfoot colony of *J. Nordmanni* appeared to attain fully even an eighth of an inch

in length, while adult females of *J. albifrons*, though specimens vary considerably, are often fully one sixth of an inch. But along with these fine and prolific specimens may be found many smaller, which have no doubt often been neglected as juveniles, as equally without doubt some of them are. A fair proportion, however, will be found to differ in construction from the females; and from the absence of the opercular plate and constant occurrence along with the females of *J. albifrons*, they may be taken with considerable certainty to be the males of that species.

They are not dilated, like the female, at the third segment, but have the body parallel-sided. The curvature of the pleon is laterally a little compressed, or in some specimens even slightly incurved; the apparatus of the underside of the pleon is divided down the centre. The plates meet but do not overlap; reaching nearly to the notch of the caudal margin, they form a flattened arch over it, ending on either side in a sharp produced point. There is no horizontal division of these plates as in *Jæra Nordmanni*; but a quasi-oval scale of the branchiæ is visible on each side. The lateral margins of this apparatus are fringed with very minute hairs, and have a sinuous outline curving outwards near the base and then inwards. The carpus of the leg has a considerable swelling at its distal end, surmounted by two short hairs or spines. This protuberance is not found in the female. Both sexes in both species have the margins of body and pleon set with hairs, not all of one length but alternately (or nearly so) long and short. *Jæra Nordmanni* is rather more setose than the other species.

EXPLANATION OF PLATES IV. & V.

- Fig. 1.* *Microdeuteropus bidentatus*; 1 *a*, first gnathopod; 1 *b*, second gnathopod.
Fig. 2. *Melita gladiosa* (female); 2 *a*, maxillipede; 2 *b*, first gnathopod; 2 *c*, second gnathopod; 2 *d*, pleon.
Fig. 3. Eyes of *Krøyeria arenaria*, seen from above.
Fig. 4. Pleon of *Lilljeborgia Normanni*.
Fig. 5. *Jæra albifrons* (male); 5 *a*, leg; 5 *b*, underside of pleon.
Fig. 6. Underside of pleon of *Jæra albifrons* (female); 6 *a*, leg.
Fig. 7. Underside of pleon of *Jæra Nordmanni*.

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Geological Survey of the North-western Territories of the United States of America.

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2. *Department of the Interior. Catalogue of the Publications of the U.S. Geological Survey of the Territories.* F. V. HAYDEN, Geologist-in-Charge. 8vo, 20 pages. Washington, 1874.
3. *Department of the Interior. Bulletin of the U.S. Geological and Geographical Survey of the Territories.* Nos. 2-4, Second Series. 8vo, pages 51-231; plates 7-18. Washington, June 10, 1875.
4. *Department of the Interior. U.S. Geological Survey of the Territories.* F. V. HAYDEN, U.S. Geologist-in-Charge. *Miscellaneous Publications.*—No. 1. *Lists of Elevations, principally in that Portion of the United States west of the Mississippi River.* 3rd Edition. Collated and arranged by HENRY GANNETT, M.E. 8vo, 74 pages. Washington, 1875.
5. *Department of the Interior. Report of the U.S. Geological Survey of the Territories.* F. V. HAYDEN, U.S. Geologist. Vol. VI. *Contributions to the Fossil Flora of the Western Territories.* Part I. *The Cretaceous Flora.* By LEO LESQUEREUX. 4to, 136 pages, 30 tinted lithograph plates. Washington, 1874.

THE U.S. Geological Survey of the Territories began in 1867 with an examination of part of the Territory of Nebraska, and with a grant of about 5000 dollars. Larger appropriations were made for this excellent work, from year to year (75,000 dollars in 1872), and the Survey was extended into the neighbouring Territories by more and more completely furnished corps of geographers, geologists, and naturalists. The publications of the Survey are Reports, Miscellaneous papers and books, and Bulletins in 8vo, and Palaeontological Contributions in 4to (of which eight volumes have been issued), also some 4to volumes of Sections, Sketches, &c., and several Maps.

The Annual Reports of the Geological Surveys carried on in the United States of America continue to prove most valuable expositions of the geographical, zoological, geological, and mineralogical conditions of the several States and Territories successively treated of; and they supply not only vast stores of facts, but carefully elaborated opinions and theories for the Biologist and Physicist. The really great scientific expeditions conducted by the United-States Geologist, Dr. F. V. Hayden, throughout Nebraska, round about the headwaters of the Missouri, the Yellowstone, the Snake, and the Kansas, together with the neighbouring portions of the Rocky Moun-

tains, have given us an insight into the structure and capabilities of one of the most wonderful parts of the mighty North-American continent. Here, before many years shall have passed, a great population (with their railroads leading from ocean to ocean, their wealth of gold and silver, their wealth of iron and fossil fuel, of fertile lands, forests, and pasturage, with their glorious mountains, rivers, lakes, and geysers) will be utilizing what the Indian passes almost unnoticed, and what the Surveyors, amidst obstacles and dangers, with skill and enthusiasm, have mapped and described with scientific accuracy. Nor are the Antiquities by any means neglected. See, for instance, Bulletin, 2nd ser. No. 1, for an account of the old towers and cliff-houses of S.W. Colorado, and Prof. Leidy's illustrated paper on the Remains of Primitive Art in the Bridger Basin of Southern Wyoming, and Dr. Thomas on the Ancient Mounds of Dakota, in the Report for 1872.

The Report of Progress in 1873 fully supports the character of the work done in former years, and digested in former volumes, giving excellent results for geographer, naturalist, and geologist, and supplying definite information as to the agricultural capabilities and the mineral resources of the districts examined. Owing to the distance of the Territory, and the hostility of the Indians in the unsurveyed lands adjacent to Montana, Idaho, Wyoming, and Utah, already reported on, the Survey operations were carried on in 1873 in the Middle-Park, South-Park, and San-Luis districts of Colorado and New Mexico, especially as this region is becoming rapidly developed by railroads and increased population. The ground had to be geographically surveyed by triangulation, which the more complete staff of 1873 efficiently carried out. The methods of topographical work are described in the Report (p. 6 &c. and p. 627 &c.); and the necessity of combining topographical observation with geological research is insisted on. Contoured maps are especially recommended as of use to the geologist. "He may note by his observations, and express by means of vertical sections, the arrangement of strata throughout a certain mountain, ridge, or range; and the contour given on the map will then greatly facilitate his work, by enabling him to define more correctly than in any other way the limits of the successive strata" (p. 7 & p. 12). Part IV. of the Report (pp. 627-684), treating of the geography and topography, supplies the elevations of many datum-points on the railways, great lakes, and rivers of the United States, and on the Rocky Mountains, with good maps, by Messrs. Gardner, Gannett, and Ladd; indeed, besides the heights, other points are treated of throughout by the geographers, such as means of communication, distribution of timber, grass-lands, and population.

The geologists of the Expedition, under Dr. Hayden, were Mr. Marvin, Dr. Peale, and Dr. Endlich, and their assistants. With the willing cooperation of the geographers, and of Messrs. Jackson and Holmes (talented artists and topographers), the Surveyors have worked out an extensive area of the great Nebraska formations and

their mountain-boundary, and, besides ordinary sections, have produced some of the best sketches of geological appearances and rock-scenery, and panoramic views exhibiting geological structure, that any Reports have given to the public.

"The mountains are composed of a great series of metamorphic schists, gneisses, and granites of pre-Silurian ('Archæan') age, with minor masses of eruptive rocks, all thrown into a complex system of folds, difficult to trace on account of the absence of permanent features in any one horizon." Silurian, Devonian (?), and Carboniferous strata are recognized in the San-Luis district. Magnificent inversions of Palæozoic and Mesozoic strata occur on the East River (plate xvii.), and in the Madison range (Report for 1872, p. 162). The unaltered strata of the great plains are all thrown up along the mountain-base, with folds and faults, their edges being exposed. The lowest are the Triassic, resting on the Archæan, succeeded by Jurassic, Cretaceous, and Lignitic (Upper Cretaceous or Eocene), with Post-tertiary lake-beds, gravels, and lavas. In "Middle Park," however, the Cretaceous seem to be the oldest of the Secondary strata, and rest directly on the Archæan; and there is observed in the district an unconformity "between the Cretaceous and Lignitic formations, proving that a small east and west anticlinal fold, which occurs along the Lower Grand River in the Park, was formed at the close of the Cretaceous, and before the more extended Rocky Mountains uplift; the inclination of probably Post-tertiary lake-beds, pointing to a comparatively recent slight continuation of this uplift."

Notes and *résumés* of these interesting formations of the N.W. Territories will be found in the 'Annals,' ser. 3, vol. xi. (1863), pp. 372, &c., and ser. iv. vol. vi. pp. 487, &c.

The mining-operations in the several localities concerned are described in their places in the Report; and the minerals, especially the Tellurium and Tellurides lately discovered at Gold Hill and Red Cloud, are treated of in the Appendix at p. 352 &c., and by Mr. Marvine and Prof. B. Silliman at pp. 685-691.

The special reports on Palæontology (pp. 365-536) comprise valuable memoirs by Professors Lesquereux and Cope. In Prof. Leo Lesquereux's memoir on the Lignitic formation of Colorado and its fossil Flora, the claims of these strata to be regarded as Eocene rather than Cretaceous are strongly advanced. The beds with *Scaphites*, *Inocerami*, &c., said to be found above, or in, the Lignitic series, are regarded by some as inverted strata (p. 368); but the continuance of some Cretaceous forms of life into the early Tertiary seas of America is regarded by Prof. Lesquereux as the real cause of the apparent anomaly.

In his memoir on the Cretaceous and Tertiary Vertebrata of Colorado and Dakota, Prof. E. D. Cope* indicates 149 species, 94 of which

* In the Report for 1872, Prof. Cope described, as new members of the Eocene fauna of Wyoming, about 45 species of Mammalia, 3 of Birds, 44 Reptiles, 1 Batrachian, and 26 Fishes.

are new. The Cretaceous groups of strata yielding them are:—
 1 (lowest). Dakota. 2. Benton, with *Hyposaurus* (Crocodile), *Apsohelix* and *Pelecoparis* (Fishes). 3. Niobara: Natatorial Birds, 2, and (?) *Saururæ*, 2; *Dinosauria*, 1; *Pterosauria*, 4; *Sauropterygia*, 3; *Testudinata*, 3; *Pythonomorpha*, 27; *Isospondyli*, 31; *Selachii*, 10.
 4. Pierre: Reptiles and Fishes in New Jersey, Mosasauroids in Colorado. 5. Fox Hills. The next group, Fort-Union or Lignitic, is "Transitional," having a Cretaceous fauna with a Tertiary flora. Bitter-Creek and Bear-River groups are regarded as of Tertiary age, some portions being as late as the Miocene. The Loup-River group, of Pliocene age, so rich in Equine remains, is also present. Seven good plates illustrate this portion of the Report.

From the Fort-Union group Prof Cope describes (p. 444 &c.):—

- Dinosaurs—*Agathaumas sylvestris*,
Hadrosaurus occidentalis,
Cionodon arctatus,
Polygonax mortuarius;
 Crocodile—*Botrosaurus perrugosus*;
 Testudinates—*Trionyx vagans*,
Plastomenus (?) punctulatus,
 — (?) *insignis*,
Adocus (?) lineolatus,
Compsemys victus, Leidy.

From the Eocene of Wyoming and Colorado, Prof. Cope describes as new:—

- Mammals—*Eobasileus (Loxolophodon) galeatus*,
Achenodon insolens,
Phenacodus primævus,
Orotherium index;
 Fishes—*Rhineaster pectinatus*,
Amyzon commune,
Clupea theta.

The Vertebrates of the Miocene strata (White-River group) occupy Chapter iv. p. 461. Their new Insectivora are:—*Herpetotherium*, 5; *Embassis*, 2; *Domnina* 3; *Isaxis*, 1.

Of the Rodentia:—*Eumys*, 1; *Sciurus*, 1; *Gymnoptychus*, 2; *Heliscomys*, 1; *Ischyromys*, 1; *Palæolagus*, 4.

Of the Perissodactyla:—*Symborodon*, 7; *Hyracodon*, 1; *Aceratherium*, 3; *Anchitherium*, 4.

Of the Artiodactyla:—*Orcodon*, 2; *Proëbrotherium*, 1; *Hypisodus*, 1; *Hypertragulus*, 2; *Leptomeryx*, 1; *Stibarus*, 1; *Pelonax*, 2.

Of Carnivora:—*Hyænodon*, 2; *Amphicyon*, 1; *Canis*, 4; *Bunæurus*, 1; *Daptophilus*, 1; *Hoplophoneus*, 1.

Of Quadrumana:—*Menotherium*, 1.

Testudinata, 5. Lacertilia, 7; Ophidia, 5.

In the Pliocene strata of the Loup-Fork epoch there are:—

- | | |
|--------------------|-----------------|
| Carnivora, 4, | Proboscidea, 1, |
| Perissodactyla, 8, | Testudinata, 1. |
| Artiodactyla, 7, | |

The Zoological Part III. of the Report (pp. 537-626) contains lists and papers by Lieut. W. L. Carpenter, Dr. A. S. Packard, Jun., C. R. Osten-Sacken, H. Ulke, and Dr. H. A. Hagen, on the *Lepidoptera*, *Diptera*, *Coleoptera*, and *Neuroptera* collected by the Expedition, with collateral Notes. Dr. Packard also describes the Myriopods, a Lernaean, and some Phyllopods; Mr. S. I. Smith the Amphipods; A. E. Verrill the Leeches; and W. G. Binney enumerates the Land-Shells. Twenty-four new species of Invertebrates are here described, with numerous illustrations.

In performing so great an amount of field-work, and publishing so freely and rapidly as they do, the Geological Surveyors of the Territories are quite aware of the probable imperfection of the conclusions arrived at, and the possible existence of mistakes. They well know the difficulty of assigning a fixed age to the Lignitic Group, for instance; and they know better than others the weakest spots in their Surveys; but by continued labours they will correct and improve, truth being their aim. Well does Dr. Hayden observe:—"Problems are arising, and will continue to arise, about which there will be difference of opinion among true men of science. We shall accept the verdict founded on the evidence as soon as it comes fairly before us, regardless of our preconceived opinions."

The elegant quarto monograph by Prof. L. Lesquereux on the Fossil Plants found in the "Dakota Group," chiefly of Nebraska and Kansas, and known to be low down in the Cretaceous series of North America, is of the greatest interest to geologists, and has been produced in a form worthy of the great national Survey under Dr. Hayden's charge. The fossil flora under notice presents a Tertiary *faucis*, characterized by numerous Dicotyledonous Angiosperms (110 to 20 others: Monocotyledones, 3; Gymnosperms, 8; Cryptogams 7).

Prof. Lesquereux has collated this flora with the illustrated fossil plants of Europe and elsewhere, described by Heer, Schimper, Debey, Dunker, Ettingshausen, Saporta, Marion, &c., especially with those of Gelinden in Belgium, referred by Dewalque to the Lowest Tertiary or "Paleocene" (preceding the Eocene, Oligocene, Miocene, and Pliocene) of Europe, which has the limestone of Mons at the base, succeeded by the Heersian (including the Gelinden beds), the Landenian, Ypresian, and Panislian stages.

Still wanting more material for exact comparison with known Cretaceous and Tertiary floras of other regions, and recognizing the probable isolation of these and other plant-bearing beds of the late Mesozoic and early Tertiary epochs in the American area, Prof. Lesquereux acknowledges the want of homogeneity, or successional connexion, of the fossil floræ in North America, up from these wonderfully interesting Cretaceous deposits of Nebraska and Colorado, as far as the Lower Miocene. In the mean time he has executed his task of describing and illustrating these fossils in a masterly manner, trusting to have added his share of knowledge as a recorder of facts.

Geology of British North America.

British North-American Boundary Commission. Report on the Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel, from the Lake of the Woods to the Rocky Mountains; with Lists of Plants and Animals collected, and Notes on the Fossils. By G. M. DAWSON, Assoc. R.S.M., F.G.S., Geologist and Botanist to the Commission. 8vo, 379 pages; with plates and woodcuts. Montreal, London, and New York. 1875.

Mr. Dawson, during the two seasons of arduous work on this Survey, devoted his attention chiefly to the geological structure of the country; but, with the aid of his colleagues, he got together a collection of Insects (described by Mr. S. H. Scudder, in Appendix D), of Unionidæ (described by Dr. P. P. Carpenter, in Appendix E), and Grasses, Mosses, &c. (described by Prof. Macoun and Mr. G. Barnston, in Appendix F). Dr. Elliott Coues, accompanying the United-States contingent of the Boundary Survey as Naturalist, has zoological reports in preparation.

The geological observations extend over 800 miles across the central region of the continent, hitherto geologically examined in some parts only, and for 300 miles in longitude not even geographically known previously. Thus Mr. Dawson has worked out some important links between what was known of the geology and fossils north of his line (from the labours of Richardson, Bigsby, Isbister, Hind, Hector, Owen, Keating, Meek, Heer, Selwyn, and Bell), and what was known of the geology of the U.S. Territories on the headwaters of the Missouri, Yellowstone, Kansas, &c. (from the Surveys for the Pacific Railways, the U.S. Surveyors, and other sources).

Laurentian, Huronian, Lower and Upper Silurian, and Devonian rocks are noticed in succession, going from the Lake of the Woods, through Manitoba; and the possible existence of Carboniferous rocks, under the prairies, but probably without good coal-seams, is adverted to. Permian and Triassic strata are wanting. The Cretaceous beds succeed, but rest on different bed-rocks in different localities. They are not yet known in detail here; but further south, in Upper Missouri, Meek and Hayden make them 26,000 feet thick. The Tertiary Lignitic beds succeed, as on the north and the south. These are famous for their stores of fossil fuel, for their abundant vertebrate remains, and for their interesting, but as yet not sufficiently disentangled, geological history. These, with the Cretaceous beds below them, reach to the borders of the Rocky Mountains; but a thick mantle of sands and clays, referable to the Glacial Period and to former great lakes, covers almost the entire surface of the enormous plains of which they are the substrata.

The capabilities of the country with regard to settlement are carefully considered, and the maintenance and planting of forests especially insisted on as indispensable.

Dr. J. W. Dawson, F.R.S., supplies Appendix A (with a Plate),

on the fossil plants from the Lignitic shales, and points out their "Miocene" characters, as compared with other fossil floræ of North America and Europe; but, seeing that Reptiles of Mesozoic types are associated with them, that *Baculites* and *Inocerami* occur also in the Lignitic series, and that a similar fossil flora occurs with "Cretaceous" marine animal remains in both Dakota and Vancouver, he declines to assign these transitional beds to a definite systematic period, unless it be Lower Eocene, when the "Cretaceous" fauna would thus seem to have persisted in the sea, whilst the land was becoming covered with a new flora. He enumerates:—*Filices*, 2; *Equisetaceæ*, 2; *Coniferæ*, 3; *Monocotyledones*, 4; *Dicotyledones*, 15. Several fossil woods examined by the microscope are also described and illustrated.

The fossil plants above mentioned came—some from "Porcupine Creek," agreeing with the "Fort-Union group" of Nebraska, and others from "Great Valley," more nearly corresponding with the "Green-River group." The shales of the first of these groups, at Milk River, yielded fragmentary remains of several Dinosaurs, Tortoises, and Gar-fishes, determined by Prof. Cope, in Appendix B, as *Cionodon stenopsis*, *Hydrosaurus?*, *Trionyx vagans?*, *Trionyx* sp.(?), *Plastomenus costatus*, *Pl. coalescens*, *Compsemys ogmuis*, *C.? victus*, *Clastes*, sp.

The Report has a good Index. It is well printed, and is illustrated throughout with numerous careful sections, mostly copied by "photo-engraving" from pen-and-ink sketches by the author.

Geology of Indiana.

Fifth Annual Report of the Geological Survey of Indiana, made during the year 1873, by E. T. Cox, State Geologist, assisted by Prof. JOHN COLLETT, Prof. W. W. BORDEN, and Dr. G. M. LEVETTE. 8vo, 494 pages, with maps, views, and sections. Indianapolis, 1874.

In continuation of former Reports (noticed in the 'Annals,' July 1873), Mr. E. T. Cox and his assistants present the results of their further surveys in Indiana. Rich in coal and iron, this region demands the attention of metallurgists, as the chief portion of the Report satisfactorily shows. Indeed in the interest of the American iron-workers, Reports, by Mr. Hartmann, on the Exhibition of coal and iron at the Universal Exposition at Vienna, on the Iron and Steel Industries of Rhenish Prussia and Westphalia, with a map, and on the manufacture of Spiegeleisen (pp. 5-101), precede the Geological Report of Indiana. This latter continues to give careful details of local geology, notices of all minerals and stones of commercial value, and of the manufactures and agricultural resources. The Antiquities, some of the most remarkable in the world, are not neglected; for frequent mention is made of the Mound-builders and of their shell-heaps, tools, and extensive works. At a bend of the Wabash River, in Posey County, an isolated bank, 35 feet high, overhangs the river, which has eaten it half away

within the memory of man, exposing the abundant bones, pottery, and other relics of the Archaic inhabitants. The pottery is described as peculiar, good for food-cooking, thin, and resisting fire to a wonderful extent; some of it will be illustrated next year. A remarkable group of stone fortifications and mounds on the Ohio, in Clarke County, is also delineated and described. The Caves in Lawrence County, with their blind fauna, also receive attention. The Tripoli found in pockets in the cherty limestone, forming the roof of the coal, in Dubois County, is described as siliceous particles of organic origin, probably due to Foraminifera and Sponges (p. 424). Near the base of the Coal-measures in Warren County, Mr. Collett discovered a slab of sandy mud-stone bearing casts of cracks and footprints; of these latter Mr. E. T. Cox gives a lithograph, of the natural size, with the name *Colletosaurus indianensis*. He notices that the bones of the *Amphibamus grandiceps*, Cope, were found in a similar geological horizon in Illinois.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 17, 1875.—Joseph Dalton Hooker, C.B., President, in the Chair.

“First Report of the Naturalist accompanying the Transit-of-Venus Expedition to Kerguelen’s Island in 1874.” (Conclusion.)
By the Rev. A. E. EATON.

In January 1875, shortly after the departure of the American Expedition from Royal Sound, an opportunity occurred of visiting another part of Kerguelen’s Island. To relieve the ennui of his officers and men, who by that time were thoroughly tired of being detained without any definite occupation in an uninhabited island, Captain Fairfax ordered the ‘Volage’ to leave Observatory Bay, and proceeded to Swain’s Bay, where he remained three weeks. During this period he entertained me as his guest, took me to the best localities in the bay for collecting, and rendered me every assistance that lay in his power. The Royal Society is therefore indebted to Captain Fairfax for a fine series of Algæ from Swain’s Bay, comprising many species not found in Observatory Bay, and some that were not known to be indigenous to the island. Most of these are described in the ‘Flora Antarctica’ as Falkland-Islands species. Captain Fairfax at the same time enabled me to secure the skeleton of a *Globiocephalus*, which was found dead in shallow water by Mr. Forrest (Mids.). Most of the epidermis had been removed by small crustacea, so that it was not possible to ascertain the colour of the animal; but Lieut. Goodridge, R.N., very kindly photographed the carcass before it was flensed, and its

dimensions were carefully taken by one of the boat'screw, and therefore it will be easily identified.

Young Sea-Elephants were frequently found by us in Swain's Bay. Some examples are uniformly reddish brown, others are pale, blotched and spotted with darker grey. They usually lie just above the beach, separately, in hollows among the *Acena* and *Azorella*, where they are sheltered from the wind. On being approached they make no attempt to move away (possibly because there are no land animals indigenous to the country capable of molesting them to cause them to acquire a habit of flight), but raise up the fore part of their body, open the mouth wide, and utter a peculiar slobbering cry. My mammalian specimens, unfortunately, are not so complete as they were when first procured, owing to the impossibility of preventing "liberty men" and others taking an interest in such "great curiosities" whilst the process of cleaning them was in progress. The removal of stones, purposely laid upon some of the bones, led to the loss of the fore limbs of seals, &c., which were blown away by the wind.

All of the birds, with the exception of two species (a *Procellaria* and a *Thalassidroma*), are represented in the Cape-town Museum.

Thalassidroma Wilsoni (Dr. Wyville Thomson, however, seems to consider the Kerguelen-Island bird to be another species) arrived in the Sound in great numbers a few days before the "Transit." Towards the end of January they commenced laying their eggs generally. By the second and third weeks of February the incubation of the eggs was usually far advanced; and a day or two before we left the island, Capt. Fairfax sent me a young bird recently hatched. The tarso-metatarsal joint is not elongated in the chick. I failed to find the eggs of *Thalassidroma melanogaster*; the birds occurred to me only in pairs.

It may be well to explain that Petrels sit in their holes in pairs until the egg is laid. Then usually only one bird is found at a time upon the nest until the young are hatched; and soon after they have issued from the egg the young are found alone during the day. For whilst incubation is in progress, the bird not upon the nest is either asleep in a siding or branch of the burrow or (more commonly) is spending the day at sea; and when the young are a day or two old, both of the parents absent themselves during the day, and only return at night for the purpose of feeding them.

Along the coast, outside Swain's Bay, a few examples of *Diomedea melanophrys*, a species not observed in Royal Sound, were noticed.

In the less frequented parts of the island some of the birds were unusually fearless and tame. Shags would submit to be stroked along the back without getting off their nests or attempting to peck the hand. More than once Sheathbills, and on one occasion a Skua, fed out of my hand. A Sheathbill, after pecking at my boots, ate in succession six eggs held out to it. But the Skua behaved in a still more extraordinary manner. On approaching within three hundred yards of the nest it was evident,

from the excitement of the old birds, that the young were hatched; and on searching for the nestlings, the old birds commenced their usual onslaught when within two hundred yards of the nest. Disregarding their outcries and fierce swooping down, I soon found the young ones crouching amongst the herbage some distance apart from one another and the nest (which they leave at an early age), and sat beside the nearest. The hen Skua immediately alighted within a yard of me and continued her vociferations, whilst the cock withdrew to the other nestling. On stroking her chick the hen became more excited than ever and advanced a little nearer. Taking a Prion's egg from my pocket and holding it out, her cries ceased whilst she eyed the egg, but recommenced when she again looked at me. She once more looked at the egg, became silent, waddled cautiously up and pecked gently at my finger, then, reassured, pecked the egg, which she very soon made an end of. In the same way she ate a young Prion killed for the purpose, and afterwards flew to the hole from whence the bird had been taken to see if it contained another; and upon my digging at some other holes, she came near and stood by in eager expectancy of further gratuities. With regard to her pecking first at the finger before the egg, I would observe that wild birds usually do this previous to feeding out of the hand. The Sheathbills did the same, and so do English birds which have never been in confinement. It seems to be their way of testing the nature of any strange-looking object.

The Sheathbill was plentiful in Swain's Bay, and a fair number of their eggs were procured. As Dr. Kidder, the American Naturalist, had not succeeded in finding any, I was anxious that he should have some; but did not consider myself at liberty to give him more than one, and that a damaged specimen almost in halves. The Royal Society will now be able to be more liberal.

A fine male example of a *Raia*, differing from the species previously found in Royal Sound, was shot by Mr. Budds, the chaplain of H.M.S. 'Volage,' two days before we sailed.

The *Agrostis* mentioned when I last wrote came into flower about the third week in January. It can scarcely be said to form a sward, or pasturage even, in the neighbourhoods visited by me. The *Limosella* was found in February in fruit and flower, very sparingly, in only one shallow lake between the Observatory and Mount Crozier.

I omitted to inform you that the Kerguelen-Island *Callitriche*, given in the 'Flora Antarctica' as *C. verna* var. *terrestris*, should (I think) be regarded as a form of *C. pedunculata* rather than of *C. verna*. It has no bracts, and seems to exhibit other peculiarities of *C. pedunculata*. Prof. Wyville Thomson alludes to it as *C. verna*; but probably he adopted the name from the 'Flora' without suspicion, unless, indeed (which is unlikely), both species occur on the island. For the satisfaction of other botanists I have brought back specimens of the plants in spirits, showing flower and fruit, as well as dried examples.

The fern, which was new to me, according to Lady Barkly, may be a form of *Polypodium (Grammitis) australe*.

In the following particulars I am sorry to have occasion to report failure.

The moss-eating Lepidopterous larvæ all died before our arrival at the Cape.

All the larger Algæ collected were spoilt. One suite of dried examples was lost, through the box in which they were contained being placed open, in the rain, by one of the servants a few days before we sailed, without my knowing it had been moved from its place. The second set, gathered the day before we left the island, was sent on board the 'Supply,' with directions that the box should be placed in an accessible position: unfortunately the message miscarried, the box was stowed away in the hold, and I could not get at it until a fortnight afterwards, when almost the whole of its contents were completely decomposed.

Again, series of examples of some of the flowering plants were lost through the difficulty of attending to them when collected.

I left Kerguelen's Island in H.M.S. 'Supply' on the 27th February, arrived at Simon's Bay on the 31st March, and at Gravesend on the evening of the 7th May. In the course of the voyage I collected a few animals and Algæ with the towing-net.

MISCELLANEOUS.

On Hemisepius, a new Genus of the Family Sepiidae, with some Remarks on the Species of the Genus Sepia in general. By M. J. STEENSTRUP.

IN the memoir of which this is a summary I give, first, a short sketch of the history of the genus *Sepia* from the time of Linné, remarking that this genus, as limited by Lamarck in 1798, has since preserved the same signification, although the number of its species has been much augmented: instead of two species only, which it comprised in the time of Lamarck, it now includes more than thirty, of which a third, it is true, are only known by their test (*sepium*).

The *Sepiæ* are rightly considered littoral animals; and we find them on the coasts of nearly every sea, although the two coasts of America have hitherto furnished very few species. Thinking that I could establish that the littoral species of the Cephalopoda have not generally an extensive geographical distribution, or at least not so extensive as the oceanic or pelagic forms, I have naturally been led to suppose that the genus *Sepia* ought to include a considerable number of unknown species, and I indicate some new ones in my memoir; but beyond new species it ought no doubt to have also other forms still more modified, which might be placed by the side of the genus *Sepia* as distinct genera; and of this I give evidence in this memoir, the principal object of which is to make known to

zoologists a little sepian which Captain Andrea has brought me from Table Bay, at the Cape of Good Hope, and which I now publish as a distinct genus, under the name of *Hemisepius typicus*. Bearing in mind, on the one hand, the common characters which all known species of *Sepiæ* present, as well as the modifications that these characters often undergo according to the species, and, on the other hand, the differences due to sex, age, and season, that a long study of the Cephalopoda* has enabled me to demonstrate in individuals of the same species, I establish provisionally, until the discovery of new forms, the three following characters for my *Hemisepius*, considered as a genus.

Hemisepius, which in other respects completely resembles a *Sepia*, has (1) a mantle which bears on its ventral surface deep pores, which in the *H. typicus* are disposed in two rows of twelve pores each, one on each side; these pores are situated in little nipples, and united with one another by a little longitudinal groove; (2) a test which is only half-developed (whence its name); the very rudimentary calcareous partitions do not cover the anterior portion of the dorsal plate, and their anterior margin is not parallel to the corresponding margin of that excessively thin plate; (3) on the eight arms only two rows of suckers, which differ besides from those of the true *Sepiæ* by their much depressed and nearly discoidal form. Even without the presence of the pores on the lower surface of the mantle, either of the two latter characters, if we consider the generality of the known species of the genus *Sepia*, would have sufficed to induce the establishment of a new genus; but as similar pores, so far as I know, are only found in the genus *Sepioidea*, and are there accompanied by characters which render its separation from the genus *Sepiola* quite natural, I have thought that I ought to attach all the more importance to their appearance in *Hemisepius*.

The individual put at my disposal being small (it only measures 53 millimetres long), it was important to get rid of any idea that the animal in growing might lose the characters which distinguish it from all the known *Sepiæ*, as to the feeble development of its test and the peculiar form of its suckers &c. I therefore show that this individual, which is a female and would perhaps have grown larger, may be regarded as adult. In fact, not only is it fit for reproduction, but it has already received spermatophores in the very peculiar situation where they are fixed on all the *Sepiæ*, the *Sepioteuthes*, and the *Loligines*, as I showed for these three genera, eighteen years ago, in my memoir on the hectocotylyzed arms of the male Cephalopoda in general. I reproduce here the following passage relating to these remarkable characters, which have been far too much neglected up to the present time by the naturalists of some countries:—

“The right of employing, as we have done here, the hectocotylyzed arm as the check of a natural grouping of the Cephalopoda, resides

* These differences between individuals of the same species have generally passed unrecognized; and from this a deplorable confusion in the determination of the species and genera and even of the families has often resulted.

in its importance for reproduction in general. It is evident that this peculiar structure, sometimes of one pair of arms, sometimes of another, sometimes to the right, sometimes to the left, sometimes at the summit, sometimes at the base, &c., must involve many differences in the mode of fixation of the spermatc masses or spermatophores on the females, and (inasmuch as the semen does not seem to be poured upon the eggs by involuntary or mechanical, but by conscious movements) in the manner in which fecundation is effected. What simple reflection tells us on this subject is equally confirmed by observation. The spermatc masses are in reality fixed on very different places and in very different conditions, a thing which I shall explain in another memoir of which I here give only the general conclusion—namely, that the genera *Sepia*, *Sepioteuthis*, and *Loligo* (consequently all those in which I have found the left ventral arm hectocotylyzed) fix the spermatc masses on the internal surface of the buccal membrane of the females, which is specially organized for that purpose; whilst in the other Decapoda I have never found the sperm fixed in that place, but in various points of the mantle or of the interior organs, in *Ommatostrephes* for example, far back in the cavity of the mantle, towards the middle part of the back”*.

Lastly, I show in my memoir how the application of these spermatc bodies, on such extraordinary points, is effected in reality, in the families of the Sepians and the Loliginians, by means of figures representing types of the principal groups of the Sepias. One of these figures represents the buccal part of *Sepia hierredda*, a species closely allied to *Sepia officinalis*, and which might pass for a type of the Sepias with a very strongly developed test, terminating behind in the form of a beak; another the corresponding part of *Sepia inermis*, which, as a contrast, furnishes a good type of the Sepias with the test very feebly developed and not produced behind. Lastly, *Sepioteuthis sepioidea* is the representative of the great group of the Loliginians. In all these cephalopods the spermatc masses in their cylindrical sacs are always fixed to the internal surface of the buccal membrane. I have found this arrangement in many species of these three genera, with only slight modifications in the different species and different individuals of the same species.

Although these characters are of very great importance in the determination of the sex and age of the Cephalopoda, no very clear idea is generally entertained of them. It has even been denied, of late years, that the male Sepias observed in the aquarium had hectocotylyzed arms, although it is so easy to prove this conformation of the arms in all male individuals; and after this it is not astonishing that we should have had to wait so long for the recognition of the corresponding character on the buccal membrane of the females, although Sepias exist now in many aquariums.

To the figures just mentioned I have added the representation of

* ‘Mémoires de l’Académie Royale Danoise des Sciences,’ 5th series, vol. iv. p. 213, with two plates (translated in ‘Wiegmann’s Archiv’ for 1857, p. 211, and in Ann. & Mag. Nat. Hist. ser. 2, vol. xx. p. 81, with two plates).

the buccal parts of the female of *Sepia tuberculata* of the Cape, because it presented the following peculiarity: the male had fixed the whole mass of the spermatophores on the external surface of the buccal membrane—a thing which I have never seen in any other *Sepia*, although I have sometimes observed that a few spermatophores had separated from the others and fixed on the external surface, nay, even near the base of the arms. How far is this arrangement entirely accidental in *S. tuberculata*? This I cannot decide, as I have examined only one individual; at any rate the observation in question is not without interest relatively to *Hemisepius*, for in that species the spermatophores are fixed on the part of the lip which usually fulfils this office in the Sepians and the Loliginians; but some are found, nevertheless, on the margin of the lip, and even on the external surface. The preceding will suffice, I think, to show that in the actual state of our knowledge our example of *Hemisepius*, although small, ought not to be regarded as a young and undeveloped individual, but as an adult.

To facilitate the comparison of the characters of *Hemisepius* and the Sepias the two plates which accompany this memoir contain many details hitherto unknown. It will be seen, for example, that in the species which seems to me to be the *Sepia tuberculata*, Lamk., there are eight rows of suckers at the extremity of the eight arms, instead of four or two,—that a new species from Japan (*S. Andreana*) has the arms of the second pair elongated in an extraordinary manner, doubtless to fulfil some particular function,—and that there are even some Sepias which have the lobes of their buccal membrane provided with suckers, like the greater part of the Loliginians, for example the *Sepia aculeata*, v. Hass.—*Comptes Rendus*, October 4, 1875, p. 567.

On the Ichthyological Fauna of the Island of St. Paul.

By M. H. E. SAUVAGE.

The study of the distribution of living creatures on the surface of the globe has acquired great importance of late years, and more than ever we are now-a-days interested in botanical and zoological geography. It is only by the knowledge of the distribution of organisms that we shall succeed in understanding how the forms are grouped which sometimes give so peculiar a physiognomy to a country—that we shall arrive, no doubt, at a knowledge of the migrations of these creatures, and how they have radiated from their centres of origin.

As may be easily understood, isolated islands possess the greatest interest from this point of view. Their flora and fauna have, in fact, remained what they were from the first; and the variations, if variations have taken place, must have been confined within narrow limits, not exceeding what they may be in the type. Undoubtedly the study of the terrestrial and fluviatile animals is most instructive from this point of view; but that of the marine animals nevertheless possesses great interest.

The island of St. Paul, lost in the Indian Ocean, must possess

special interest ; and therefore we have carefully investigated the few representatives of the ichthyological fauna of that island, for which science has to thank the researches of the expeditions of the 'Novara' and of the commission of the transit of Venus. Although it is only known by a very small number of species (ten), this fauna has led us to some results to which we beg the Academy to attend for a few moments*.

In consequence of the geological structure of the island, the species found at St. Paul have a very limited geographical extension ; but the study of the species is for this reason only the more instructive.

Of the species collected at St. Paul, only three have been met with in other regions ; and two others of them have been captured in the open sea.

Acanthias vulgaris is a shark of very wide geographical distribution, the species having been indicated in the Channel, the Atlantic Ocean, and the Mediterranean, at the Mauritius, and at the Cape. The types of *Latris hecateia* and *Nemadactylus concinnus* were found at Van Diemen's Land by Richardson. The other species belong to the genera *Serranus*, *Bovichthys*, *Sebastes*, *Mendosoma*, *Labrichthys*, and *Motella*.

The *Serranus*, named by Kner *S. novemcinctus*, belongs to the group of *Serranus scriba*, which must have passed into the Mediterranean during the Tertiary epoch, when that sea communicated with the Red Sea.

At the same epoch the type of the *Sebastes* of the Indian Ocean, the European representative of which is *Sebastes (Sebastichthys) dactylopterus*, emigrated towards the Mediterranean. It is to this group of *Sebastichthys* that the *Sebastes* of St. Paul, which we regard as a new species, belongs. Allied to the *Sebastes percoides* of New Zealand, Van Diemen's Land, and South Australia, the *Sebastes Mouchezi* differs therefrom by the narrower space between the eyes, the longer muzzle, the narrower palatine band, the smaller backward prolongation of the maxillary, the black tongue, the shorter dorsal and anal spines, and the uniform tint of the body.

It is with the species of the south of Australia (that is to say, with those that we find almost under the same parallel) that the fishes of the island of St. Paul present the most relationships. We have mentioned *Latris hecateia* and *Nemadactylus concinnus*, and described *Sebastes Mouchezi*, allied to *S. percoides* ; we can further cite two species of *Labrichthys* representing South-Australian species.

One of these, *Labrichthys Lantzii*, n. sp., belongs to the group which includes species of which the cheeks and the base of the dorsals are garnished with several rows of scales. Our species differs from those resembling it by the presence of a posterior canine tooth, several series of teeth in the jaws ; the body of a light mahogany colour, tinged with violet on each scale, a violet line uniting the

* The Museum of Natural History has received the fishes of the island of St. Paul, through the care of MM. de l'Isle and Velain.

eyes by passing below the mouth, and a line of the same colour running from the mouth to the thorax; the dorsals of the same colour as the body, but tinged with brown and red, and adorned with three violet bands; a black spot between the first two spines of the dorsal; anal yellowish, violet at the extremity.

The other species, *Labrichthys isleanus*, n. sp., belongs to a group the species of which have only two series of scales on the cheek. As in the preceding species, we observe a posterior canine tooth and small successional teeth in the jaws. The body, of a red-lead colour, orange on the belly, is traversed by longitudinal lines of a darker tint. A black spot is observed between the first two spines of the dorsal, another spot of the same colour between the penultimate pair of rays of the soft fin, and a third spot at the posterior and superior part of the pedicle of the caudal.

The genus *Mendosoma* was only represented by a single Chilian species (*Mendosoma lineatum*) when Kner met with the genus at St. Paul (*M. elongatum*).

As to *Bovichthys psychrolutes*, Günth., the species belongs to a group bearing the seal of the genera characteristic of cold regions. This is also the case with *Motella capensis*, Kaup, a form essentially characteristic of the colder parts of the southern Atlantic hemisphere.—*Comptes Rendus*, November 22, 1875, p. 987.

On a gigantic Stridulating Spider. By JAMES WOOD-MASON.

Mr. Wood-Mason exhibited specimens of a gigantic spider belonging to the genus *Mygale*, which had the power of emitting a loud stridulating sound, and stated that that interesting discovery had been made by Mr. S. E. Peal of Sibságar, Assam, who, at his request, had drawn up a most graphic account of his observations on the living animal. Mr. Mason had himself undertaken to ascertain the position and to describe the structure of the sound-producing apparatus, which he had found to consist of a *comb*, composed of a number of highly elastic and indurated chitinous rods, situated on the inner face of the so-called *maxille*, and of a *scraper*, formed by an irregular row of sharp spines on the outer surface of the *chelicere*. This apparatus was equally well developed in both sexes, as in most Coleopterous insects, and was not confined to the males as in the Orthoptera, Homoptera, and the stridulating spiders (*Theridion*) observed by Westring, in all of which the exclusive purpose of the sounds emitted seemed to be to charm or call the opposite sex.

In conclusion, Mr. Mason discussed the probable purposes of the sounds emitted, and pointed out how the *Mygale stridulans*, as he proposed to call the species observed by Mr. Peal, differed from its nearest ally *M. javanensis*, in which no stridulating organs were developed. A full account will shortly be published in the Society's Journal.—*Proc. As. Soc. Bengal*, November 1875.

*On the Mechanism and Causes of the Changes of Colour in the
Chameleon.* By M. P. BERT.

The observations and experiments which are developed in the memoir that I have the honour to lay before the Academy may be summed up in the following propositions:—

1. There exist, in the skin of the chameleon, contractile corpuscles of different colours, which are sometimes hidden in the depths of the dermis and sometimes spread out at the surface in innumerable ramifications, interlacing from one corpuscle to another (Milne-Edwards, Brucke, G. Pouchet).

We also find in it a superficial yellow pigment and a *cærulescent layer* (G. Pouchet), yellow by transmitted light, blue on an absorbent ground.

2. The section of a mixed nerve has the result of giving to the whole of the cutaneous region that it innervates a dark blackish tint; its excitation causes the same region to acquire first a green, then a yellow tint.

This is the case also with a fragment of skin separated from the body and then excited by electricity (Brucke).

3. The section and the excitation of the spinal marrow produce the same effects in the whole posterior region of the body.

When the section is effected in the cervical region, the head and the anterior part of the body are also blackened. The nerves which run to the coloured corpuscles of these regions originate between the third and the sixth dorsal vertebrae; they follow the great sympathetic nerve of the neck.

4. After the section of the medulla the energetic excitation of a mixed nerve induces, by reflex action, a slight lightening of the skin, especially on the corresponding side.

5. Semisection of the spinal marrow causes the blackening of the corresponding side.

6. After the ablation of the two cerebral hemispheres the animal no longer spontaneously changes colour, but it changes as before when it is excited. The same result follows the removal of the optic tubercles, the cerebellum, or the commissure.

But if the *medulla oblongata* be cut transversely beyond the fourth ventricle, the whole body becomes black, and no longer changes colour.

7. During sleep and anæsthesia, and after death, the whole body becomes yellowish white.

8. After the ablation of one cerebral hemisphere (an ablation the consequence of which is the loss of the opposite eye), the corresponding side changes colour much more rapidly than the opposite side; moreover, it remains always of a much darker tint. The ablation of the sound eye does not restore the equilibrium.

After the ablation of one eye the corresponding side remains much

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lighter than that upon which the animal can see; the ablation of both eyes restores the equilibrium.

9. Curare does not act upon the colorator nerves, the excitation of which induces the light tint when the motor nerves no longer produce muscular contraction; eserine (physostigmine), on the contrary, acts first upon the colorator nerves.

10. Light gives a dark tint to the portions of the skin that it strikes (C. Perrault, Vrolik, Brucke). This action, which is exceedingly distinct during sleep, during anæsthesia, and after death, is very manifest even during the waking state. It takes place through dark blue glass, but not through red and yellow glasses.

Conclusions.—From the whole of these facts the following conclusions may be drawn:—

a. The various colours and tints that chameleons assume are due to the change of position of the coloured corpuscles, which, according as they bury themselves under the dermis, or form an opaque ground beneath the cærulescent layer, or spread out in superficial ramifications, either leave the skin its yellow colour or give it green and black colours.

b. The movements of these corpuscles are governed by two kinds of nerves, some of which cause them to travel from the depths towards the surface, while the others produce the opposite effect. In the state of maximum excitation these corpuscles conceal themselves beneath the dermis; this is also the case in the state of complete repose (sleep, anæsthesia, death).

c. The nerves which cause the corpuscles to flow back beneath the dermis have the greatest analogies with the vaso-constrictor nerves.

Like these, in fact, they follow the mixed nerves of the limbs and the great sympathetic of the neck; like them they do not intercross in the spinal marrow; like them they have their origin for the head at the commencement of the dorsal region; like them they possess a very powerful reflex centre in the *medulla oblongata*, the entire spinal marrow being another much less energetic centre; like them they are not affected by curare and poisoned by eserine.

d. The nerves which bring the corpuscles towards the surface are comparable to the vaso-dilatator nerves; but although we are forced to assume their existence, it is difficult to say any thing very distinct as to their anatomical distribution and their relations to the nervous centres; it is very probable that they traverse nervous cells before passing to the colouring corpuscles.

e. Each cerebral hemisphere, by the intermediation of the reflex centres, governs the colorator nerves of both sides of the body; but it acts principally upon the nerves analogous to the vaso-constrictors of its own side, and on the nerves analogous to the vaso-dilatators of the opposite side.

In the regular condition of things each hemisphere comes into play (besides the excitations arising by general sensibility) under

the influence of excitations coming through the eye of the opposite side.

f. The luminous rays belonging to the blue-violet region of the spectrum act directly upon the contractile matter of the corpuscles, causing them to move and to approach the surface of the skin.

I think I am justified in expressing the hope that these investigations will at last throw some light upon the history of the vasodilator nerves, of which so little is known; they will also serve me as a starting point for studying the action that light must exercise upon the contractile substance under other circumstances, and particularly upon the sanguiferous capillaries of the human skin.—*Comptes Rendus*, November 22, 1875, p. 938.

On the Anatomy and Histology of Lucernaria.

By M. A. DE KOROTNEFF.

During the summer of the present year I occupied myself with the anatomical and histological investigation of *Lucernaria octoradiata* in the laboratory of M. de Lacaze-Duthiers at Roscoff. The abundance of the animal and the perfect arrangement of the laboratory enabled me quickly to arrive at the results which I now communicate to the Academy.

The walls of the body consist of four layers:—1, the ectoderm, covered by a cuticle; 2, the gelatinous layer; 3, the elastic membrane; 4, the entoderm. At the bottom of the ectoderm, as well as in the entoderm, there are cells which become transformed into nematocysts or into glandular cells. The gelatinous layer and the *membrana propria* are traversed by elastic fibrils, which are prolongations of the entodermic cells. Two kinds of muscles occur in the *Lucernaria*, longitudinal and circular; the latter always form an exterior layer. The longitudinal muscles are represented by four trunks, which commence at the bottom of the foot. Halfway up the body of the animal each trunk divides into two rods; and each rod enters into a bundle of tentacles. A layer of longitudinal muscular fibres occurs in the walls of the peristome and of the buccal tube. The circular muscles exist (1) round the mouth, (2) along the margins of the body, and (3) in the tentacles. Each fibre is a simple cell, containing a very refractive fibril. The cells may unite by prolongations and develop a single fibril, which traverses a whole series of cells. The fibril grows at the expense of the cell itself; the protoplasm of the latter disappears almost entirely, and the nucleus is enclosed in the fibrous mass. The peristome on its outer surface is clothed with well-developed muscular cells; these cells at the same time separate a perforated cuticle; the presence of the latter proves that it is a layer of a muscular epithelium.

With regard to the nervous system of the Hydraria there are many suppositions, but nothing is positively known. Kleinenberg, without much reason, attributes a nervous character to the cells of

the muscular epithelium. Schultze regards the threads (*cnidocils*) of the urticating organs as organs of touch. The study of *Lucernaria* has enabled me to extend Schultze's observations: the heads of the tentacles of the animal in question are covered with nematocysts (urticating organs). Each nematocyst is placed in a cell, which bears a thread. This cell is produced into a long fibril, which traverses another bipolar or multipolar cell. The fibril in question terminates by a small peduncle, which penetrates into the *membrana propria*. The multipolar cell may be regarded as a nervous cell. The analogy with the tactile organs of the Arthropoda is complete. Between these tactile organs there are long glandular cells filled with a mucous substance, which enables the *Lucernaria* to attach itself by its tentacles.

The digestive cavity contains a stomach and four wide radial canals; the walls of this cavity are clothed with a layer of entodermic cells, which are ciliated on the peristome and simple on the outer walls of the body. Among the entodermic elements there are unicellular flask-shaped glands, which secrete a digestive fluid. The surface of the cavity above mentioned is increased by mesenteric filaments. One side of each filament is formed by glandular cells, whilst the other is ciliated. I suppose that the ciliated cells serve to produce a circulation in the cavity, and the simple entodermic cells absorb the nutritive liquid.

The sexual elements are developed in special capsules of entodermic origin. Each capsule is composed of the entoderm and of an elastic membrane (*membrana propria*); the interior of the capsule is filled with ovigenous cells; the young ovum has a large germinal vesicle, which disappears as it enlarges. The developed ovum is surrounded by a strong membrane with a large micropyle. The mature capsule is furnished, near its base, with a duct, which serves for the issue of the sexual products; this duct is closed, which is due to the elasticity of the *membrana propria*. The pressure of the mature ova from the interior opens the duct; a few ova issue, and the duct closes again.—*Comptes Rendus*, November 8, 1875, p. 827.

Instinct(?) in Hermit Crabs. By ALEXANDER AGASSIZ.

While tracing the development of one of our species of hermit crabs I raised from very young stages a number of specimens till they reached the size when they need the protection of a shell for their further development. I was, of course, curious to see how they would act when first supplied with the necessary shells. For this purpose, a number of shells, some of them empty, others with the animal living, were placed in the glass dish with the young crabs. Scarcely had the shells reached the bottom before the crabs made a rush for the shells, turned them round and round, carefully examining them, invariably at the mouth; and soon a couple of the crabs decided to venture in, which they did with remarkable alacrity; and

after stretching backward and forward, they settled down into their shells with immense satisfaction. The crabs who were so unfortunate as to obtain for their share living shells, remained riding round upon the mouth of their future dwelling, and on the death of the mollusk, which generally occurred soon after in captivity, commenced at once to tear out the animal, and having eaten him, proceeded to take his place within the shell.

It is, of course, very difficult to apply to Invertebrates many of the laws of natural selection; and thus far we know so little of the habits of most of our marine animals, that it is idle to speculate upon the effect of causes which may effectually modify the life of higher animals. In the case above mentioned, there is no possible connexion between the embryo and the parent to account for the young having learned from the former the use of the shell and its value for his existence. We can therefore only explain the faculty of performing this act as inherited, or else as a simple mechanical act rendered necessary by the conditions of the young hermit crab. The latter seems the more probable case from the nature of the test of the hermit crab in its younger stages. While the young hermit crab, soon after leaving the egg, is still provided with its powerful temporary swimming-feet, and while the feet of the adult can only be traced as mere rudiments behind them, the whole test of the cephalothorax and abdomen (which are symmetrical) is of considerable consistency up to the last moults preceding the stage when it seeks a shell. At that time the young are no longer symmetrical, the feet, which are now fully developed, being largest on the right side, and the abdomen beginning to curve in the same direction away from the longitudinal axis. When the moult has taken place which brings them to the stage at which they need a shell, we find important changes in the two hind pairs of feet, now changed to shorter feet capable of propelling the crab in and out of the shell; we find also that all the abdominal appendages except those of the last joint are lost: but the great distinction between this stage and the one preceding it is the curling of the abdomen; its rings, so distinctly marked in the previous stages, are quite indistinct, and the test covering it is reduced to a mere film, so that the whole abdomen becomes of course very sensitive. It is therefore natural that the young crab should seek some shelter for this exposed portion of his body; and, from what I have observed, any cavity will answer the purpose—one of the young crabs having established himself most comfortably in the anterior part of the cast skin of a small isopod, which seemed to satisfy him as well as a shell, there being several empty shells at his disposal. This mechanical explanation still leaves unanswered the eagerness with which the crabs rushed for the shells, their careful examination of the openings, their taking the animal out and occupying its place—all acts which seem to require considerable intelligence (?) and to show remarkable forethought (?).—*Silliman's American Journal*, October 1875.

Newport, August 23, 1875.

On the Organization of the Acarina of the Family Gamasidæ—Characters which prove that they constitute a natural Transition between the Hexapod Insects and the Arachnida. By M. MÉGNIN.

In our opinion the type of the family Gamasidæ is the genus *Uropoda* and not *Gamasus**, because it is the *Uropodæ* that present the most perfect organization, most nearly approaching that of insects and even of the highest insects. This goes so far that we might perfectly well maintain that they are true Hexapoda, seeing that the feet of the first pair form an integral part of the organs of the mouth, and constitute true labial palpi by the union of the coxæ of this pair with the mentum, which forms a true labium, and by their insertion within the margins of the buccal cavity.

This organization of the *Uropodæ*, so much resembling that of certain suctorial insects, falls off gradually when we pass to the genera *Gamasus*, *Dermanyssus*, and *Pteroptus*, to acquire that which principally characterizes the Arachnida—that is to say, to become plainly octopod; thus the feet of the first pair, which still fulfil the functions of palpi, and differ from the rest in the form of the tarsus in the *Gamasi* and *Dermanyssii*, in which the coxæ are separated from the mentum, become like the rest in form and attachment in the *Pteropti*, and are then exclusively organs of progression.

It is not only by the form and functions of the first pair of feet that the Gamasidæ depart from all the other Arachnida, but also by the number and form of the parts of the rostrum, the composition of which much resembles that of the Hymenoptera. As in the latter, the maxillæ concur to form a tube sheathing the ligula; this tube is completed superiorly by an advanced *labium*, which does not exist in the Arachnida; and the complete tube, with the organs it contains, forms a true trunk, shorter than in the Hymenoptera, but movable as in those insects, and containing nearly the same elements. The principal difference consists in the position and form of the mandibles, which, instead of being short, robust, and attached in front of the trunk as in the Hymenoptera, are in the form of rods terminated by a chela, or of styles sliding in the interior of the rostral tube and moving independently of each other; they thus remind us in form of the mandibles in the Hemiptera, in some Diptera, and especially in the fleas. It may be added that we find as accessory parts of the rostrum, besides the large pair of maxillary palpi common to all insects and all Arachnida, a second pair of small cultriform maxillary palpi, of two joints, of which only the terminal one is free and movable, resembling those of the Cicindelidæ and Carabidæ, or, better still, the *galea* of the Orthoptera—secondary palpi which are not met with in any arachnid of other families.

The Gamasidæ also possess an independent, movable and setiferous mentum, such as is not presented by any other Acarian family,

* See a previous note on this subject, *Comptes Rendus*, May 31, 1875.

and which has no resemblance to the sternal lip of the larger Arachnida.

These generalities upon the anatomy of the Gamasidæ show how much justification we had to regard this family as the first in the order Acarina, and as establishing the transition between the class Arachnida and that of insects.—*Comptes Rendus*, December 6, 1875, p. 1135.

On the Presence in existing Seas of a Type of Sarcodaria of the Secondary Formations. By M. P. FISCHER.

Thirty years ago Quenstedt noticed*, under the name of *Dendrina*, some excavations of unknown origin observed by him in the most superficial layers of the *Belemnitellæ* of the Chalk. These were so imperfectly defined that the German author questioned whether they were not due to a morbid alteration of the test of the *Belemnitellæ*.

The *Dendrinæ* of Quenstedt remained long comparatively unknown. Morris approximated them to the *Talpinæ*, which I regard provisionally as perforations of fossil Bryozoa or Hydrozoa; Pietet and other palæontologists attributed them (I do not know why) to Annelids; Etallon established a distinct order for these excavations, and thought he could describe several species of *Dendrina* from the Jurassic formations, species characterized solely by the general form of the perforations.

By examining the *Dendrinæ* of the test of *Belemnitella*, I ascertained, by means of solution of carmine, that there existed a manifest osculum at which each *Dendrina* opened, and that these oscula were not without resemblance to the efferent orifices or proctides of the sponges of the genus *Cliona*. It was therefore probable that the *Dendrinæ* were related to the sponges.

An unexpected discovery has just furnished fresh materials for the elucidation of this question. Shells dredged at a depth of 25–90 fathoms in the Bay of Biscay showed perforations of existing animals which I could not but regard as allied to those described in the fossil state by Quenstedt. Soon afterwards the same fact recurred in shells from the Mediterranean and the Indian Seas, and I acquired the certainty that the *Dendrinæ* still exist in nearly all the seas of the globe, and that they present the same characters and have the same perforating habits as those which riddled the fossil shells of the Secondary formations with their perforations.

If we examine with a lens the outer surface of some coloured shells (*Pecten*, for example), small, opaque, irregular, lobulated whitish spots may be observed; these are *Dendrinæ*. A rounded orifice terminates a tolerably wide oblique canal, and forms a communication between the exterior and the cavity of the perforating animal. The orifice is single, and resembles the large oscula or efferent apertures of the *Clionæ*; the lobules also are probably in

* Petrefactenkunde Deutschl. Cephal. Taf. xxx. fig. 36.

communication with the ambient liquids by exceedingly delicate canals starting from their periphery, a certain number of which open at the surface of the perforated shells. On this hypothesis these canals would represent the afferent apertures of the *Clionæ*.

In thin plates of shells the perforations of the *Dendrinæ* are seen to be composed of more or less numerous irregularly branched vacuoles, which are inflated here and there, but retain throughout a pretty wide diameter. The youngest are ovoid or lageniform.

Although the size of the *Dendrinæ* is variable, it is rare for an individual from the French coast (*Dendrina europæa*, Fisch.) to attain 0·8 millim.; generally the maximum diameter is 0·6–0·7 millim. The large osculum measures 0·07 millim., and the lobules vary between 0·06 and 0·08 millim. in diameter. I have counted from 60 to 80 individuals of *Dendrina* upon a surface of 1 square centimetre of the shell of *Pecten opercularis*.

When a *Dendrina* is highly magnified, a quantity of minute canals are seen to start from the periphery of the lobules and penetrate the perforated shell in all directions. These canaliculi are cylindrical, rectilinear, slightly dilated near their point of emergence, truncated at their extremities. Sometimes some are a little wider than the others, or slightly curved. Each canaliculus seems to have a distinct origin; there are no anastomoses or bifurcations; the interior is filled with a brownish organic material. Their length is from 0·03 to 0·06 millim., and their diameter from 0·0010 to 0·0015 millim. It may be supposed that sarcodic processes more or less analogous to the pseudopodia of the Rhizopods pass into these canaliculi.

I have been unable to ascertain the existence of spicules in the interior of the *Dendrinæ*, even with a power of 500 diameters. We see no trace of the siliceous plates or corpuscles which consolidate the surface of the *Clionæ* and *Rhoosæ*.

The *Dendrinæ* cannot be confounded with young *Clionæ*. The latter have a more or less rounded initial chamber of much larger dimensions; in a more advanced stage the excavations of the *Clionæ* are united to each other by narrow canaliculi, and several oscula open at the surface of the perforated body, whilst in the *Dendrinæ* there exists only one principal orifice, at which the canal penetrating into all the lobules terminates.

The size of the *Clionæ* is only limited by the extent of the perforated body; sometimes, even, the *Clionæ*, which have commenced their work of destruction at various points, become confounded into a mass by a process to which I have given the name of *aggregation by coalescence*. The dimensions of the *Dendrinæ* are comparatively limited, and hardly vary more than those of the existing Foraminifera. This last character, with the presence of the peripheral canaliculi and the absence of spicules, leads me to regard the *Dendrinæ* as a peculiar type of perforant Sarcodaria more nearly related to the Rhizopods than to the Sponges.—*Comptes Rendus*, December 6, 1875, p. 1131.

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XI.—*Descriptions of Species of Asteriidæ and Ophiuridæ from Kerguelen's Island.* By EDGAR A. SMITH, F.Z.S., Zoological Department, British Museum.

THIS is the first account of any starfish from the above locality; and consequently the very large proportion of new species among the eleven here enumerated is not altogether surprising. The specimens now described form part of the collections made by the Rev. A. E. Eaton, the naturalist sent by the Royal Society with the British expedition for observing the Transit of Venus in the early part of last year. The Asteriidæ were all dredged in Royal Sound, at a depth of from 5 to 10 fathoms. Further remarks on their similarity to boreal types and their relation to other faunas will be made in a subsequent paper.

Asteriidæ.

Asterias meridionalis, Perrier, Ann. & Mag. Nat. Hist. 1876, vol. xvii. p. 36.

Body six-rayed, reddish brown above, pale buff beneath. The rays thickish, taperingly conical, convex above, rather more than twice as long as the width of the disk. Ambulacral spines in two series: the lower margin of the rays with a double or triple series of short spines; dorsal margin with a similar row. Upper surface of the body and arms covered with numerous short, blunt, irregularly disposed spines.

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Diameter between extremities of opposite arms 6 inches ; diameter of disk $1\frac{5}{12}$ inch.

Var. With the spines on the upper surface longer and acute.

Hab. Royal Sound, Kerguelen's Island.

The specimens which I associate with this species differ from the type of it described by M. Perrier in a few particulars. In one example the ambulacral spines are not constantly in a double row ; towards the mouth they are in but a single series, and only become double at intervals up the rays. This specimen has the spines on the upper surface blunt and short, as in the type ; but another example differs, being covered with longer conically acute mobile spines.

Asterias Perrieri, sp. nov.

Radii sex, cylindraco-attenuati, ad latera supraque rotundati, inferne anguste complanati ; discus mediocriter magnus, diametri maximæ circiter $\frac{2}{7}$ æquans ; sulci ambulacrales haud latissimi ; spinæ ambulacrales serie unica (in exemplo maximo longitudine circiter 3 millim.), subgraciles, latitudine æquales, ad apicem haud clavata, modo rotundata ; spinæ ventrales serie duplici, prope spinas ambulacrales sitæ, in paribus divergentibus (vel magis infrequentior spinis tribus), spina intima quam cæteræ majore, atque quam ambulacrales brevior sed crassior, aliquantoque acuminata ; superficies dorsalis et lateralis spinis minutis brevissimis, paulo conicis, irregulariter sparsis munitæ, interque spinas papulis innumerabilibus instructæ ; tessella madreporiformis parviuscula, ad medium inter disci centrum et marginem sita. Color saturate fusco-rufus. Diam. extrema (6 poll.) 150 millim.

The ventral spines are in pairs (except near the base of the arms, where there are three or four single ones), the two spines diverging from their bases, where they are adjacent ; they are rather thick and conical, the inner one being somewhat the larger. The spines on the sides and dorsal surface are very minute, very numerous, and irregularly disseminated, except along the side of the arms near the base, where there appears to be a single continuous series ; and all the spines of this species are granulously roughened.

The largest specimen has a cluster of some hundreds of young ones clinging to the ventral disk. They are all invariably six-rayed, have only two rows of ambulacral tentacles and a single series of spines bordering them. The rays are very short and broad, nearly as broad as long, the lateral dorsal margins with a single row of large spines, and a similar series down the centre of the rays.

A. rugispina of Stimpson is allied to this species, with which I feel much pleasure in associating the name of M. Edmond

Perrier, of the Jardin des Plantes at Paris, who very recently identified many species of Asteriidæ in the British-Museum collection.

Pedicellaster scaber, sp. nov.

Discus 5-radiatus, latitudine circiter radii longitudinis $\frac{1}{2}$ æquans; radii sensim attenuati, cylindracei, haud acutissimi, spinis brevissimis singularibus, obtusis, scabrosis, modo irregulari aliquanto reticulato ordinatis muniti, iis prope ambulacra quam cæteris paulo longioribus; interstitia inter reticulationes nuda, pedicellarias magnas gerentia; spinæ ambulacrales in seriebus tribus, graciles longitudinisque æqualis, quam dorsalibus duplo longiores; oris anguli interradales spinis duabus parvis terminati; anus fere centralis; tessella madreporiformis in angulo interradales prope marginem sita.

Disci diam. 9 millim.; radiatorum longit. 18, ad basim crass. $5\frac{1}{2}$; disci crass. 6.

This species appears to agree very fairly with Sars's description of his genus *Pedicellaster*, except that the ambulacral furrows cannot be said to be "broad," and the ambulacral spines are not in two rows but three. But these are more specific than generic characters; and therefore I think this may safely be regarded as a second species of that northern form.

The spines are roughened with minute prickles, those of the dorsal surface being about twice as long as thick, and blunt at the tips; and a row or two near the ambulacral spines are rather longer, and the latter are still more elongated. The spines on the back of the disk and arms do not display any regular arrangement, but are disposed in an irregularly and rather closely reticulating manner.

Othilia spinulifera, sp. nov.

Discus 5-radiatus, latitudine circiter radii longitudinis $\frac{1}{2}$ æquans, mediocriter crassus, superne leviter rotundatus; radii cylindraceo-attenuati, spinas numerosas, brevissimas scabrosas irregulariter dispositas sed modo aliquanto reticulato gerentes; tamen prope spinas ambulacrales, spatium est lineare fere nudum, iis parallelum, versusque radiatorum basim sensim latius, spinarum minutarum quam ambulacrales longe minorum serie unica munitum; spinæ ambulacrales supra quamque tessellam quatuor, transversim sitæ, divergentes, intimis 2 quam aliæ paulo longioribus, et ad intimæ basim spina gracillima parva sita est; oris anguli interradales spinis duabus parvis terminati; anus subcentralis; tessella madreporiformis submarginalis, in radiatorum angulo.

Radiatorum longit. 14 millim., diam. ad basim $4\frac{1}{2}$; disci diam. 7, crass. 6.

This curious little species does not display any particular

arrangement of spines on the dorsal surface; but towards the ambulacral furrow there is, first of all, parallel with the spines which border it, a series of very small spines, only one on each plate, so that a narrow bare space is seen; above this the spines are two or three on a plate.

Pteraster affinis, sp. nov.?

Discus magnus, 5-radiatus, inferne planus, supra convexus, medio-criter crassus, latitudine radiatorum longitudinem adæquans; radii breves, ad basim lati, versus extremitates recurvatas sulcos ambulacrales exponentes rapide angustantes; eorum superficies infera utrinque membrana tenui spinis circitor 30 gracilibus munita (quarum apices vix extra membranam projiciunt) obtecta; tessellæ interambulacrales spinas quatuor graciles, membrana tenuissima fere ad earum apices extendente connexas gerentes; oris angulus quisque interradians spinas 8 similes, membrana pariter connexas gerens, extremis duabus quàm cæteræ maxime brevioribus, medianis duabus longissimis; illas supra sunt spinæ duæ crassæ, altera alteræ parallela, medio leviter concavæ, longitudine spinarum 30 lateralium elongatissimam æquantes, et versus apices leviter acuminatæ; superficies dorsalis et laterales projecturis minimis spiniferis munitæ, et inter has poris minutis haud numerosis perforatæ; spinæ supra projecturas scabræ 4-10, membrana præter ad apices amictæ; foramen centrale mediocre, circulare, lacinia spinarum brevium membrana connexarum circumdatum.

Exempli maximi disci diam. 15 millim., crass. 7; radiatorum longit. 17, diam. ad basim 8. Exempli minoris disci diam. 10 millim., crass. 5, radiatorum longit. 9.

This species approaches very closely to *Pt. Danaë* of Verrill, described in the 'Proceedings' of the Boston Society of Natural History, 1869, vol. vii. pp. 386 & 387, and which is supposed to have been found at Rio Janeiro. It appears, however, to be provided with longer arms; the spines of the dorsal fascicles are everywhere similar and scabrous; the spines at the inter-radial corners of the mouth are only eight in number; and the two larger spines above them are not very long, but stout. In these respects it chiefly differs from *Pt. Danaë*. The smaller specimen, it will be noticed, is considerably shorter in the rays.

Porania antarctica, sp. nov.

Discus 5-radiatus, medio-criter crassus, latitudine radiatorum longitudinem æquans; superficies infera omnino plana, supera convexa; radii aliquanto breviter conici, versus apicem acuminati; totum animal cute crassa carnosa amictum, inferne a marginibus ad sulcos ambulacrales lineariter radiatim sulcata, superne lævi spinis paucis tubercularibus parvis prope medium supraque radios sparsim or-

nata; margines ventrales laterales spinis brevibus compressis ad apices truncatis, una supra quamque tessellam (quæ sulcis linearibus notatæ) laciniati; spinæ ambulacrales biseriatæ; exteriores interiorum longitudinem duplam æquant, latæ, ad apices quadrate truncatæ, extra sulco parvo, aspectum ipsis duplicem præbente, insculptæ; spinæ interiores exterioribus porro longe breviores, multo quoque graciliores; tessella madreporiformis rotundato-ovalis, paulo propius a centro quam a margine sita; anus centralis, papillis spinæformibus circiter 12 brevissimis circumdatus. Color carneus vel sanguineus.

Diam. maxim. 90 millim., minim. 48.

This species is rather closely related to the northern *Porania pulvillus* of Müller. From this, however, it may be distinguished by the different number and character of the marginal spines; and also the ambulacral spines offer some distinctions: *P. pulvillus* has three or four spines on each of the marginal plates; and these are much smaller than the single one found in the present species. The furrow on the exterior of the outer ambulacral spines exists chiefly in the skin which clothes them. The minute tubercles on the back do not display any regular arrangement; there are about a dozen on the central portion of the disk, and a few on the short conical arms.

Astrogonium meridionale, sp. nov.

Discus 5-radiatus, latitudine radiorum longitudinis $\frac{4}{5}$ adæquans, depressus, superne infraque leviter convexus; radii ad basim lati, versus apicem aliquanto rapide attenuati; spinæ ambulacrales quadriseriatæ, intimis ad apices quam basi latioribus, quadrateque truncatis, cæteris longitudinis æqualis, simplicibus, cylindricis, ad apices rotundatis; anguli oris interradales spina unica crassa conica, et eam infra lacinia spinarum 6-8 parvarum intus directarum muniti; radiorum et disci superficies inferior fasciulis spinarum brevium aliquanto acuminatarum ornata, fasciulis in seriebus a sulcis ambulacralibus usque ad margines radiantibus; latera seriebus duabus angustis spinarum in fasciculos parvos quadratos confertos dispositarum (20 supra radium) marginata; spinæ serici inferioris iis superficiei inferioris similes, serici superioris iis dorsi; superficies dorsalis fasciulis numerosissimis fere contiguis spinarum circiter 10-20 munita, spinis tubercularibus, obtusis, pedunculatis; interstitia inter spinarum fasciculos supra et infra nuda, pedicellarias numerosas magnas gerentia; radii tuberculo unico magno superne terminati; tessella madreporiformis circularis, prope medium inter centrum et marginem lateralem sita; anus subcentralis.

Disci diam. 24 millim., crass. 10; radiorum longit. 29.

This species belongs to that section of *Astrogonium* which includes *A. parvilosum* as described by Gray, Proc. Zool. Soc. 1847, p. 79, but it is not so flat either above or beneath.

LEPTYCHASTER, gen. nov.

Discus 5-radiatus, compressus; radii mediocriter elongati; superficies dorsalis fasciculos pedunculatos confertos spinarum minutarum gerens; radorum latera serie unica tessellarum tenuium transversarum lamellarium, ad ambulacra haud productarum munita; interstitia inter tessellas et ambulacra spinarum parvarum fasciculis ordinatim cum tessellis dispositis ornata; tessella madreporiformis marginalis, in angulo interradiali sita.

This genus shows more affinity to *Luidia* than to any other. It differs from it, however, in the lateral lamellar plates being covered with minute spines not extending to the ambulacra, in the absence of elongated spines, and the body being proportionally larger than in that genus.

Leptychaster kerguelenensis, sp. nov.

Discus 5-radiatus, mediocriter magnus, compressus, supra infraque planus, latitudine radorum longitudinis circiter $\frac{3}{2}$ æquans; radii sensim attenuati, basi haud latissimi; spinæ ambulacrales graciles, quaternis vel quinis sulcis transversæ, intimis duobus longissimis, cæteris sensim brevioribus; oris anguli interradiales acuti, spinis 4-5 utrinque muniti; radorum latera et superficies inferiores tessellis transversis, angustis, lamellaribus (quæ versus radorum apicem fere ad spinas ambulacrales productæ, sed basim versus ab illis, spatium triangulare in angulo interradiali relinquentes, recedunt) instructa; hæ tessellæ spinis minutis scabris amictæ, ad angulos interradiales longissimæ, et versus radorum apices sensim decurtatæ; inter eas spinasque ambulacrales fere per radorum longitudinem totam series est unica fasciculorum parvorum spinarum brevium, sed versus radorum basim sunt sensim series secunda, tertia et quarta, omnes ordinatim cum tessellis dispositæ; superficies dorsalis fasciculos pedunculatos confertos spinarum brevium gerens; tessella madreporiformis mediocriter magna, subovalis, marginalis, in angulo interradiali sita, et spinarum fasciculis oblecta.

Disci diam. 23 millim., crass. 8; radorum longit. 38, diam. ad basim 13.

The fascicles of little spines on the dorsal surface are raised on short fleshy peduncles, and are very closely packed; and the madreporic plate is concealed by similar groups of spines.

Ophiuridæ.

Ophiacantha vivipara?, Ljungman.

The specimens from Kerguelen's Island appear to differ slightly in a few respects from those described by Ljungman, in the 'Oefversigt af Kongl. Vetenskaps Akad. Förhandl.' 1870, p. 471. The habitat given (Altata, on the west coast of Mexico)

is probably an error, as suggested by Lütken, 'Zoological Record' for 1872, p. 448, who gives Patagonia as the home of this species. The Kerguelen examples at hand are rather smaller, the diameter of the disk being 12 millims.; but this may be accounted for by age. The conical scabrous tubercles on the disk are similar to those described by Ljungman; the oral shields are about as long as broad; the adorals more quadrangular than triangular, the angles being rounded, and they are not a great deal smaller than the oral shields, the oral sides being broader than the aboral, and the lateral margins consequently converging slightly outwardly. The lower and side arm-plates agree with the description of those of the typical form, and the spines and ambulacral papillæ also; but the dorsal ray-shields are not so broad as described by Ljungman.

Thus it will be seen that a few slight differences are found in the specimens from Kerguelen's Island, but not sufficient (at all events without comparison with the types) to warrant the separation of this variety from the Patagonian species.

Ophioglypha hexactis, sp. nov.

Discus hexagonalis, angulis radiis interruptis, ad latera leviter concavus, depressus; papillæ orales (ad quemque angulum) 7, apicalis longissima, tres utrinque sensim breviores, omnes conicæ, acutæ; scuta oralia parva, ligoniformia, manubrio brevissimo latissimoque aboraliter sito, apice ad os verso, manubrio ipso cordiformi, lateribus inferioribus convergentibus, leviter concaviuseulis; scuta adoralia præcedentibus contigua, angustissima, linearia; infra illa et iis transversa oris angulos occupantia sunt scuta duo similia, oblonga, subovalia, et eorum basi unicum parvum apicali transverse situm; radii 6, elongati, longitudine quam disci latitudo duplo vel triplo majores; scuta inferiora—sextum a basi transverse latissimum, breve, margine aborali medio leviter angulato, lateribus brevissimis, rotunde truncatis, marginibus oralibus aboralibus fere similibus, sed angulo medio productiore; scuta brachialia lateralia inferne adjuncta, juncturæ lineis versus brachiorum apicem sensim longioribus; scuta superiora (prope brachii medium) subquadrata, extra quam versus discum latiora, margine exteriori arcuato, interiore concavo, marginibus lateralibus rectis, versus discum leviter vergentibus; scuta aliqua propius discum forma longe diversa, sensim decrescentia, brevia, transverseque lata, subovalia, ad scuta lateralia scutulis aliis parvis irregularibus juncta; disci squamæ minutæ, numerosæ, forma et digestionem irregulares; scuta radialia parva, elongato-subovalia, longe distantia; papillæ ad latera incisuræ disci minimæ numerosissimæ (circiter 40), et ad basim brachiorum superiorum est lacinia papillaris sex superioribus seriei aliæ opposita; spinæ brachiales 3

breves, crassiusculæ, haud multo acuminatæ, suprema generaliter earum longissima, infima brevissima; papillæ ambulacrales supra poros ultimos (infrabrachiales) fissuræ oris junctos 4, supra penultimum 3, paucos sequentes supra 2, et reliquos supra 1, forma diversæ, aliquæ scutis brevibus compressis similes, aliæque fere spinis brachialibus similes sed aliquanto breviores. Color superne purpureo-niger, inferne sordide albidus.

Disci diam. 21 mill.

Hab. Kerguelen's Island.

This species cannot be confounded with any which have hitherto been described; the number of the rays, the spade-like form of the oral shields, and the peculiarities of the ray-shields and spines at once distinguish it. The portion of the disk which is visible on the lower side between the arms is large, and the oral shields are only as long as the space between them and the sides of the disk.

Ophioglypha brevispina, sp. nov.

Discus latitudine radiorum longitudinis circiter $\frac{1}{3}$ æquans, compressus, ad margines leviterque supra rotundatus; papillæ orales 7-8 ad quemque oris angulum, extrema cæteris latior, his brevibus, crassis, et conicis, earum centrali ad anguli apicem longissima; dentes 4, compressi, hastulæformes, lateribus curvatis; scuta oralia longiora quam lata, triangulariter cordiformia, angulis duobus superioribus et margine rotundatis, lateribus leviter, apice orali aliquanto acute acuminatis; scuta adoralia angustissima, oralium lateribus inferioribus adjuncta, latiora intus, ubi contigua; radii 5, mediocriter elongati, paulo latiores quam crassi; scuta inferiora—sextum a basi latius quam longum, margine aborali curvato sed medio leviter acuminato, marginibus lateralibus brevissimis rectiusculis, marg. oralibus paululum excavatis, apice acuto convergentibus; scutum basale cæteris dissimile, superne sinuatum vice anguli levis, basi que haud acuminatum secundum sequente majus, cætera que versus radiorum apices sensim minora, denique minutissima; scuta brachialia lateralia inferne haud usque ad scutum quartum vel quintum adjuncta (juncturæ linea inde versus brachiorum apicem sensim longiore), superne haud usque ad scutum 17^{um} contigua; scuta brachialia dorsalia—sextum a basi quam longa paulo latius, arcuatum, margine exteriori rotundato, lateribus versus discum recte vergentibus; marg. interiore concavo-truncato; scuta cætera versus brachiorum apices sensim angustiora, margine interiore præsertim, et denique angulo acuto producto; disci squamæ forma et magnitudine irregulares, una centralis, et 5-6 ab illa paululum remotæ mediocriter magnæ; scuta radialia æque magna ac præcedentia, forma irregularia, contigua; papillæ ad latera incisuræ disci (in exemplo maximo) 22, (in minoribus 16-17), supremæ 6-7 cæteris majores; spinæ brachiales ternæ, brevissimæ, crassæ, paululum tantum longiores squamis

ambulacralibus, his numero duabus supra scutum tertium, quartum, aliquando quintum, unica supra cætera, et supra quimque marginem pori ambulacralis primi (infrabrachialis) papillis 4-5. Color albidus.

Disci diam. 9 millim.

Hab. Swain's Bay.

The spines on the rays are very small, and similar to those described by Ljungman as existing in *O. Lymani*, which cannot be confounded with the present species, as it differs in size, length of the arms, form and size of the radial shields, &c.

XII.—*Descriptions of some new Species of Hydroïda from Kerguelen's Island.* By Professor ALLMAN, M.D., LL.D., F.R.S., P.L.S.

SEVEN species of *Hydroïda* were collected recently in Kerguelen's Island while the English Transit Expedition was there. They comprise one representative of the *Gymnoblastic* and six of the *Calyptoblastic* hydroids. None of them has been previously described; and one is the type of a new genus.

I reserve figures and full particulars respecting them for my formal report upon the collection, giving merely short descriptions of them here.

HYDROÏDA CALYPTOBLASTEÆ.

Genus SERTULARELLA, Gray.

Sertularella kerguelenensis, n. sp.

Trophosome. Hydrocaulus about an inch in height, much and irregularly branched, monosiphonic; internodes with shallow annulations at their proximal ends. Hydrothecæ springing each from an internode close to its distal end, somewhat tumid below, tapering towards the summit, which is slightly incurved towards the stem; orifice with four distinct teeth.

Gonosome. Gonangia springing each from a point just below a hydrotheca, subsessile, ovoid, with a short tubular 4-toothed summit, annulated, the annulations becoming obsolete towards the base.

Hab. Swain's Bay (*Eaton*).

Nearly allied to *S. polyzonias*.

Sertularella unilateralis, n. sp.

Trophosome. Hydrocaulus about $1\frac{1}{2}$ inch in height, alternately pinnate, monosiphonic. Hydrothecæ deep, divergent, and somewhat tumid below, slightly curving towards the stem above, strongly 4-toothed, all deflected towards one side of the stem and branches.

Gonosome. Gonangia arising just below the base of a hydrotheca, ovoid, with a 4-toothed terminal orifice; distal portion with wide annulations, which become obsolete towards the proximal end.

Hab. Swain's Bay (*Eaton*).

Sertularella lagena, n. sp.

Trophosome. Hydrocaulus springing from a creeping stolon, about 1 inch high, slightly branched; internodes much attenuated towards their proximal ends, where they are also marked with two or three oblique well-defined annulations. Hydrothecæ rather distant, borne by the internode close to its distal end, tumid below, becoming narrow towards the distinctly 4-toothed orifice.

Gonosome not known.

Hab. Observatory Bay, Royal Sound (*Eaton*).

Genus *HALECIUM*, Oken.*Halecium mutilum*, n. sp.

Trophosome. Hydrocaulus about 1 inch in height, irregularly branched, the branches with two or three oblique annulations at their origin; internodes short, each carrying close to its distal end, for the support of the hydranth, a bracket-shaped process which is not produced into a tube (in this respect it resembles *H. macrocephalus*, Allman, and *H. sessilis*, Norman, which are also without the usual tubular prolongation), and is surrounded by a narrow, slightly everted punctate margin.

Gonosome not known.

Hab. Observatory Bay (*Eaton*).

? Genus *CAMPANULARIA*, Lam. (restrict.).*Campanularia cylindrica*, n. sp.

Trophosome. Hydroid about $\frac{1}{4}$ inch high; peduncles springing from a creeping filiform stolon, each with several annulations at its proximal end, followed by a slightly corrugated space, which is succeeded by a single globular annulation bearing the hydrotheca. Hydrothecæ deep, cylindrical, with the margin deeply and strongly 12-toothed.

Gonosome. Gonangia cylindrical above, with a flat summit, tapering below towards the very short peduncle, which springs from the creeping stolon.

Hab. Swain's Bay (*Eaton*); also Baffin's Bay.

In the absence of any fuller knowledge of its gonosome, this species (which is undistinguishable from a species obtained last autumn in Baffin's Bay by H.M.S. 'Valorous') is only provisionally referred to the genus *Campanularia*.

Genus HYPANTHEA, n. g.

Trophosome. Hydrothecæ pedunculate, inoperculate, with the walls enormously thickened, and so encroaching upon the cavity as to prevent the complete retraction of the hydranth.

Gonosome. Gonangia enclosing fixed sporosacs.

Type *H. repens*, n. sp.

Hypanthea repens, n. sp.

Trophosome. Peduncles about $\frac{1}{4}$ inch high, springing at intervals from a creeping stolon, with a globular annulus just below the hydrotheca, but otherwise smooth. Hydrothecæ obconical with very oblique margin, their cavity forming distally a shallow cup, which is prolonged as a narrow cylindrical tube backwards through the axis of the hydrotheca.

Gonosome. Gonangia elongated, narrow, passing gradually into a short peduncle which springs from the creeping stolon; colonies monœcious, the male gonangia surpassing in height the hydrothecal peduncles, fusiform, opening on the summit by a narrow circular orifice; the female shorter than the male, scarcely narrowing towards the distal extremity, where is a wide orifice.

Hab. Swain's Bay (*Eaton*).

HYDROIDA GYMNOBLASTEÆ.

? Genus CORYNE, Ehrenb.

Coryne conferta, n. sp.

Trophosome. Hydrocaulus about $1\frac{1}{2}$ inch high, much and irregularly branched, forming dense tufts; stems and branches distinctly and regularly annulated. Hydranth with about twenty tentacles.

Gonosome not known.

Hab. Observatory Bay (*Eaton*).

In the absence of the gonosome, it is impossible to ascertain whether this is a *Coryne* or a *Syncoryne*.

January 8, 1876.

XIII.—*Descriptions of some new Species of Polyzoa from Kerguelen's Island.* By Professor G. BUSK, F.R.S.

THE collection of Polyzoa made in Kerguelen's Island during the stay of the British Transit-of-Venus Expedition contains twenty-six species and four varieties of a twenty-seventh, all of which, excepting six species and three of the varieties, have been previously described. Most of them are common to the southern extremity of America; a few are also European, South-African, Australian, or New-Zealand species; but I do not observe a single Arctic form among them, which is rather surprising, since two or three species that inhabit the Arctic sea are known to exist in the Antarctic regions also. I fancy their absence is due to the circumstance that the collection was made exclusively in the Laminarian zone, the majority of the specimens having been obtained by a ten-tooth grapple attached to six fathoms of cord cast from the shore.

The following are the novelties. Figures of them and of some other species will be given in my full report upon the collection.

Suborder CHEILOSTOMATA.

Fam. **Salicornariadæ.**

Genus ONCHOPORA, Bk. (restricted).

Type *Onchopora Sinclairii*, Bk.

The genus *Onchopora* as originally constituted embraced *Tubulicellaria* of D'Orbigny; but I now propose to confine it to those forms which have no tubular prolongation of the mouth, which certainly constitute a very distinct type.

Fam. **Flustradæ.**

Genus DIACHORIS, Bk.

Diachoris costata, n. sp.

Cells elongated oval, posterior surface glistening; aperture protected by nine to twelve acute, sometimes furcate costæ, which arch over and interdigitate in the middle line; four to six strong oral spines; a pedunculate reclinate *avicularium* on one or, more usually, both sides, near the upper part of the cell.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*); Falkland Islands (*Darwin*).

The cells have some resemblance to those of *Beania australis*,

which, however, are more or less erect, are attached in a linear series to a connecting tube, and are without *avicularia*. In *D. hirtissima*, Heller, which otherwise much resembles the present species, there are no *avicularia*, and the back of the cells is set with numerous forked spines or setæ.

Fam. **Membraniporidae**.

Genus **LEPRALIA**, Johnst.

§ *INARMATÆ*.

Lepralia Eatoni, n. sp.

Cells broadly oval, distinct; mouth semicircular, lower lip straight, notched in the middle; four to six erect oral spines. Surface of cells in interior of zoarium smooth, entire or obscurely pitted round the border, sometimes umbonate; in the marginal cells a row of distinct pores exists round the border; ovicell prominent, subglobose, with faint radiating lines in front and a row of small pores round the base.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

Lepralia hyalina, Linn.

In addition to the varieties of this protean species given in the British-Museum Catalogue, the present collection contains three which are doubtfully referred to it.

Var. ϵ . *conferta* (n. var.), characterized by the crowded and compressed growth of the cells and ovicells in the central portion of the patch, giving the zoarium the aspect of a *Cellepora*, and by the wide and patulous mouth, more especially of the marginal cells.

Var. ξ . *Bougainvillei*, which appears to be identical with the form figured by M. d'Orbigny, whose name I have therefore retained.

Var. η (n. var.), characterized by the smaller than normal size of the cells, and by their surface being thickly studded with short spines, as is also that of the ovicells.

Suborder **CYCLOSTOMATA**.

Fam. **Crisiadae**, Bk.

Genus **CRISIA**, Lamouroux.

Crisia kerguelensis, n. sp.

Zooecia 3-5 in each internode; branches arising from the second or third, elongated, curved abruptly forwards; mouth slightly expanded; peristome thin, membranous: ooecia

pyriform, somewhat compressed and subacuminate at top; opening behind curved, tubular. Growth lax, straggling, irregular.

Hab. Swain's Bay.

It has much of the habit and general aspect of *Crisidia geniculata*, but differs in the number of cells in the internode, the very sparse punctuation of the surface, and in the form of the ooecia.

Fam. **Tubuliporidae.**

Genus TUBULIPORA, Lam.

Tubulipora stellata, n. sp.?

Zoarium irregularly stellate; zooecia diverging from the centre in all directions.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

Fam. **Discoporellidae.**

Genus DISCOPELLELLA, Bk.

Discoporella infundibuliformis, n. sp.

Zoarium stipitate infundibuliform: zooecia arising from the interior of the funnel; mouth expanded, with five or six acute teeth.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

Discoporella canaliculata, n. sp.

Zoarium circular, bordered, slightly convex; tubes very irregularly uniserial, with a raised canalicular fillet on one side; interspaces cancellous.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

XIV.—*On Mr. Carter's Objections to Eozoon.*

By Principal J. W. DAWSON, LL.D., F.R.S.

WITH reference to these, as stated in the December number of the 'Annals,' I beg to make an explanation as to matters of fact. The woodcut which Mr. Carter criticises was introduced into my little book in connexion with the *history of the discovery of Eozoon*, and as an illustration from Dr. Carpenter of the tubulated wall first recognized by him. There are in the book several other illustrations of these structures, though of course not nearly so many as my collections could furnish. The appearance of this cut as an illustration of my note in 'Nature' was an accident for which I am not respon-

sible. I sent with the note a tracing of the structures in question from a specimen of my own ; but, instead of engraving this, the Editor borrowed, as I suppose, the cut which had appeared in Dr. Carpenter's paper, and which certainly represented structures of the same character.

As to the relations of the canal-system to the tubuli, I can only say that, after studying a very large number of slices and other preparations of *Eozoon*, and comparing these with *Nummulina*, *Calcarina*, and other more modern forms, many of them prepared and mounted with my own hands, I cannot discover any greater diversity of structure than that which might be expected in a gigantic Stromatoporoid form of so great antiquity, and separated by so vast an interval of time from any thing with which we can compare it.

In any case *Eozoon* exists, and, projecting in *Stromatopora*-like masses from the weathered outcrops of our Laurentian limestones, so resembles certain well-known fossils that the geologist cannot deny it attention, however its presence may clash with any preconceived notions ; and I have yet to learn that the laborious collection of such specimens, the preparation and study of hundreds of slices, and the comparison of them with the forms, recent and fossil, which they may be supposed to resemble, can be fairly stigmatized as "wild speculation." It is certainly a speculation which makes more demands on time, muscle, and eyesight than some others that can be mentioned ; and I only regret that I am unable adequately to present to naturalists the materials, almost a museum in themselves, that have accumulated on my hands in the study of this ancient fossil, and which have testified more and more not only to its importance and wide distribution, but to its organic nature. I am not a specialist in the study of the Foraminifera any further than the Postpliocene species of Canada and their successors in the Gulf of St. Lawrence are concerned. The study of *Eozoon* was forced on me by circumstances and by its evident geological significance, and has been pursued as specimens presented themselves and as time permitted, but, I can honestly affirm, without any desire to support any preconceived hypothesis or to further any current speculation. On the one hand, I can plainly perceive the use which may be made of it to favour theories of development in which I have no faith ; on the other, I can equally see its inconsistency with the exaggerated antiquity claimed by many for the human period in geology ; but the investigation and statement of facts must be independent of all consideration of such consequences.

M^cGill College, Montreal,
Dec. 24, 1875.

XV.—*A Conspectus of the Species of Paratelphusa, an Indo-Malayan Genus of Freshwater Crabs.* By JAMES WOOD-MASON, Professor of Comparative Anatomy, Medical College, Calcutta.

THE genus *Paratelphusa* was established in 1855 by Milne-Edwards for the reception of two new species of crabs, one of which (*P. sinensis*) was supposed to have come from the "China seas," the other (*P. tridentata*) from New Zealand.

Stimpson, in his preliminary account of the Invertebrata collected during the United-States expedition to the North Pacific, records the occurrence of the former at Canton, in brackish water; and Heller ('Reise d. österr. Fregatte Novara,' zoologisch. Theil, Crustaceen, p. 34) gives Java as a locality for the latter.

Dr. E. von Martens (in 'Archiv für Naturgesch.' 1868, pp. 18-22) states that he himself had collected specimens of *P. sinensis* on the banks of freshwater streams at Bangkok and Petshaburi, in Siam, and of *P. tridentata* at Sinkawang in Western Borneo, at Surabaya in Eastern Java, and at Lahat in Central Sumatra, and satisfactorily accounts for the mistake in the localities given for the original examples of the species by Milne-Edwards.

In 1871 I myself described two new species, the one from Upper Burmah and the other from the Gangetic valley, through-out which it occurs from Hardwar (the point at which the great river issues from the Siwalik Hills) far down into the delta, where the water is brackish; and I then pointed out that the species resembled many Canceridæ, and differed from all the rest of the Telphusidæ in having the distal ends of the mero-podal joints of the chelipeds armed with a sharp spine: not only are they to be distinguished by the presence of this spine and by being in other respects more like certain Canceridæ, but also by the armature of the antero-lateral margins of the carapace, the teeth of which in point of number and form are as constant for the several species as are those of the Portunidæ.

The following conspectus, giving short characteristics, which it is hoped will suffice for the ready recognition of the different forms in the mean time, is published in anticipation of fuller accounts in my illustrated monograph of all the Telphusidæ of India and its dependencies.

I am indebted to Dr. von Martens for specimens of the two species collected by him.

Family Telphusidæ.

Genus PARATELPHUSA, M.-Edw.

Conspectus of the Species.

- Latero-anterior margins of the carapace armed with a single large, acute, conical and salient epibranchial tooth *P. spinigera*, W.-M.
- Latero-anterior margins of the carapace armed with two epibranchial teeth. Meropodal joints of all the legs armed at their distal ends with a sharp spine *P. tridentata*, M.-Edw.
- Latero-anterior margins of the carapace armed with three epibranchial teeth.
- The first two teeth slightly flattened, the last almost conical and smaller than the rest. Meropodal joints of all the legs armed at their distal ends with a sharp spine. Penultimate somite of ♂ post-abdomen constricted anteriorly so as to form with the preceding an hourglass-shaped mass *P. sinensis*, M.-Edw.
- The first tooth similar to the extraorbital angle, but smaller; the rest salient, acute, and conical. Meropodal joints of the legs unarmed *P. Martensi*, W.-M.
- Latero-anterior margins of the carapace armed with four epibranchial teeth.
- The teeth feebly developed, flattened, acute, curving forwards and inwards, and diminishing gradually in size from before backwards. The carapace perfectly smooth, longitudinally very convex, its antero-lateral margins much inclined; post-frontal crest well developed *P. Dayana*, W.-M.
- The teeth all equal, and similar to one another, large, almost conical, and very salient. Carapace considerably areolated, longitudinally very convex, its antero-lateral margins much inclined; postfrontal crest well developed *P. Edwardsi*, W.-M.
- The teeth tolerably well developed and salient, flattened, acute, and diminishing gradually in size from before backwards. Carapace perfectly smooth, depressed, and but slightly convex, its antero-lateral margins hardly inclined. The frontal and orbital margins conspicuously, the edges of the feebly developed postfrontal crest and of the epibranchial teeth faintly crenulated *P. crenulifera*, W.-M.

§ I. *Postabdomen of the male with its sides converging from the base of the third to the apex of the fifth somite, thence to its extremity narrow.* (Vide J. A. S. B. 1871, vol. xl. pl. 12. fig. 4.)

1. *Paratelphusa spinigera*.

Paratelphusa spinigera, Wood-Mason, J. A. S. B. 1871, vol. xl. part 2, pl. 12. figs. 1-4.

Telphusa spinigera, White, List Crust. Brit. Mus. p. 30 (nomen nudum).

Hab. Hardwar; Purneah; Jessore District; Calcutta, &c. In both fresh and brackish water.

2. *Paratelphusa tridentata*.

Paratelphusa tridentata, Milne-Edwards, Arch. du Mus. 1854-55, vol. vii. p. 171, pl. 13. figs. 1, 1 a, 1 b; Ann. des Sci. Nat. 3^e sér. t. xx. p. 213; Von Martens, Arch. für Naturgesch. 1868, pp. 19 *et seq.*

Hab. Java; Sumatra; Borneo. In fresh water.

3. *Paratelphusa sinensis*.

Paratelphusa sinensis, Milne-Edwards, *op. cit.* p. 173, figs. 2, 2 a; Von Martens, *op. cit.*

Hab. Bangkok and Petshaburi, in Siam (Von Martens); Moulmein, Burmah (Wood-Mason). In both fresh and brackish water.

§ II. *Postabdomen of the male triangular.* (Vide J. A. S. B. 1871, vol. xl. pl. 11. fig. 5.)

4. *Paratelphusa Martensi*, n. sp., W.-M.

Hab. Hardwar; Purneah; Allahabad; Jessore District. In fresh water.

5. *Paratelphusa Dayana*.

Paratelphusa Dayana, Wood-Mason, J. A. S. B. 1871, vol. xl. p. 192, pl. xi.

Hab. Prome and Maundalay, Upper Burmah. In fresh water.

6. *Paratelphusa Edwardsi*, n. sp., W.-M.

Hab. Garo, Daffa, and Naga hills; Cachar; Saddya; Harmatti. In fresh water.

7. *Paratelphusa crenulifera*, n. sp., W.-M.

Hab. Pegu Yomah. In fresh water.

The species described by me have all been found in localities the fauna of which is largely leavened with Malay forms, both identical and representative.

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

[Continued from p. 70.]

[Plate VIII.]

Genus DIPHYPHYLLUM.

Diphyphyllum, Lonsdale, Murch. Vern. & Keys. Russ. and Ur. p. 623.

Gen. char. Corallum compound—formed of long, slender, cylindrical corallites, which are usually placed at some little distance from one another, and are associated into fasciculate masses. The corallites have a distinct epitheca; and the mode of increase is by parietal or calicular gemmation. The septa are well developed, but do not reach the centre of the visceral chamber. Internally there is a small central area, occupied exclusively by the tabulæ. Externally the interseptal loculi are rendered vesicular by the development of dissepiments. No columella.

The typical corals of the genus *Diphyphyllum* form fasciculate masses, often of very large size, composed of cylindrical corallites, which may be occasionally united at certain points here and there, but are usually quite free. As rightly pointed out by Prof. de Koninck, Mr. Lonsdale was in error in asserting that the increase of the corallum was effected by means of fission of the old tubes. On the contrary, the increase is almost always by means of parietal or calicular gemmation, the old corallites continuing to grow, and the new corallites maintaining a position nearly parallel with that of the parents (Pl. VIII. fig. 1 A). It seems not improbable that, in one species, at any rate (viz. *D. Archiaci*, Billings), the corallum is occasionally simple; but this point requires further investigation.

The central area of each of the corallites is occupied by the tabulæ, which are perfectly smooth (Pl. VIII. fig. 1). The floor of the cylindrical, moderately deep calice of each is formed by the uppermost tabula in the centre. The septa do not encroach upon the median tabulate area; but we are unable to confirm M. de Koninck's view that this area is (as a rule, at any rate) surrounded by a special mural investment.

There are no traces of any columella; nor are there any grounds for believing that the absence of this organ is accidental, as formerly held by Milne-Edwards and Haime (Pol.

Foss. des Terr. Pal. p. 446). On the contrary, there is abundant evidence that no columella ever existed in any of the corals properly referred to *Diphyphyllum*.

The septa are well developed; but the primary ones invariably fall short of the centre, and leave the tabulæ exposed over a larger or smaller median space. Towards the circumference of the visceral chamber the interseptal loculi become filled by minute lenticular vesicles, formed by the development of numerous dissepiments (Pl. VIII. fig. 1).

The epitheca is thin, with encircling striæ, and occasionally accretions of growth. Sometimes there are horizontal outgrowths of the epitheca, uniting two adjacent corallites; but this is of rare occurrence.

Mr. Lonsdale's original definition of the genus *Diphyphyllum* is as follows (*op. jam cit.* p. 623, t. i.):—"A stony lamelliferous polypidom; lamellæ exceeding twelve, biplated; branched, branches dichotomous; internal structure triareal: (1) central area, intersected by flat, convex, or irregular diaphragms, no persistent axis; (2) intermediate area, traversed vertically by lamellæ; interspaces crossed obliquely or downwards by extensions of the diaphragms and subordinate plates; (3) outer area, traversed by lateral extensions of lamellæ; interspaces crossed by arched or vesicular laminæ inclined upwards and outwards; stems not uniformly thickened by external secretions, but occasionally united when in juxtaposition." The type species, upon which the above definition is founded, is *D. concinnum*, Lonsd., from the Carboniferous rocks of Russia.

Prof. McCoy (Brit. Pal. Foss. p. 87) followed Mr. Lonsdale in all essential points, more especially as regards the supposed fissiparous mode of increase, and defined the genus as follows:—"Corallum forming elongate cylindrical branches, dividing by dichotomous fissure of the main stem; no axis; biareal; the large central area occupied by strong, simple, transverse diaphragms, deflected at the circumference, surrounded by a narrow outer vesicular area; outer wall thick, radiating lamellæ numerous, not reaching the centre." He described two species, from the Carboniferous rocks of Britain, viz. *D. gracile* and *D. latiseptatum*, the latter of these being apparently identical with *D. concinnum*, Lonsd.

Milne-Edwards and Haime consider that *Diphyphyllum concinnum* was founded upon a *Lithostrotion* in which the columella had been accidentally destroyed, and they therefore reject the genus altogether (Pol. Foss. des Terr. Pal. p. 446). De Fromental adopts the same view, but retains the name of *Diphyphyllum* for the fasciculate species of *Lithostrotion* (Int.

à l'étude des Polyp. Foss. p. 304). Prof. de Koninck, however, by his excellent description and figures of the type form, *D. concinnum*, Lonsd., has thoroughly established the correctness of Mr. Lonsdale's original views and the validity of the genus (Nouv. Recherches sur les An. Foss., partie i. p. 36, pl. ii. figs. 4-4d, 1872). We need only add that the forms which we have examined from the Carboniferous rocks of Scotland and the Devonian rocks of America agree in all points of generic importance with the type form *D. concinnum*. We quite agree with Mr. Billings (Can. Journ., new series, vol. iv. p. 134), as well as with M. de Koninck, in thinking that Mr. Lonsdale was in error in making fissiparous division to be one of the characters of the genus; but this misconception as to a single character is not of itself sufficient to invalidate his definition or to lead to the abandonment of his name.

It follows from the above that the genus *Lithostrotion* is sufficiently separated from *Diphyphyllum* by the presence in the former of a well-developed and continuous columella, which is wholly wanting in the latter. Hence transverse and longitudinal sections will in all cases enable the palaeontologist to at once separate the *Diphyphylla* from the fasciculate species of *Lithostrotion*, in spite of the close external resemblance between the two groups.

From the typical species of *Cyathophyllum* the species of *Diphyphyllum* are at once separated by the limitation of the septa of the latter to the external portion of the corallum. In no case do the septa in *Diphyphyllum* meet in the centre of the visceral chamber, or become twisted together so as to form a pseudo-columella. This distinction, however, is not available as separating *Diphyphyllum* from forms like *Cyathophyllum paracida*, McCoy, or *C. (Caninia) giganteum*, Mich., since in these latter the septa fall short of the centre. In this case the chief available characters are to be found in the fasciculate growth of the former, and the strongly developed peripheral vesicular zone of the latter. When we come, however, to such forms as *C. caespitosum*, Goldf., it must be admitted that it is almost impossible to draw a rigid line between this and *Diphyphyllum*, since the septa in the former seem occasionally to fall short of the centre, and the form and mode of growth of the corallum are as in the latter genus.

Dybowski has recently founded the genus *Donacophyllum* (Mon. der Zoanth. scler. rug. aus der Silurform. Esthlands &c., p. 80) for corals which are said to differ from *Diphyphyllum* only in the fact that the vesicles of the exterior zone are of large size. We have seen no examples of the genus, and can pronounce no opinion as to its value.

The genus *Eridophyllum*, Edw. & Haime, is, again, precisely similar to *Diphyphyllum* in all the essential points of its internal structure, and differs only in the fact that the corallites are united at intervals by abundant lateral outgrowths of the epitheca. Occasionally, however, such epithecal outgrowths are sparingly developed in *Diphyphyllum*; and we are inclined to doubt if their absence or presence can be considered a ground of generic distinction. We do not think that Dybowski has brought forward any sufficient reasons for separating groups so closely allied, and placing them, as he has done (*op. jam cit.* p. 81), in different families.

The genus *Diplophyllum*, Hall, was founded for the reception of some corals from the Niagara Limestone (Pal. N. Y. vol. ii. p. 115), which in most respects agree with *Diphyphyllum*, but are stated to have the septa meeting in the centre of the visceral chamber. They are also stated to possess an inner mural investment surrounding the central tabulate area. This latter distinction, however, cannot be relied upon, since an inner wall (though certainly wanting as a rule in *Diphyphyllum*) is stated by De Koninck to be present in *D. concinnum*, Lonsd. Upon the whole, it seems probable that *Diplophyllum*, Hall, will prove on further examination to be properly referable to *Diphyphyllum*.

The geological range of the genus *Diphyphyllum* is a tolerably wide one. It appears to commence in the Upper Silurian, being represented in the Guelph Limestones of Canada. Several species are found in the Devonian rocks; and the genus is well represented in the Carboniferous. In the Carboniferous rocks of Scotland the genus is rare, but it is represented by the type species (*D. concinnum*, Lonsd.), as well as by another form at present undetermined.

Genus LOPHOPHYLLUM.

Lophophyllum, Edwards & Haime, Pol. Foss. des Terr. Pal. p. 349. and Brit. Foss. Cor. Intr. p. lxvi.

Gen. char. Corallum simple, conical, with a complete epitheca. Tabulæ convex, irregular, passing with more or less interruption completely across the visceral chamber. A septal fossette is present. A cristiform or clavate columella in the centre of the uppermost tabula, joined by one extremity with the single septum contained in the septal fossette, and sometimes connected by the other with the opposite primary septum. Septa extending nearly, but not quite, to the centre of the visceral chamber.

So far as is known, all the species of *Lophophyllum* are

simple, and their form is more or less conical and usually curved. The epitheca is complete, sometimes thin, but in other cases thick, with strong longitudinal striæ. Minute encircling lines of growth are present, along with annulations of growth. The calice is moderately deep, and the septa extend nearly to the centre of the visceral chamber, apparently without ever quite reaching it. Small secondary septa usually, but by no means always, alternate with the primary septa. As a general rule dissepiments are present, in the form of delicate plates crossing the interseptal loculi; but these are never developed in such quantity as to form a distinct zone of vesicular tissue exteriorly (Pl. VIII. figs. 5 A, 6 A, 7 A).

The tabulæ are always present, and are always well developed, though they do not possess the form of distinct, strong, transverse plates. On the contrary, they form a series of more or less irregular arched plates, with their convexities upwards, which anastomose and become more or less freely united with one another. They are not, however, confined to the central area of the corallum, but reach the inner surface of the wall (Pl. VIII. figs. 6 & 7).

The columella is invariably present, and is formed by a cristiform or clavate prominence in each successive tabula. It is thus not a true columella, as is sufficiently shown by longitudinal sections (Pl. VIII. figs. 6 & 7), where there is simply a pseudo-columellarian line passing down the centre. One extremity of this pseudo-columella is joined directly with the septum occupying the septal fossette. The other extremity seems sometimes to be connected with the primary septum directly opposite to the septal fossula; but more commonly it appears to be free, and no such connexion seems to be established (Pl. VIII. figs. 3 A-7 A). In *L. breve*, De Kon., the columellar prominence is said not even to have its usual connexion with the septum in the fossula. Though well marked in specimens exhibiting the interior of the calice, the septal fossette is not a conspicuous object in transverse sections of *Lophophyllum*, and is generally only recognizable by the fact that the columellar eminence is prolonged into it.

The genus *Lophophyllum* agrees in many respects with *Zaphrentis*, more especially in the characters of the septa and dissepiments. It is distinguished, however, from this by the comparatively irregular tabulæ, the different nature of the fossula, and the presence of the central columellar eminence. Almost the only genus with which *Lophophyllum* runs any risk of being confounded is *Cyathaxonia*, Mich.; but sections at once show that it is fundamentally distinguished from the latter by the possession of tabulæ. In *Cyathaxonia*, also,

there are no endothecal dissepiments, and the columella forms a single styliform rod, which commences at the bottom of the visceral chamber, and is continued through to the floor of the calice. (It may not be out of place to note here that *Cyathaxonia Dalmani*, E. & H., is not a true *Cyathaxonia*, but has been formed into a new genus by Lindström under the name of *Centrotus*.)

The genus *Lophophyllum* commences in the Devonian, but attains its maximum in the Carboniferous rocks, where it dies out. All the known species are small, rarely exceeding an inch or an inch and a half in length. The type of the genus is *L. Konincki*, E. & H., from the Carboniferous rocks of Belgium. With the exception of a form which seems to be identical with *L. (Cyathopsis) eruca*, M'Coy, all the examples figured by us (Pl. VIII. figs. 3-6) are new; but we reserve the description of their specific characters till another occasion.

EXPLANATION OF PLATE VIII.

(All the figures are drawn of the natural size.)

- Fig. 1.* *Diphyphyllum concinnum*, Lonsd., transverse section of a small slab, exhibiting calicular gemmation at different stages of the process; 1 A, longitudinal section of the same, showing the production of young corallites and the continued growth of the parent tubes. Lower Carboniferous, Bathgate, Linlithgowshire.
- Fig. 2.* *Diphyphyllum*, sp., transverse section of a small slab, exhibiting fissiparous development of the corallites. Lower Carboniferous, Scotland.
- Fig. 3.* *Lophophyllum parvulum*, Thomson & Nicholson, external aspect; 3 A, transverse section of the same. Lower Carboniferous, Fifeshire.
- Fig. 4.* Another example, from the Lower Carboniferous of Ayrshire; 4 A, transverse section of the same.
- Fig. 5.* *Lophophyllum reticulatum*, Thomson & Nicholson, external aspect; 5 A, transverse section of the same. Lower Carboniferous, Shiels, East Kilbride.
- Fig. 6.* *Lophophyllum*, sp., longitudinal section; 6 A, transverse section of the same. Lower Carboniferous, Shiels, East Kilbride.
- Fig. 7.* *Lophophyllum eruca*, M'Coy (?), longitudinal section; 7 A, transverse section of the same. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.
- Figs. 8-8 B* belong to the next portion of this memoir, where their characters will be discussed.

[To be continued.]

XVII.—*Notices of British Fungi.* By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq., F.L.S.

Continued from vol. xv. p. 41.]

[Plates IX., X., & XI.]

**Agaricus* (*Amanita*) *muscarius*, L. ; Fr. Ep. p. 20.

Var. Entirely destitute of warts. Leicester, Mr. Mott.

**A.* (*Lepiota*) *cepaestipes*, Sow., var. B.

Fine specimens of the white form, exactly according with Bulliard's *A. cretaceus* (t. 374), were gathered at Batheaston by Mr. Broome. It is quite certain that Bulliard's plant is a *Lepiota*.

1501. *A.* (*Armillaria*) *bulbiger*, A. & S. ; Fr. Ep. p. 40†.

In pine-woods. Hereford, Oct. 1875. The marginato-bulbose stem reminds one of some *Cortinariæ*.

1502. *A.* (*Armillaria*) *robustus*, A. & S. ; Fr. Ep. p. 41.

Rannoch, Perthshire, Dr. Buchanan White.

Agreeing closely with Krombholz's figure. Flesh very firm ; taste and smell exactly that of *Polyporus squamosus*.

1503. *A.* (*Tricholoma*) *loricatus*, Fr. Ep. p. 60.

In woods. Viscid. Glamis, Rev. J. Stevenson. Remarkable for the thick coat of the pileus.

**A.* (*Tricholoma*) *crassifolius*, B. ; Fr. Ep. p. 61.

This fine species has been gathered again by Mr. Cecil H. Spencer Perceval.

1504. *A.* (*Tricholoma*) *virgatus*, Fr. Ep. p. 62 ; Icon. tab. 34. fig. 1.

Forres, Rev. J. Keith.

1505. *A.* (*Tricholoma*) *leucocephalus*, Fr. Ep. p. 71 ; Ic. tab. 43. fig. 2.

C. E. Broome, Oct. 1869. Bowood, Wilts.

1506. *A.* (*Tricholoma*) *militaris*, Lasch. ; Fr. Ep. p. 71.

Glamis, Rev. J. Stevenson.

1507. *A.* (*Tricholoma*) *civilis*, Fr. Ep. p. 71.

Epping, J. English. Exhibited at South Kensington, Oct. 6, 1875.

1508. *A.* (*Clitocybe*) *gilvus*, P. ; Fr. Ep. p. 95.

West Farleigh, Kent, 1874.

**A.* (*Clitocybe*) *subinvolutus*, Batsch ; Fr. Ep. p. 96.

Laxton Park, Norths, Oct. 22, 1875. Occurring in profusion in a ring under Scotch firs, twenty yards in diameter.

† The references, as far as Hymenomyces are concerned, are to the new edition of the 'Epicrisis.'

It has regularly appeared in the same spot for forty years. Exactly the plant of Batsch.

1509. *A. (Clitocybe) subalutaceus*, Batsch ; Fr. Ep. p. 84. Oxtou Exeter, growing under *Ilex*, C. H. Spencer Perceval, Esq., Nov. 1875. Smell like that of *A. putridus* and *A. rancidus*, peculiar.

1510. *A. (Clitocybe) splendens*, Fr. Ep. p. 96 ; Ic. tab. 44. fig. 1.

Reading, Mr. Austin. Exhibited at the Fungus show, South Kensington, 1874.

1511. *A. (Clitocybe) expallens*, Fr. Ep. p. 100.

Glamis, Rev. J. Stevenson.

1512. *A. (Clitocybe) concavus*, Scop. ; Fr. Ep. p. 102 ; Ic. tab. 57. fig. 2.

C. E. Broome.

1513. *A. (Collybia) rancidus*, Fr. Ep. p. 125.

Under cedars. Burnham Beeches, Nov. 1875, Rev. G. B. Sawyer and C. E. Broome.

The smell is very peculiar ; the gills very dark, so as to be easily mistaken for those of a *Hebeloma*. Though the specimens do not answer in every respect, still, on comparing them with a drawing by Fries, who remarks that there are many varieties, they are referred without hesitation as above.

1514. *A. (Collybia) ventricosus*, Bull. tab. 411. fig. 1 ; Fr. Ep. p. 120.

Oct. 25, 1874, C. E. Broome. Bathford.

1515. *A. (Omphalia) maurus*, Fr. Ep. p. 156.

On lawns. Coed Coch.

1516. *A. (Mycena) aurantio-marginatus*, Fr. Ep. p. 131 ; Fl. Dan. tab. 1292. fig. 2.

Near Perth, Dr. Buchanan White, Nov. 1, 1875.

This is a most interesting addition to our list of Fungi. It is admirably figured in the 'Flora Danica,' and has a peculiar aspect which separates it from other species, looking more like a *Marasmius* than a *Mycena*.

Stem very brittle, fistulose. Smell strong. Margin striate.

1517. *A. (Mycena) excisus*, Lasch. ; Fr. Ic. tab. 81. fig. 1.

Glamis, Rev. J. Stevenson.

1518. *A. (Mycena) psammicola*, B. & Br. Pileo subhemisphærico hygrophano, particulis minutissimis irrorato, margine striato ; stipite brevi, solido, radicante, deorsum umbrino, sursum albo, toto albo-pulverulento ; lamellis segmentoideis breviter adnatis postice sinuatis ; odor fortis sed non nitrosus.

On a sand bank amongst moss. Addington, Kent, Sept. 28, 1875.

Pileus 3 lines across ; stem not 6 lines high, about $\frac{1}{2}$ a line

thick, firm; pileus brown, becoming paler towards the margin. A small but well marked species.

1519. *A.* (*Mycena*) *metatus*, Fr. Ep. p. 142.

Forres, Rev. J. Keith. Wrotham, Kent, Oct. 1875.

1520. *A.* (*Mycena*) *collariatus*, Fr. Ep. p. 146; Ic. tab. 82. fig. 5.

Glamis, Rev. J. Stevenson. Addington, Kent, Oct. 1875.

1521. *A.* (*Mycena*) *debilis*, Fr. Ep. p. 145.

In a chestnut wood. Wrotham, Kent, Oct. 1, 1875.

1522. *A.* (*Pleurotus*) *pulmonarius*, Fr. Ep. p. 176.

This interesting species was exhibited at the Aberdeen Fungus show in 1874, the specimens exactly according with Paulet's figure, tab. 21.

1523. *A.* (*Entoloma*) *Thomsoni*, B. & Br. Pileo plano, griseo tomentoso, costis reticulatis ornato; stipite pallidior fibrilloso tomentoso; lamellis latis incarnatis.

Amongst grass in a plantation. West Farleigh. Found in company with Dr. Thomson.

Pileus $1\frac{1}{4}$ to nearly 2 inches across, adorned with raised radiating ribs, which form reticulations in the centre; stem $1\frac{1}{2}$ line high, about 2 lines thick. The structure seems entirely peculiar to this species; for the ribs are not like those of *A. phlebophorus*.

1524. *A.* (*Pholiota*) *unicolor*, Fr. Ep. p. 227.

Hereford, Mr. J. Renny.

1525. *A.* (*Inocybe*) *maritimus*, Fr. Ep. p. 229.

Glamis, Rev. J. Stevenson. Menmuir, Rev. M. Anderson.

1526. *A.* (*Inocybe*) *descissus*, Fr. Ep. p. 233.

C. E. Broome.

1527. *A.* (*Inocybe*) *Whitei*, B. & Br. Pileo convexo, primum hemisphærico, fulvo, margine albo viscidulo, cortina candida fibrillosa, demum expanso toto fulvo; stipite e candido fulvescente, glabrescente, solido; lamellis e candidis adnexis.

Rannoch, Oct. 1, 1875, Dr. Buchanan White.

A very curious and beautiful little species, allied to *A. vaticosus*. Stature that of *A. geophyllus*.

1528. *A.* (*Flammula*) *lupinus*, Fr. Ep. p. 246.

Glamis, Rev. J. Stevenson.

1529. *A.* (*Flammula*) *apicreus*, Fr. Ep. p. 249.

On rotten trunks. New Pitsligo, Rev. J. Fergusson.

1530. *A.* (*Naucoria*) *temulentus*, Fr. Ep. p. 262.

Glamis, Rev. J. Stevenson.

1531. *A.* (*Hebeloma*) *firmus*, P.; Fr. Ep. p. 238.

Laxton Park, Norths, Oct. 22, 1875. Near fir trees.

1532. *A.* (*Naucoria*) *graminicola*, Nees, Syst. f. 186; Fr. Ep. p. 265.

Glamis, Rev. J. Stevenson.

A very rare species, which certainly belongs to *Naucoria*, a point still remaining doubtful in the last edition of the 'Epicrasis,' but which we are fortunately able to confirm.

1533. *A. (Pholiota) terrigenus*, Fr. Ep. p. 215.

Var. *minor*.

Amongst chips of hop-poles, West Farleigh, Kent.

Resembling closely *A. punctulatus*, Kalch. ; but that is described as having brown spores, whereas in the present case they are ferruginous.

**A. (Psalliota) campestris*, L.

Var. *villaticus*, Brond. Cr. Ag. tab. 7.

An enormous specimen, 13 inches in diameter, with a stem 3 inches thick, was sent by Messrs. Lee of Hammersmith, who received it from Dr. Bennett. The pileus was covered with rich pilose scales, and had a very grand appearance. It comes up in Dr. Bennett's garden every year.

1534. *A. (Psalliota) hæmorrhoidarius*, Schulz. Kalchb. p. 29, tab. 18. fig. 1.

In the Duke of Cleveland's woods, Lilleshall, Salop, Nov. 1875, Rev. W. Houghton. King's Cliffe, Norths.

Like *A. Badhami*, the whole plant turns red when bruised or cut. Dr. Badham considered this one of the most excellent Fungi; but it is not included or mentioned in his book. Pileus 4 inches across; stem 4 inches high, 1 thick.

1535. *A. (Galera) vittæformis*, Fr. Ep. p. 269; Schæff. tab. 63. figs. 4-6.

Perth, Dr. Buchanan White, Nov. 4, 1875.

1536. *A. (Stropharia) caput-medusæ*, Fr. Ep. p. 288.

Glamis, Rev. J. Stevenson. A very rare and interesting species, which has occurred again this year, and was exhibited at the Fungus show at Perth.

1537. *A. (Hypholoma) cascus*, Fr. Ep. p. 294.

Rannoch, Perthshire, Dr. Buchanan White.

1538. *A. (Psilocybe) chondrodermus*, B. & Br. Pileo campanulato carnosio, margine appendiculato excepto glaberrimo lævi spadiceo, hic illic rimoso; stipite subæquali fistuloso pallidiore, fibrilloso, basi squamuloso; lamellis ventricosis affixis secedentibus, margine albo.

In pine woods. Glamis, Rev. J. Stevenson.

Pileus 1 inch across, dark bright brown, cracked here and there in different directions; veil woven and jagged; stem 2½ lines thick above, 3 at the base. Spores .00025 inch long, half as much wide, purple-black, almost oblong. Pileus stains the paper yellow. The species, which is quite distinct, will take its place in the first section of *Psilocybe*.

1539. *A. (Psilocybe) nucisedus*, Fr. Ep. p. 300.

Amongst small chips in a wood. West Farleigh, Kent.

This interesting species may be easily mistaken, if the spores are not carefully observed. We have a characteristic drawing from Fries. White when dry.

1540. *A.* (*Psathyrella*) *caliginosus*, Jungh. in Linn. v. 5, tab. 6. fig. 13.

Glamis, Rev. J. Stevenson.

1541. *Cortinarius* (*Phlegmacium*) *claricolor*, Fr. Ep. p. 336.

Glamis, Rev. J. Stevenson.

1541*bis.* *C.* (*Phlegmacium*) *decoloratus*, Fr. Ep. p. 351.

Epping, Mr. J. English.

1542. *C.* (*Phlegmacium*) *sebaceus*, Fr. Ep. p. 337.

Glamis, Rev. J. Stevenson.

1543. *C.* (*Phlegmacium*) *croceo-cæruleus*, Fr. Ep. p. 352; Ag. Pers. Ic. et Desc. tab. 1. fig. 2.

Laxton Park, Norths, Oct. 22, 1875.

1544. *C.* (*Inoloma*) *cyanites*, Fr. Ep. p. 361.

Brought from Reading by Mr. Austin to the Fungus show at South Kensington, 1874.

The specimens belong to the variety which turns red slower when bruised. We have a drawing of this magnificent species from Fries. It is one of the finest of the genus.

1545. *C.* (*Inoloma*) *redimitus*, Fr. Ep. p. 363.

Glamis, Rev. J. Stevenson.

1546. *C.* (*Dermocybe*) *camurus*, Fr. Ep. p. 367.

J. Renny. We have no information as to the locality of this or of 1549 and 1551, which we have received from Mr. Renny.

1547. *C.* (*Dermocybe*) *myrtilinus*, Fr. Ep. p. 368.

Glamis, Rev. J. Stevenson. Rannoch, Dr. Buchanan White.

1548. *C.* (*Dermocybe*) *venetus*, Fr. Ep. p. 374.

Rannoch, Perthshire, Dr. Buchanan White. A small but interesting species, differing in colour from any species with which we are acquainted.

1549. *C.* (*Telamonia*) *licinipes*, Fr. Ep. p. 376.

J. Renny.

1550. *C.* (*Telamonia*) *plumiger*, Fr. Ep. p. 377.

Glamis, Rev. J. Stevenson. A single small specimen, densely plumose.

1551. *C.* (*Telamonia*) *punctatus*, Fr. Ep. p. 382.

J. Renny.

1552. *C.* (*Hydrocybe*) *detonsus*, Fr. Ep. p. 397.

Glamis, Rev. J. Stevenson. Amongst moss in woods. Probably a very common species.

1553. *C.* (*Hydrocybe*) *milvinus*, Fr. Ep. p. 399.

In woods. Wrotham, Kent, Oct. 1, 1875.

1554. *Paxillus Lepista*, Fr. Ep. p. 402.

Slough, M. Terry, Esq. This is one of the most interesting additions to our list of Fungi. The rigid, almost horny cuticle, large size, and thick stem render it one of the most remarkable of the *Agaricini*.

1555. *P. paradoxus* (Kalchb.). *Agaricus paradoxus*, Kalchb. tab. 16. fig. 1; Fr. Ep. p. 244.

Near Shrewsbury, W. Phillips, Esq. Wrotham, Kent, Sept. 30, 1875. Amongst decayed furze.

This very curious plant, which is admirably figured in the work above quoted, is undoubtedly a *Paxillus*. The spores are more like those of a *Boletus* than an Agaric; they are oblong, .00035–.00036 inch long, and about a fourth as much wide. It is at once distinguished from *P. leptopus* by the gills being distant, and not “admodum confertæ.”

1556. *Lactarius squalidus*, Krombh. tab. 4. figs. 23–25.

Scotland, 1875.

1557. *L. minimus*, Smith, in Journ. of Bot. 1873, p. 205.

Forres, Rev. J. Keith.

1558. *Hygrophorus discoideus*, Fr. Ep. p. 408. *Agaricus semigilvus*, Secret. no. 771.

Laxton Park, Norths, Oct. 22, 1875. Exactly answering to the description of Secretan, but not so stout as in a figure received from Fries. Solitary or tufted, stem dotted all over with viscid granules.

1559. *H. lacmus*, Fr. Ep. p. 416.

Epping, Mr. James English. Exhibited at South Kensington, 1875.

**H. Colemannianus*, Blox.; Fr. Ep. p. 417.

A form of this species apparently occurred at Laxton, which at first seemed an exaggerated state of *H. ceraceus*. The pileus and stem were extremely viscid, and of a full but rather dull yellow; the stem hollow and extremely brittle. As it became dry the colour changed to various tints of tawny; the gills very decurrent, thin, and variously shaded. The margin was subplicato-striate as in *H. vitellinus*, not subdecurrent as in *H. lætus*, besides which the stem was any thing rather than tough. As two specimens only were found, it is thought better to refer them to *H. Colemannianus* than to propose a new species.

1560. *H. sciophanus*, Fr. Ep. p. 417.

Perth, Dr. Buchanan White.

Spores very pale clay-coloured. There were two forms—one with a darker pileus and the flesh dark, the other paler, with the flesh also pale. The former only deposited spores; it is probable therefore that the pale form was not so fully

developed. Species of *Coprinus* occasionally occur without a trace of spores.

1561. *H. cinereus*, Fr. Ep. p. 413; Ätl. Svamp. tab. 30.

Coed Coch, Mrs. Lloyd Wynne. Great Elm, Somerset, C. E. Broome. Rannoch, Dr. Buchanan White. Exactly according with the upper figures in the plate cited above, and surely distinct from *H. pratensis*.

1562. *Russula olivacea*, Fr. Ep. p. 445.

Slough, M. Terry, Esq.

1563. *R. galochroa*, Fr. Ep. p. 447; Bull. tab. 509 L, M.

Slough, M. Terry, Esq.

1564. *R. pectinata*, Fr. Ep. p. 449; Bull. tab. 409 N, O, P.

Glamis, Rev. J. Stevenson. Smell like that of *R. fetens*. Pellicle separable. Exactly resembling the two latter figures of Bulliard, which he refers rather doubtfully to *R. heterophylla*.

1565. *Cantharellus Haughtoni*, Phillips, MS. Pileo tenui, convexo, umbilicato, glabro; stipite gracili, apice incrassato, primum subtiliter fibrilloso; lamellis subdecurrentibus angustis pallide carneis.

Hereford, W. Phillips and others.

Pileus 1 inch or more across, thin, dirty white, with a tinge of flesh-colour. Stem 2 inches high, 1 line thick, slightly thickened above, minutely fibrillose, stuffed, rooting at the base, which is more or less cottony. Gills scarcely forked, narrow, slightly decurrent. Sometimes 2 inches across. Allied to *C. albidus*, and possibly included by Fries, but very different from the 'Flora-Danica' plant recorded before under no. 1421.

1566. *Marasmius epichloe*, Fr. Ep. p. 479. *M. gramineus*, Lév.

On the base of grasses. Hereford, J. Renny. Undoubtedly Lévillé's plant, but possibly a mere form of *M. stipitarius*.

1567. *Lentinus pulverulentus*, Fr. Ep. p. 482. *Agaricus pulverulentus*, Scop. Carn. p. 434.

Glamis, Rev. J. Stevenson.

Tufted, at first infundibuliform, then lateral flabelliform, fuliginous, floccoso-pulverulent, with little umber particles; stem elongated, at length smooth; gills thick, pallid, deeply decurrent, their edge crenulate but not torn. Pileus 2 inches across, stem 3 inches high. This seems to be truly the plant of Scopoli.

1568. *Polyporus floccopus*, Rostk. tab. 13.

Glamis, Rev. J. Stevenson.

Fries remarks that it is a question whether this species is not a form of *Polyporus brumalis*; but it appears to us quite distinct.

1569. *P. (Resupinati) subgelatinosus*, B. & Br. Orbicularis, margine elevato, subgelatinoso, albo-tomentoso, nigricante; poris griseis, parvis, acie acutis.

On dead wood. Rannoch, Dr. Buchanan White. Apparently parasitic on a decurrent form of *P. amorphus*.

This singular species forms little pulvinate masses, with an obtuse raised border, which is at first tomentose and pallid, of a subgelatinous consistence, and turning black. The pores are of a pale delicate grey, with an acute even edge, about $\frac{1}{10}$ of an inch in diameter. We cannot point out any species to which it is allied.

1570. *Trametes inodora*, Fr. Ep. p. 584.

On the flat top of an old mossy beech-stump. Stoke Poges, M. Terry, Esq.

Pores colourless, slightly angular, about $\frac{1}{110}$ inch wide, nearly $\frac{1}{4}$ inch long, not the least linear. Inodorous; externally tomentose, white, with a very slight tinge of pink at the base. As in *Dædalea latissima*, the texture radiates from a central point, and is of a pure white.

1571. *T. Terrei*, B. & Br. Resupinata, lata, suborbicularis, pulvinata, contextu suberoso albo; poris angulatis, hic illic sinuatis, pallidis.

On beech. Stoke Poges, M. Terry, Esq.

About 3 inches across, 1 inch thick in the centre; substance white, delicately fibrous, radiating from a central point, zoneless; pores about $\frac{1}{40}$ inch across, pallid, angular in the centre, sinuated towards the edge. Habit that of *Dædalea latissima*. Inodorous.

1572. *Hydnum levigatum*, Swartz; Fr. Ep. p. 599; Sverig ätl. Svamp. tab. 81.

In pine-woods. Rannoch, Dr. Buchanan White. A far more solid species than *H. fragile*.

1573. *Irpex pendulus*, Fr. Ep. p. 620.

Menmuir, Rev. M. Anderson. Agreeing with the figure of Albertini and Schweinitz. The species varies greatly; specimens obtained previously were not in a normal condition.

Amongst the Fungi still preserved in Sowerby's herbarium is one marked *Hydnum erectum*, parasitic on some *Polyporus*. This appears identical with Fries's *Sphæronema hydnoideum*, which he no longer refers to *Radulum aterrimum*.

* *Craterellus lutescens*, Fr. Ep. p. 630.

Rannoch, Perthshire, Dr. Buchanan White. The hymenium of a beautiful orange. Sent at the same time with very characteristic specimens of *Cantharellus lutescens*.

1574. *Thelephora pallida*, Fr. Ep. p. 633.

We have received from the Rev. W. Houghton and Mr.

Phillips a *Thelephora* with a hispid hymenium, which they refer to this species. It is, however, so like *T. Sowerbeii* that we hesitate about its diagnosis, but think it better to record their observation.

1575. *T. clavularis*, Fr. Ep. p. 634.

On the ground. Wallington, Northumberland, C. H. Spencer Perceval. We have lately received from Dr. White specimens which would be referred to this species were it not for the strong fœtid scent of *T. palmata*.

1576. *T. intybacea*, Pers. Syn. p. 567.

Amongst *Tetraphis pellucida*. Burnham, Rev. G. H. Sawyer. Glamis, Rev. J. Stevenson. Exactly answering to Bulliard's figures, tab. 483. figs. 6 & 7, tab. 278, and quite distinct from *T. laciniata*.

1577. *T. crustacea*, Schum. ; Fr. Ep. p. 637.

On the ground. Burnham, Rev. G. H. Sawyer. Both in this and last year.

1578. *Stereum vorticosum*, Fr. Ep. p. 639.

On beech. Menmuir, Rev. M. Anderson.

1579. *S. pini*, Fr. Ep. p. 643.

On bark of Scotch fir. Glamis, Rev. J. Stevenson.

1580. *S. rufum*, Fr. Ep. p. 644.

Glamis, Rev. J. Stevenson. Rev. J. Keith.

1581. *Corticium salicinum*, Fr. Ep. p. 647.

Forres, Rev. J. Keith.

This is certainly the same with *Exidia cinnabarina*, B. & C., which has the curved spores of *Exidia*. We have not sufficient specimens of the European form to justify us in separating it from *Corticium*, to which genus it can scarcely belong.

1582. *C. amorphum*, Fr. Ep. p. 648.

On larch. Perth, Dr. Buchanan White.

This curious plant is so like large specimens of *Peziza calycina* that it is not surprising that the two should have been confounded, and in consequence the plant figured by Willkomm under the name is really *P. calycina*. We were at first inclined to think that it might be a conidiiferous form of the *Peziza* in question, analogous to *Cyphella Currei*; but the structure is such as to make us consider it autonomous, and probably the type of a new genus; for it does not agree well with the characters of *Corticium*. The substance is white and fleshy, consisting of rather coarse threads which at the base form a close sclerotoid network. The hymenium consists of colourless threads and orange-coloured clavate bodies filled with pigment. These at length project beyond the surface, and produce four globose rough spores, .001 inch in diameter, which contain an

angular body within, which looks like a cystolith. After a time each spore becomes elliptic, and now measures $\cdot 0012$ inch in length, produces about eight elliptic echinulate sporidia in its cavity, which are from $\cdot 0004$ – $\cdot 0005$ inch long—a circumstance without parallel as far as we know in Hymenomycetes. All these points have been observed by each of us independently.

PLATE IX. fig. 1. *a.* first stage of pseudasci; *b.* second; *c.* filled with endochrome; *d.* sporophore with young spores; *e.* the same, with mature spores; *f.* separate spore; *g.* the same, producing sporidia; *h.* sporidia. All more or less magnified.

1583. *C. serum*, Fr. Ep. p. 659. *Thelephora sera*, Pers. Syn. p. 580.

Epping, Mr. James English. Numerous specimens have been received from the Rev. J. Stevenson, Rev. M. Anderson, and others from Scotland.

A very curious species, some specimens approaching, if not identical with, *Hydnum papyraceum*. The aculei are mostly very distant, either entire or plumose at the tips, with the interstices just like the hymenium of a true *Corticium*. Sometimes they are radiato-floccose; but there are intermediate states.

1584. *C. cinnamomeum*, Fr. Ep. p. 650.

On wood. Glamis, Rev. J. Stevenson.

1585. *C. ferrugineum*, P.; Fr. Ep. p. 661.

On various decayed vegetable substances. Wothorpe. Received also from Scotland.

1586. *Clavaria Krombholzii*, Fr. Ep. p. 669. *C. Kunzei*, Krombh. tab. 53. figs. 15, 16.

On the ground in woods. Glamis, Rev. J. Stevenson.

1587. *C. condensata*, Fr. Ep. p. 672.

On the ground under trees. West Farleigh, 1874.

1588. *Pterula subulata*, Fr. Ep. p. 682.

Burnham Beeches, Rev. G. H. Sawyer, 1874.

1589. *Typhula translucens*, B. & Br. *Candida pellucida*; stipite brevi sursum incrassato; capitulo irregulari subobovato. On the ground. Glamis, Rev. J. Stevenson.

Minute, pure white, resembling somewhat a prematurely dried Myxogast, but a true Hymenomycete.

1590. *Hymenula constellata*, B. & Br. Orbicularis, dein dense congesta, pallida; sporis minutis fusiformibus.

On a decaying board. C. E. Broome.

Formerly referred to *Fusarium minutulum*, Cd. Individual plants about $\cdot 007$ inch across, densely crowded in the centre, scattered towards the margin of the patches, composed of compact branched threads bearing minute spores, $\cdot 0002$ inch long, in a dense stratum.

We perfectly agree with Fries, in the new edition of the

'Epicrisis' (p. 700), that the greater part of the described species of *Hymenula* do not really belong to Hymenomycetes. Some are doubtless conidiiferous forms of ascophorous Fungi.

**Geaster mammosus*, Fr. Syst. iii. p. 17.

This curious species, of which no other British specimen was known than that figured by Sowerby, has lately been found in Berkshire by the Rev. G. H. Sawyer.

**G. Michelianus*, B. & Br.

Anglesea, Hon. W. O. Stanley.

1591. *Lycogala flavo-fuscum*, Ehrb.

Coed Coch. Named on the authority of Dr. Rostafinski.

1592. *Reticularia olivacea*, Fr. Syst. iii. p. 89.

On decayed fir. Aboyne, 1870. Named on the authority of Dr. Rostafinski, who considers *R. versicolor* synonymous. A small specimen has been gathered by Dr. Buchanan White near Perth.

1593. *Chondrioderma Ærstedii*, Rtf. Mon.

On bark more or less covered with moss. Jedburgh, R. Jerdon.

1594. *C. niveum*, Rtf. Mon.

On dead wood. Linlithgow, J. C. Bauchop.

1595. *Badhamia capsulifer* (Bull. sub *Sphaerocarpo*), Bull. tab. 470. fig. 2.

Glamis, Aug. 1874, Rev. J. Stevenson.

The spores are rough, whereas in *B. utriculosa* they are smooth. Fries, as far as we can find, does not quote Bulliard's figure. The peridia reflect the most beautiful tints of steel-blue and lilac; they are densely crowded, as in Bulliard's figure.

1596. *Physarum theioteum*, Fr. Syst. iii. p. 142. *P. virescens*, Dittm.; Sturm, D. F. tab. 61.

On little twigs. Glamis, Rev. J. Stevenson.

1597. *P. tussilaginis*, B. & Br. *Badhamia capsulifera*, Cooke, Exs. Peridiis depressis, adnatis, tenuissimis nitidis; capillitio ramoso tenui albo; sporis globosis, asperis.

On leaves of *Tussilago*, first discovered by Mr. Brittain. It is quite certain that this is not *Sphaerocarpus capsulifer*, Bull.

1598. *P. nigrum*, Fr.

On decayed wood. Glamis, Rev. J. Stevenson.

Threads slender; spores nearly black, .0007 inch in diameter.

**P. atrum*, Fr. Syst. iii. p. 147.

On very decayed *Populus alba*. Elmhurst, Dec. 1859.

1599. *Craterium leucostictum*, Fr. Syst. iii. p. 152.

On dead leaves. Glamis, Rev. J. Stevenson.

1600. *Cribraria macrocarpa*, Schrad. tab. 2. fig. 3.

Glamis, Rev. J. Stevenson.

1601. *C. fulva*, var. b. *intermedia*, Schrad. tab. i. fig. 2.

On decayed wood. Glamis, Rev. J. Stevenson.

Spores ·00035–·0005 inch in diameter.

1602. *Arcyria Friesii*, B. & Br. Gregaria; peridiis stipitatis, globoso-ovatis, cinereis; capillitio ovato-cylindrico sporisque glaucis.

On sawdust. Glamis, Rev. J. Stevenson.

The plant which generally passes for *Arcyria cinerea*, and which is figured in the 'Flora Danica,' and is common in exotic as well as British collections, has not glaucous spores. The specimens received above appear to be what Fries intended; and therefore the above name is assigned to them. The capillitium is coarser than that of *A. cinerea*, and the spores are decidedly blue. Its habit also is different, the peridia being scattered in *A. cinerea*.

1603. *A. ferruginea*, Rtf. Mon.

On dead wood. Sow. Herbarium.

Included often in *A. punicea*, from which it differs not only in colour, but in the comparative size of the spores.

1604. *A. (Lachnobolus) congesta*, B. & Br. Peridiis in massas orbiculares congestis sessilibus, nitidis, flavo-umbrinis; floccis exasperatis sporisque concoloribus.

On dry wood. Halse House, Somerset, October 1861, C. E. Broome.

Forming orbicular masses $\frac{1}{2}$ inch in diameter, consisting of crowded shining umber peridia, looking at first like a *Licea* or a heap of moth's eggs. Just the colour of gingerbread. Spores globose, ·0003–·0004 inch in diameter.

PLATE IX. fig. 2. a. plant, natural size; b. portion of plant, magnified; c. capillitium; d. spores.

1605. *Lindbladia effusa*, Fr. *Licea effusa*, P. & Ehrb.

With *Cribraria argillacea*. Aboyne, 1870. Forbes, Rev. J. Keith. We have an original specimen from Fries marked as probably belonging to a new genus, before it was characterized.

1605 bis. *Perichæna decipiens*, B. & Br. Sporis majoribus minoribusque læte aureis.

On fir-cones. Perth, Dr. Buchanan White.

The external appearance is just the same as that of *P. strobilina*; but the spores are bright yellow and of two kinds, the larger ·0009–·002 inch long, those of *P. strobilina* ·001–·0012 inch long, which is about the size of the smaller spores of *P. decipiens*.

PLATE IX. fig. 3. a. spore of *P. strobilina*; b. the smaller spores of *P. decipiens*; c. the larger spores; d. the capillitium. All more or less magnified.

1606. *Septoria Avellanae*, B. & Br.; Rab. Exs. 1958.

On the underside of leaves of *Corylus Avellana*, growing in a circinate manner. Bathford, C. E. Broome.

Spores fusiform, curved, about $\cdot 0004$ inch long.

1607. *Sporidesmium triglochinis*, B. & Br. Soris punctiformibus e basi cellulari oriundis; sporis junioribus obovatis, stipite brevi sursum incrassato, dein subglobosis oblique divisivis, demum oblongis fenestratis.

On *Triglochin palustre*. Rannoch, Dr. Buchanan White, March 1875.

Sori bright brown, $\cdot 006$ – $\cdot 008$ inch in diameter, spores $\cdot 0003$ – $\cdot 0007$. Approaches *S. pallidum*, B. & C.; but that is on fir, and the spores are not composed of globose cells as in that species.

PLATE X. fig. 4. a. plant in situ, magnified; b. group of spores; c. spores, more highly magnified.

1608. *Puccinia Moliniae*, Tul. Ann. d. Sc. Nat. Sept. 1854, p. 141.

On *Molinia caerulea*. Rannoch, Dr. Buchanan White.

**P. calthæ*. On leaves of *Ranunculus ficaria* with *Æcidium calthæ*. New Pitsligo, Rev. J. Fergusson.

**Trichobasis Cirsii*, Lasch., has been found in Perthshire by Dr. Buchanan White and Dr. Cooke.

1609. *Stilbum melleum*, B. & Br. Minutum, pallide luteum; stipite curto sursum dilatato hispido; sporis globosis, minimis, corpusculis multo majoribus verruculosus in contextu conditis.

On bark. King's Wood, Congresbury, Jan. 1861, Miss Plues.

In form resembling *Cilicium violaceum*, but of a uniform pale yellow tint; head composed of clavate processes, about $\cdot 009$ – $\cdot 01$ inch across, covered with sugary particles or the granules of crystallized honey. The globose rough bodies, $\cdot 0005$ inch in diameter, appear to be imbedded in the substance.

PLATE X. fig. 5. a. plant, magnified; b. head, showing the situation of the corpuscles; d. structure of head; e. corpuscles. All highly magnified.

1610. *Fusarium translucens*, B. & Br. Pellucidum, sub-stipitatum, margine sub lente leviter ciliato albo-lutescente, sursum umbilicato; sporis tenuibus cylindricis.

On deal. Glamis, Rev. J. Stevenson.

Forming little transparent specks about $\frac{1}{6}$ of a line in diameter. Spores $\cdot 0003$ inch long. Differs from *F. minutum*, Cd., in the form of the spores.

1611. *F. cucumerinum*, B. & Br. Pallide aurantiacum sub-globosum dein effusum; sporis breviter fusiformibus.

On diseased cucumbers. Sibbertoft.

Spores $\cdot 0003$ inch long.

1612. *F. rhabdophorum*, B. & Br. Erumpens, subfulvum, elevatum e basi orbiculata alba; sporis rectis rhabdiformibus.

On dead sticks. Forres, Rev. J. Keith.

Spores .0006 inch long.

1613. *Cylindrosporium senecionis*, B. & Br. Cæspitulis e floccis flexuosis gracilibus; sporis cylindricis e maculis candidis oriundis.

On leaves of *Senecio vulgaris*. Rannoch, Dr. Buchanan White. Forming white conspicuous irregular patches on the leaves.

Spores variable in length, .0003–.0006 inch or more long.

1614. *Penicillium coffeicolor*, B. & Br. Late effusum umbrinum; floccis brevibus crassiusculis; sporis majoribus globosis.

On Pasteur's solution, South Kensington, Profs. Huxley and Dyer.

Resembling closely in colour *Miainomyces fungicolus*, Cda., but the spores are very different. The threads are short and coarse; the spores varying much in form, the most perfect smooth, with a large nucleus, and about .0005 inch in diameter.

1615. *Exobasidium vaccinii*, Wor.; Woronin, Abh. d. naturf. Ges. zu Freiburg, iv., Fung. Aust. de Thümen, no. 322.

On leaves of *Vaccinium vitis-idaea* and other species. On *Rhododendron* it forms a thick gall-like swelling.

1616. *Schinzia alni*, Woron. Ann. d. Sc. Nat. sér. 5, x. p. 80, tab. 6. figs. 1–7.

Forming tubercles on the roots of alder. Powerscourt, 1867.

1617. *Leotia circinans*, P.; Fr. Syst. ii. p. 27.

On the ground, abundantly. Glamis, Rev. J. Stevenson.

1618. *Vibrissea microscopica*, B. & Br. Minutissima; stipite brevi nigro; capitulo griseo.

On damp fir wood. Rannoch, Dr. Buchanan White.

Scarcely visible without a lens. Stem very short, black; head grey, leaving a cup-shaped depression when completely washed off. Sporidia ejected, filiform.

1619. *Peziza* (*Geopyxis*) *arenaria*, Osb.; Fr. Syst. ii. p. 65.

On sands near St. Andrews, Rev. M. Anderson.

This very curious species, which is so brittle that it is difficult to preserve good specimens, forms a cylindrical or forked process penetrating the sand and collecting its particles. The roots of the *Psamma* are often attached, and perhaps in some cases have been mistaken for mycelium.

1620. *P.* (*Humaria*) *constellatio*, B. & Br. Minuta, gregaria nec stipitata, coccinea, convexa, sicca tantum cupulæformis;

paraphysibus linearibus apice curvatis hic illic ramosis; sporidiis globosis demum reticulatis. Fl. Dan. tab. 656. fig. 2.

Occurring in little groups, but not crowded, by the side of the road. Addington, Kent. It has also been found near Hereford by Dr. Cooke.

Sporidia $\cdot 0007$ inch in diameter. Dr. Cooke has the same thing from Hereford; and similar sporidia, but slightly larger, occur in *P. humosa*, Rehm and Fuckel. *P. humosa*, Fr., however, has cups 2–4 lines in diameter, which does not at all accord with our plant. The figure in 'Flora Danica' gives exactly the habit; and the magnified plant confirms our diagnosis.

1621. *P.* (Taphesia) *rhabdosperma*, B. & Br. Subiculo tenui tomentosio, pallide fulvo; cupulis sparsis concoloribus extus saturatoribus villosis, margine inflexo, hymenio lætiore; ascis lanceolatis, obtusis; sporidiis filiformibus.

On dead wood. Leigh Down, Nov. 5, 1860.

Sporidia $\cdot 003$ – $\cdot 0035$ inch long. Allied to *P. cœsia*.

PLATE X. fig. 6. a. plant, magnified; b. asci and sporidia, more highly magnified.

1622. *P.* (Dasyscyphæ) *fuscescens*, P.; Fr. Syst. ii. p. 95.

On beech-leaves, principally on the main nerve. Builth, South Wales, W. Phillips.

1623. *P.* (Mollisia) *tripolii*, B. & Br. Erumpens, aurantiaca, margine nigrello cincta; sporidiis oblique ellipticis binucleatis.

On dead stems of *Aster tripolium*. King's Lynn, Sept. 10, 1875, C. B. Plowright.

Minute, erumpent, surrounded by the blackened cuticle, which often splits into tooth-like laciniae. Hymenium orange. Paraphyses flexuous, sometimes forked. Sporidia obliquely elliptic, $\cdot 0005$ inch long, half as much wide. A curious species, reminding one somewhat of *P. fusarioides*.

1624. *Helotium laburni*, B. & Br. Breviter stipitatum, cupulis extus villosis furfuraceis pallidis, margine inflexo; disco ochraceo læticolori; sporidiis fusiformibus quadrinucleatis.

On decorticated branches of *Cytisus laburnum*, or beneath the cuticle, which it seems to throw off. Menmuir, Rev. M. Anderson.

Sporidia $\cdot 0009$ inch long.

Mr. Phillips, who has paid great attention to the genus, writes that the only species approaching it in the fruit is *Helotium salicellum*, Fr. Karsten has a species, *Pezicula subciformis*, which has sporidia nearly the same size and shape, with two nuclei, but is otherwise different.

**Stictis lecanora*, Schm. & Kz.; Fr. Syst. ii. p. 193.

Var. *pyri*. Disco aterrimo.

On the bark of pear-trees. Shrewsbury, W. Phillips, Esq.

We were at first inclined to think this a distinct species, as we found the sporidia much smaller, $\cdot 0004$ – $\cdot 0005$ inch long, whereas in *S. lecanora* we found them $\cdot 0009$ inch; but later observations proved that they are sometimes quite as large, and we therefore consider it a mere variety.

PLATE XI. fig. 7. *a.* asci and sporidia of *Stictis lecanora*; *b.* ditto of var. *pyri*.

1625. *Nectria Keithii*, B. & Br. Peritheciis minutis, pallidis, congestis, furfuraceis, ostiolo distincto; sporidiis fusiformibus inarticulatis; conidiophoris punctiformibus confluentibus carneo-griseis.

On cabbage-stalks. Forres, Rev. J. Keith.

Sporidia $\cdot 0002$ – $\cdot 00025$ inch long, conidia $\cdot 0002$ inch.

1626. *Sphaeria* (Byssisedæ) *Keithii*, B. & Br. Peritheciis cæspitosis e floccis atris ramosis oriundis, apice calvis roseis, radiatis; ostiolo impresso punctiformi; sporidiis fusiformibus triseptatis ad commissuras contractis.

On a piece of cord. Glasnevin Botanic Garden, W. Keit.

Perithecia rather large, the apex rose-coloured, with a punctiform impressed ostiolum, and radiated, apparently from the shrinking of the outer coat as they increase in size. Sporidia fusiform, triseptate, constricted at the division, each of which contains a large nucleus, $\cdot 0012$ inch long, $\cdot 00025$ wide.

It is possible that this very curious species may be of exotic origin, as it occurred in a hothouse. The only species to which it seems to bear any evident relation is *S. rhodosticta*, B. & Br., Fungi of Ceylon, no. 1096.

PLATE XI. fig. 8. *a.* group of perithecia; *b.* apex of ditto; *c.* early stage; *d.* ascus; *e.* sporidia.

1627. *S. empetri*, Fr. Syst. ii. p. 522.

On leaves of *Empetrum nigrum*. Sow of Athol, May 1874, Dr. Buchanan White.

Asci $\cdot 002$ inch long; sporidia pale brown, linear, uniseptate, $\cdot 0007$ inch long.

1628. *Ascomyces alni*, B. & Br. Inflorescentiam deformans; sporidiis in ascis numerosis minoribus.

On female catkins of alder forwarded by Dr. Masters.

Differs from other species in the asci containing more numerous sporidia, which are only $\cdot 0002$ – $\cdot 0003$ inch long, whereas in *A. bullatus* they are $\cdot 0004$ inch.

1629. *A. pruni* (Fuckel), sub *Excoascus*, Fungi Nassoviæ, 1861, p. 29.

On bag-plums. Extremely abundant on the common sloe at Sibbertoft.

**Labrella ptarmicæ*, Desm.; Fr. El. ii. p. 149.

On leaves of *Achillea ptarmicæ*. Rannoch, Dr. Buchanan White.

These are the first truly British specimens we have seen. It appeared for some successive seasons at King's Cliffe on plants brought from Lambersart already impregnated with the mycelium; but after a time the parasite vanished.

1630. *Rhytisma empetri*, B. White. Ambiens, atrum, lucidum, secundum longitudinem rugosum.

On *Empetrum nigrum*. Rannoch, Dr. Buchanan White. Completely surrounding the stem, shining jet-black, wrinkled longitudinally. The asci are straight, but immature.

XVIII.—On the *Habitat of Uromys aruensis* (Gray) and its Allies. By Dr. A. B. MEYER.

DR. J. E. GRAY, in describing (Ann. & Mag. Nat. Hist. ser. 4, 1873, vol. xii. p. 418) a new species of *Uromys* from my collections, introduced it with the following words:—

“The British Museum received two specimens of a male and female rat, which Dr. A. B. Meyer obtained at Aru Island in April 1870, and at Buntimunang, in the south-west part of Celebes, in November.”

This note requires a rectification on my part. I never was on the Aru Islands; and in April 1870 I was still in England; in October of the same year I arrived in Java; and it was in November 1871 that I first spent some days collecting in Bantimurang (it should be “Bantimurang,” and not “Buntimunang”). But, besides this, the female *Uromys* was not procured by me on South-west Celebes; it belonged to a small collection of animals from the Aru Islands, which I had bought before I came to Makassar, in September 1871. Some confusion must have happened in Europe with two of my labels, to have led Dr. Gray to the statement that *Uromys aruensis* occurs on the Aru Islands and in the south-west of Celebes. My diary and collection-notes are quite positive on this point; and there can remain no doubt that a mistake has been made. I regret that I did not see this incorrect statement earlier; but I now hasten to make known that from my Celebes collections no *Uromys* reached Europe. Celebes being so very poor in

mammals, it is of some consequence whether *Uromys* occurs there or not.

Although I did not collect the two specimens in question on the Aru Islands myself, I have no doubt that the locality is correct, because I discovered a closely allied species on New Guinea in May 1873, near Rubi, the south point of Geelvink Bay (therefore not very far from the Aru Islands)—which I call *Uromys papuanus*.

The habitats of the three now known species of *Uromys*, which are very closely allied to each other, are therefore the following:—

1. *Uromys macropus* (Gray) : North Australia, Cape York.
2. — *aruensis*, Gray : Aru Islands.
3. — *papuanus*, Meyer : New Guinea, Rubi.

Royal Natural-History Museum,
Dresden, January 23, 1876.

BIBLIOGRAPHICAL NOTICE.

Medicinal Plants; being Descriptions with Original Figures of the Principal Plants employed in Medicine, and an Account of their Properties and Uses. By R. BENTLEY, F.L.S., and H. TRIMEN, M.B., F.L.S. London: J. & A. Churchill, 1876. (Four parts issued.)

THIS work will supply a want which has been felt for a long time, as there is no recent trustworthy book in the English language on the important subject with which it deals; and now that Flückiger and Hanbury's admirable 'Pharmacographia' is published, an illustrated handbook of the plants used in medicine seems more needed than ever. The present work is issued in monthly parts, and contains original coloured plates (natural size), with botanical descriptions and an account of the geographical distribution and officinal properties, of the plants that yield the drugs in common use. In making the selection the British Pharmacopœia has been taken as a foundation; and to the species there included have been added a number of others used medicinally in India and the United States. Altogether the selection made includes between 250 and 300 species. Four parts of the work are already out, with eight or, if the plate be double, seven plants in each. No regular botanical order has been followed; but the plates are numbered so that they may be bound in botanical sequence, according to the natural system, when the book is finished. Of common European officinal plants we have flax, rue, white and black mustard, the juniper, the common poppy, and foxglove; amongst cultivated fruits, the olive, orange, quince.

and almond; and of tropical drug- or food-yielding species *Theobroma cacao*, *Croton Eluteria* and *Tigilium*, *Paullinia sorbilis*, and *Mallotus philippinensis*. As far as possible the plates have been drawn from living specimens. They are drawn and lithographed by Mr. Blair, a young and rising botanical artist, and are well executed, with abundant structural detail and colouring not overdone, though in some cases (e. g. *Mentha viridis* and *Digitalis purpurea*) the pictorial effect is marred by superabundance of shading. The letterpress, both botanical and pharmacological, is full and accurate; and altogether the book may be safely recommended as likely to be a complete and trustworthy handbook for medical men, chemists, and all who are interested in the subject.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

November 25, 1875.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

“On the Structure and Relations of the Alcyonarian *Heliopora cœrulea*, with some Account of the Anatomy of a Species of *Sarcophyton*; Notes on the Structure of Species of the Genera *Millepora*, *Pocillopora*, and *Stylaster*; and Remarks on the Affinities of certain Palæozoic Corals.” By H. N. MOSELEY, M.A. (Oxon.), Naturalist to the ‘Challenger’ Expedition.

Introduction.—The author having undertaken the examination of the Deep-sea Corals dredged during the voyage of H.M.S. ‘Challenger,’ was led to the study of the structure of corals generally, and especially to the examination of the Milleporidæ, which seemed of peculiar interest, since they had been determined by Professor Agassiz to be Hydroids, and had been regarded by him as living representatives of the Palæozoic Rugosa. *Millepora alcicornis* was obtained and examined at Bermuda, and another species of *Millepora* at Zamboangan, Mindanao, Philippine Islands. The examination of these Millepores was found to be beset with great difficulties, and the present notes on their structure are to be regarded as only preliminary. Further investigations will be made with specimens which it is hoped will be obtained at the Sandwich Islands. At Zamboangan, *Heliopora cœrulea* was obtained, and found at once to be an Alcyonarian. Its structure is described in full in the paper. Another Alcyonarian of the genus *Sarcophyton* (Lesson) was examined for the purpose of comparison. It proved to present special features of interest, and a general description of its anatomy also is therefore given. Notes are further appended on the anatomy of a species of *Pocillopora* obtained at Zamboangan.

and that of a Stylasteracean dredged off the Meangis Islands in 500 fathoms.

Literature of the Subject.—Few original works relating to the subjects treated of in this paper were available for reference on board the ‘Challenger.’ A review of what has been able to be gathered of the recent literature relating to the Tabulate and Rugose Corals and the Alcyonarians is given, and also a history of the various systematic arrangements to which the Tabulata and Rugosa have been subjected.

Professor Agassiz published his opinion as to the hydroid affinities of the Milleporidæ in 1859 (“*Les Animaux des Millépores sont des Acalèphes et non des Polypes*,” *Bibl. Univ. de Genève, Arch. des Sci.*, Mai 1859), and figured the animals of the *Millepora alcicornis* in his ‘Contributions to the Natural History of the United States,’ vol. iii. plate 15. Pourtales observed the animals in company with Agassiz. He says that one which he saw was “shorter than they are represented to be in the figure, and had five tentacular masses rather than tentacles.” M.-Edwards considered Professor Agassiz’s evidence as to the hydroid nature of *Millepora* insufficient, as does also Professor Allman.

Professors Claus, Pourtales, Verrill, and many other authors accept Agassiz’s conclusion with regard to the Milleporidæ, but do not accept his views with regard to the Rugosa.

Professor Verrill (*Silliman’s American Journal*, 1872, vol. iii. pp. 187, 194) found that *Pocillopora*, a genus with extremely well-marked tabulæ, was a true Hexactinian, and showed that the presence of tabulæ, the character relied on by Professor Agassiz, was of little importance. Pourtales and L. Ludwig have come to the conclusion that the tetrameral arrangement in the Rugosa is merely apparent, and that the original arrangement in the young coral was hexameral. Professor Martin Duncan arrived at similar conclusions from the examination of *Gygnia annulata*. Kunth, however, still adheres to the tetrameral primary division. Lindström, the first discoverer of the opercular apparatus of certain Rugosa, compares these structures with skeletal structures of *Primnoa*. The latest paper on the classification of Corals is by M. Dollfus (*Comptes Rendus de l’Acad. des Sciences*, t. lxxx. no. 10, 8 Mars 1875, pp. 681–683). M. Dollfus connects together the genera *Heliolites* and *Propora* with *Heliopora* and *Seriatopora* by means of *Pocillopora*, considering all these to be Hydroids. Favosites, with many other genera of Palæozoic Corals, he considers to be a Bryozoon.

Methods employed.—The corals examined were hardened in alcohol or chromic acid, decalcified, and cut into fine vertical and horizontal sections. Sections of the hard parts were rubbed down in the usual manner. Portions of *Heliopora cærulea* were also examined in the fresh state.

On the Structure of Heliopora cærulea.—*Heliopora cærulea* was found growing in abundance on reefs near Zamboangan at low tide. The polyps were never seen expanded, though pieces of the

coral were carefully transferred to a glass vessel without being removed from the water. The living coral is perforated in all directions by a parasitic Annelid (*Leucodora*). The corallum of *Heliopora* is remarkable for the tubular character of its cœnenchym, which consists of a series of tubes arranged side by side at right angles to the surface of the coral, open above but closed below by successive transverse partitions or "tabulæ." The calicles are tubes essentially similar to the tubes of the cœnenchym, but larger. They are said by M.-Edwards to have twelve septa appearing as plications of the wall of their cavities. The number is, however, very variable. The tabulæ of the calicle are exactly similar in structure to those of the cœnenchym. The hard tissue is composed of doubly refracting calcareous matter, which has a half-crystalline, half-fibrous structure. It is disposed in a series of systems vertically to the surface of the corallum, the axes of which systems lie in the interspaces between the cœnenchymal tubes. In each system the fibres of hard tissue are disposed radially around the central vertical axes, and at the same time with an upward inclination at an equal angle all around.

The colony of *Heliopora* is developed entirely by budding. In a growing point of the corallum the cœnenchymal tubes are widely open and polygonal in outline. New calicles are formed by the junction of a number of tubes around a central tube or tubes arrested in growth which form a base. The outer walls only of the surrounding tubes continue to grow and form the lateral wall of the calicle. The newly formed calicle thus has tubular prolongations at its base; and the so-called septa are, in the main, due to the circumstance that the wall is composed of a series of fused curved outer walls of tubes. The calcareous matter is deposited in a finely fibrous calciferous tissue, connected apparently with the formation of which is a layer of connective tissue which everywhere covers the hard parts.

There is no trace of the corallum of *Heliopora* being composed of fused spicules as in the case of *Corallium* and *Tubipora**

The deep blue colouring of the corallum of *Heliopora* is due to an amorphous colouring-matter insoluble in strong hydrochloric acid, but soluble in acidified alcohol. It forms an intensely blue solution of a sulphate of copper colour, which transmits the blue and part of the green only of the spectrum.

In the soft tissues of *Heliopora* an ectoderm, entoderm, and mesoderm are to be distinguished. The ectoderm is composed of club-shaped cells; it has the usual disposition. Small oval nematocysts are present in it and in the upper part of the mesodermic layer beneath. The mesoderm consists of three histological elements,

* The fact that the corallum is so formed in *Tubipora* seems to have been hitherto unknown (Claus, 'Grundzüge der Zoologie,' 3^e Aufl. p. 204). It is plainly shown at the mouth of any growing tube in spirit specimens. Professor Wyville Thomson drew my attention to the fact, an account of which he thinks has been published by Professor Perceval Wright in the 'Annals and Magazine of Natural History.'

homogeneous connective tissue, layers of connective-tissue cells, and finely fibrous calciferous tissue. Prolongations of the two former form sacs lining the cœnenchymal tubes and calicles. The sacs are further lined by the entoderm, which consists of spherical cells containing yellow pigment, as in other Alcyonarians. Only a surface-layer in *Heliopora* is living. Hardly any soft tissue is to be found in the tubes beneath the last-formed tabula. The sacs lining the tubes do not communicate anywhere directly with the exterior, but are connected with one another above, and with the calicular cavities, by wide transverse canals. The superficial tissues are permeated by smaller canals. The polyps of *Heliopora* have eight mesenteries and eight lobed tentacles. In the contracted state of the polyp the tentacles are completely introverted, and rest in the intermesenterial spaces. The stomach is like that of any other Alcyonarian. Retractor muscles are present, which are disposed with regard to the mesenterial plates as in Pennatulids, showing a "Dorsalfach" and "Ventralfach." No definite protractor muscles were observed to be present. No regular arrangement of the eight mesenteries with regard to the twelve so-called septa could be found. Eight mesenterial filaments are present, two of which appear to be longer than the others. In three individuals only of the single colony examined were ova found—in one four ova, in the others only one. The ova are attached to the mesenteries. The four ova were attached to four separate mesenteries. No male elements were found. The colonies are probably unisexual. The arrangement of the polyps in the colony is somewhat irregular; but the "Dorsalfach" seems always to be uppermost in the vertical plates of which the coral consists, the polyps being thus placed back to back.

On the Structure of Sarcophyton, sp.—An Alcyonarian was obtained at the Admiralty Islands which agrees in every respect with Lesson's genus *Sarcophyton* (M.-Edwards, Hist. Nat. des Corall. t. i. p. 22). A genus called *Sarcophyton* is, however, cited by Claus as having been formed by Sars. The Alcyonarian is mushroom-shaped. Two kinds of individuals, zooids and polyps, compose the colony; the stem is composed of large tubes ("sinus"), the prolongations of polyp-cavities. The polyps offer no marked peculiarities; their retractor and protractor muscles are arranged as in Pennatulids with regard to the mesenteries. They have two mesenterial filaments longer than the rest. The zooids have eight short mesenteries, four of which, the "dorsal" and "ventral," are deeper than the rest. They have two mesenterial filaments, the dorsal only. They have no tubercles and no generative organs. They have a simple globular stomach, communicating by a short tube with the exterior, and lined with long cilia. A sarcosome of transparent homogeneous connective-tissue, containing small ramified nucleate corpuscles, connects the polyp- and zooid-cavities; these cavities are connected by vertical and horizontal systems of canals. The vertical canals are continuous with the bottoms of the zooid-cavities; they form networks of

canals in the sarcosome. The sarcosome contains elongate tuberculate spicules of the usual form, which are largest and most thickly set in the stem of the *Sarcophyton*. Smaller spicules are present in the tentacles of the polyps. The spicules show a special sheath of transparent tissue, in which structure was not seen. The "Dorsalfächer" of the polyps and zooids have a general direction towards the central axis of the stem and centre of the pileus; but both polyps and zooids are often more or less twisted on their axes.

On the Structure of Millepora.—The examination of *Millepora* is beset with serious difficulties; the present notes are merely preliminary. The calcareous cœnenchymal tissue of *Millepora* differs extremely from that of *Heliopora* in being reticulate, not tubular: in histological structure it is similar to *Heliopora*. The coral has only a thin superficial layer of soft living tissue, composed of a network of canals filled with cells resembling those of the canals of Alcyonarians, and covered externally with nematocysts. Two kinds of nematocysts, small and large, are present: the small ones are confined to the tentacles. Two kinds of polyps are present, large and small. Tentacles are present in both kinds; they appear to be four in number and compound. They are simply retracted by means of muscular fibres, which are arranged round the base of the cylindrical stomach radially, but, as far as has yet been seen, without any disposition in definite groups. No mesenteries have been seen.

On the Structure of Pocillopora (P. acuta).—The corallum is very dense and composed of definite prisms of calcareous matter, which show a transverse banding, somewhat like that of striped muscular fibres. The polyps have twelve tentacles, six large and six small, and twelve mesenteries with long mesenterial filaments coiled up. A very thin layer of living tissue covers the corallum; it is devoid of canals.

On the Structure of Stylaster.—A *Stylaster* dredged in 500 fathoms was found to have the tentacles disposed *between* the calcareous septa, as was shown to be the case in *Allopora oculina* by Sars (Forh. Selsk. Chr. 1872, p. 115). The septa are twenty-two in number, and the tentacles also twenty-two. The stomach has a conical projecting mouth or proboscis, as seen by Sars in *Allopora oculina*. It has apparently no inferior outlet. There are no well-defined mesenteries, and no mesenterial filaments. A very open network of soft tissue surrounds the stomach and tube leading to it from the circle of the tentacles. Suspended in this reticulate tissue are the testes, large sacs filled with spermatie cells disposed sometimes in one, sometimes in two vertical rows; they occupy the interior of the ampullæ. These corals are diœcious. *Cryptohelia* resembles *Stylaster* most closely in structure, and is also diœcious.

Vegetable Parasites.—The corallum of both *Millepora* and *Pocillopora* is permeated by fine ramified canals, formed by parasitic vegetable organisms of the same nature as those described by Dr.

Carpenter and Professor Kölliker as occurring in the shells of mollusks &c. The organisms were found in abundant fructification; they are green, but otherwise appear to be fungi, as are the parasites of shells &c. Similar parasites are to be found in various coralla from widely distant parts of the world.

CONCLUSIONS.

Heliopora is most undoubtedly an Alcyonarian. The number of its mesenteries, and the distribution with regard to them of the retractor muscles, the form and number of its tentacles, are decisive evidence in the matter; and this evidence is borne out by almost every item of histological structure. In the peculiar manner in which the retraction of the tentacles takes place, viz. by introversion, *Heliopora* seems to differ from all other Alcyonarians except *Corallium**. From both *Corallium* and *Tubipora*, *Heliopora* differs in that the hard tissue of its corallum shows no signs of being composed of fused spicules, but in its histological structure most closely resembles Zoantharian Corals. With the Milleporidæ and with the Pocilloporidæ and Seriatoporidæ *Heliopora* is allied solely on account of its possession of tabulæ. Now that an Alcyonarian is added to the list of various Anthozoa possessing these peculiar structures, their presence becomes of less classificatory importance even than Professor Verrill proved it to be. There can hardly be a doubt that *Seriatopora* will prove to be, like *Pocillopora*, a Zoantharian; and *Millepora* is certainly very different in structure from *Heliopora*. *Heliopora* thus stands quite alone amongst modern forms; and in the peculiar structure of its cellular cœnenchym it is so remarkable that it is unlikely that on examination of the soft parts of other corals, at present known from their coralla only, any near relatives of it will be discovered. Amongst extinct forms, however, *Heliopora* has several close allies, and the genus itself existed in the Cretaceous period. The genus *Polytremacis* differs apparently only in the more perfect development of the so-called septa, which reach to the centres of the tabulæ. The genus occurs in the Chalk, Greensand, and in Eocene formations. *Heliopora* has, further, a very closely allied palæozoic representative in *Heliolites*, in which the cœnenchymal tubes are provided with very closely placed tabulæ.

The three genera *Heliopora*, *Polytremacis*, and *Heliolites* differ from one another in so slight a degree that they are placed under the one genus *Heliopora* by Quenstedt. To include these three genera, a new family of Alcyonarians must be formed, for which the term Helioporidæ appears most suitable, which family may from the recent species be thus characterized:—

* I have found no information on this point in any of the text-books; but in Schmarda's 'Zoologie' there is a figure of *Corallium*, copied from Lacaze-Duthiers's 'Hist. Nat. du Corail,' in which the tentacles are drawn introverted as they are in *Heliopora*.

Family HELIOPORIDÆ.

A compact corallum present, composed of a fibro-crystalline calcareous tissue as in *Madreporaria*. Corallum consisting of an abundant tubular cœnenchym, and with calicles having an irregular number of lateral ridges resembling septa. Calicles and cœnenchymal tubes closed below by a succession of transverse partitions. Polyps completely retractile, with tentacles when in retraction introverted. Mouths of the sacs lining the cœnenchymal tubes closed with a layer of soft tissue, but communicating with one another and with the calicular cavities by a system of transverse canals.

The structure of the cœnenchym of the Helioporidæ is entirely unique amongst Anthozoa; no other form has a cœnenchym composed thus of a series of long tubes packed side by side, and lying parallel to the calicular tubes and at right angles to the surface. It is to be remarked that the tubes are like the calicles in being open above, that they have walls composed in exactly the same manner as those of the calicles, and that they are closed below at intervals in the same way by exactly similar tabulæ. Further, the soft tissues lining the cavities of the cœnenchymal tubes are identical in structure with those lining the calicular cavities, and the same transverse system of canals connects the summits of the tubes with one another and with the summits of the calicular cavities.

It seems by no means improbable that the cœnenchym here is composed of the tubes of absorbed polyps or zooids which have lost the rudimentary organs, which they still possess in such a form as *Sarcophyton*, and have become mere tubular cavities, whose openings to the exterior even have been obliterated; it seems impossible otherwise to account for the presence of the successions of tabulæ in the cœnenchymal tubes. The foregoing considerations are suggested by the circumstance that a series of fossil corals, grouped by M.-Edwards under the *Tabulata*, appear most probably to have been Alcyonarians as well as *Heliopora*.

The genus *Chætetes* was considered by Keyserling to have belonged to the Alcyonarians, because of the absence of septa in it, and the mode in which its polyps are grouped; but Milne-Edwards retains it amongst the Zoantharians, because of its close resemblance to the Favositidæ, in which the presence of septa is regarded as conclusive in deciding against Alcyonarian affinity. The presence of calcareous septa, however, must now be considered a character of less importance than it formerly was. As is seen in the case of *Heliopora* pseudo-septa may exist, which do not necessarily correspond in any way, in disposition or number, with the membranous mesenteries. In *Stylaster* and *Cryptohelia* the calcareous septa are obviously formed as infoldings of the margin of the calicles. Here the septa are between, instead of opposite to the tentacles; and membranous mesenteries appear to be

absent, or at all events rudimentary only. In the Favositidæ the septa seem to have been no more perfect than they are in *Heliopora*, and to have been most variable in number, but often twelve, as also in *Heliopora*. M.-Edwards describes from 10 to 12 septa in *Favosites gothlandica*. In *Michelinia favosa* 30 to 40 subequal septal striæ are to be made out at the upper margin of the wall of the calicle. I cannot refer to specimens; but it seems not unlikely that the septa in the Favositidæ were pseudo-septa as in *Heliopora*, and that these coralla were formed by Alcyonarians, the perforations in the walls having transmitted transverse canals like those of *Heliopora* and *Sarcophyton*, and the coralla being free of tabular cœnenchym, because none of the polyps were aborted as in *Heliopora*. Some Favositidæ seem to have formed a compound colony, consisting of polyps and zooids, as *Favosites Forbesii*, where a few large cells are seen set amongst numerous surrounding small ones. *Heliolites* seems to a certain extent to form a transition stage between a condition such as that in *Favosites Forbesii* and the condition in *Heliopora*; for in *Heliolites*, the more ancient form, the cœnenchymal tubes are regularly hexagonal, and apparently much more nearly equal in breadth to the calicles than in *Heliopora*. In the growing points of *Heliopora* the hard parts are made up of a series of open, often hexagonal tubes, and resemble *Favosites* in their surface aspect. In *Heliopora* the transverse canals pass over notches in the summits of the walls of the cœnenchymal tubes and calicles, in order to place these cavities in communication with one another. In *Favosites* the calcareous tissue surrounded the transverse canals, and the perforations in the walls of the calicles were thus produced.

If *Favosites* was an Alcyonarian, *Chaetetes* was of course also of that group. The genus *Alveolites* amongst the Favositidæ is peculiar for the possession of three tooth-like prominences as the only representatives of septa. One tooth, well developed, is situate inside the calicle; on that side of each calicle which lies externally in the colony, and opposed to this on the tip of the calicle next the interior of the colony, are a pair of rudimentary teeth. This arrangement reminds us at once of the distinction of dorsal and ventral mesenterial interspaces in Alcyonarians, and the direction of all the "Dorsalfächer" in *Sarcophyton* and *Heliopora* towards the central axis of the colony. In *Alveolites* the two teeth seem to correspond to the "Dorsalfach," and the single one to the "Ventralfach," the two teeth having occupied the space devoid of retractor muscles. Kölliker describes a series of teeth as existing at the margin of the calicle in *Renilla*, which follow a constant law in their relation to the septa. When only one tooth is present it is opposite the "Dorsalfach;" when three, one is opposite the "Dorsalfach," and the two others opposite the lateral "Ventralfach." In *Alveolites* the one tooth is ventral instead of dorsal. In *Syringopora* the septa seem to be very much of the same nature as in *Heliopora*; and in *Heliopora*, as already described, the tabulæ are not merely transverse floors, but the bottoms of

cups of hard tissue fitted inside the older tubes and calicles. In *Syringopora* this condition of the tabulæ is much more marked, and the corallum appears as if formed of a series of calicles fitted one within another.

A difficulty appears to arise from the peculiar mode of the development of the calicles by budding in *Heliopora*, the foldings of the walls of the calicles being due, to a considerable extent at least, to the formation of these walls from a circle of cœnenchymal tubes. The septa are, however, not entirely formed in this way. It would of course be of great interest to see whether the primitive calicle, in the developing *Heliopora* colony, forms calcareous septa.

Heliopora having so commonly twelve septa, and in conjunction with these eight mesenteries, it was at first thought that here some key would be found to the elucidation of the question of the relations of the tetrameral corals to the Hexactinians; but no definite arrangement of the eight mesenteries to the twelve septa could be discovered. Ludwig and Pourtales have concluded that the tetrameral condition in the *Rugosa* is the result of a modification of an originally hexamerous arrangement—that the *Rugosa* are, in fact, modifications of the Hexactinian type. Kunth, however, using similar methods, has come to an opposite conclusion. Now that it is known that an Alcyonarian exists which constructs a solid calcareous corallum, in histological structure scarcely, if at all, to be distinguished from that of many *Madreporaria*, and that this Alcyonarian also possesses marked calcareous septa, which septa show, notwithstanding the octamerous arrangement of the mesenteries, a hexamerous disposition in being often twelve in number, it seems that the question of the affinities of the *Rugosa* may fairly be reopened. The presence of well-marked calcareous septa in *Cryptohelia* and other *Stylasteridæ* (which septa are equal to the tentacles in number, but nevertheless to be regarded, like those of *Heliopora*, as pseudo-septa) is significant. The marked tetrameral arrangement of the septa in *Rugosa*, and the presence in many forms of tabulæ, are certainly characters not opposed to the alliance of these corals with the Alcyonarians; and the fact that paired series of opercula occur in certain *Rugosa*, which are compared by Lindström, their discoverer, to the skeletal structures of certain *Primnoæ*, seems to be evidence in favour of such an alliance of the very strongest kind. In no *Madreporaria* do paired hard structures, at all resembling those of *Primnoæ* or of *Goniophyllum pyramidale*, occur. The opercular structures in the coralla of *Cryptohelia* and *Lepidopora* can scarcely be regarded as comparable with the opercula of *Rugosa*. The structures are merely folds of the lip of the calicle, and are continuous with it and immovable, not movable separate articulate structures. Many *Rugosa* show an arrangement which may well be compared to the distinction of dorsal and ventral regions in Alcyonaria. The most important distinctive character of the *Rugosa* appears to be the

occurrence in them, alone of all Anthozoa, of intracalicular gemination*.

With regard to *Sarcophyton*, the fact that compound colonies composed of multitudes of zooids, combined with a lesser number of sexual polyps, occur amongst the Alcyonidæ, as well as amongst the Pennatulidæ, in which they are so well known from Kölliker's great work, appears to be new to science. That in such colonies and in *Heliopora* the "Dorsalfächer" are all turned towards the axis of the colony and directed upwards is also a new fact. The zooids in their structure seem to conform very closely to those of Pennatulids (*Sarcophyllum*, e. g.); but to the list of distinctive differences between the zooids and polyps of Pennatulids given by Kölliker, viz. the absence in the zooids of tentacles, the presence of two mesenterial filaments (the dorsal ones), the absence of generative organs, and the shortening of the hypogastric region to such an extent that it fuses with the anastomosing canal-system—to these marks of distinction must be added, in the case of the zooids of *Sarcophyton*, the fact that four of the mesenteries, the dorsal and ventral pairs, are deeper than the others.

It seems extremely difficult to reconcile the extraordinary succession of the mesenteries in the development of the Zoantharians, discovered by Lacaze-Duthiers, with the facts presented by Alcyonarians. Did the development of the eight mesenteries of Alcyonaria correspond with that of the first eight mesenteries formed in Actiniadæ, the first mesenteries formed would be either the lateral dorsal or lateral ventral; but these are those which are most rudimentary in the zooids of *Sarcophyton*. Moreover the mesenterial filaments of the two lateral pairs of septa are in the development of Actiniadæ the first to appear, and not the dorsal, which are longest in the Alcyonarian polyps and most persistent in the zooids. Apparently, however, development in Alcyonarians follows a different course.

In *Halysceptrum*, the development of which has been examined by Kölliker, the eight mesenteries appear from the very first. In *Kalliphobe* (Busch), one of the *Edwardsiæ*, according to Metschnikoff, the larva has, in its earliest stage, eight tentacles and two mesenterial filaments.

The peculiarities presented by the Stylasteridæ have struck many observers. M.-Edwards and Haime placed these corals (Stylasteracea) under the Oculinidæ. Gray, however, established a family (Stylasteridæ) for the genus *Stylaster* alone. Pourtales, who in his 'Deep-Sea Corals' dwells upon the many peculiarities of the corallum of this family, places under it the genera *Allopora*, *Stylaster*, *Distichopora*, *Cryptohelia*†, *Lepidopora*, and *Errina*. The

* An examination of the Cornulariadæ, the only recent solitary Alcyonarians, might very possibly throw light on the question of the affinities of the Rugosa.

† Pourtales has remarked that the genus *Endohelia* of M.-Edwards and Haime appears undistinguishable from the genus *Cryptohelia* of the same authors. *Endohelia* is founded on a Japanese species. The 'Challenger' dredged a coral certainly not generically distinguishable from *Cryptohelia* off the coast of Japan.

peculiarities in the structure of the soft parts, and the relations of the tentacles to the septa, described in this paper as occurring in a *Stylaster* and a *Cryptohelia*, and the similar facts observed by Sars in the genus *Allopora*, strengthen the facts brought forward by Pourtales, with regard to the coralla, in a very potent manner. I hope to make a close study of the structure of *Stylaster*. The apparent absence of mesenteries is most remarkable, and a similar condition appears to occur also in *Millepora*. The number of tentacles and septa in the Stylasteridæ seems hardly to follow the usual hexamerous law. In the species of *Stylaster* examined by me there are invariably twenty-two septa and twenty-two tentacles. In *Stylaster erubescens*, Pourtales describes the septa as being in number from nine to twelve, most frequently eleven. In *Allopora miniata* the septa are from seven to ten, generally eight. *Cryptohelia* has commonly sixteen.

With regard to the affinities of the Milleporidæ, no certain conclusion can be arrived at from the few facts yet ascertained. I hope to obtain specimens at Hawaii in sexually mature condition.

H.M.S. 'Challenger,' North Pacific.
21st July, 1875.

POSTSCRIPT.

Since the above was written I have been able to refer at Honolulu to Prof. Lacaze-Duthiers's 'Histoire Naturelle du Corail.' I therefore add a few notes.

In *Corallium* the contracted polyp presents externally at the surface eight lobes coloured red. When the polyp is expanded, these lobes form a coloured cup with eight dentations at its margin, which surrounds the lower part of the expanded colourless polyp (see pl. 2 of Prof. Lacaze-Duthiers's work). The eight lobes described as closing the mouth of the calicle in the contracted polyp of *Heliopora* probably occupy a similar position, and have a similar appearance in the expanded condition of the polyp.

In *Corallium* the pinnæ or barbules of the tentacles are all severally introverted (*l.c.* p. 57), as well as the tentacles themselves. In *Heliopora* this appears not to be the case. In the hard tissue of *Corallium* boring vegetable parasites occur, as observed in *Millepora* and *Pocillopora*.

I have further been able to refer to Dana's great work on Corals in the splendid collection of scientific works in the Government Library at Honolulu, and to other works relating to *Heliopora*.

Dana states (U.S. Expl. Exped. vol. vii. Zoophytes, J. D. Dana, Philad. 1846, p. 539) that the blue colour of *Heliopora* is of animal origin and is lost on immersion of the coral in nitric acid. The colouring-matter was not analyzed by Mr. Gilliman.

In the Atlas of the 'Voyage de l'Astrolabe,' Zoophytes, pl. 20. figs. 12, 13, 14, the expanded polyps of *Heliopora corulea* are figured by MM. Hombron and Jacquinot. In fig. 14 sixteen very short, simple, conical tentacles are shown, in fig. 13 only fifteen

tentacles. The figures are evidently very erroneous. The corresponding description I have been unable to refer to, the volume containing it being wanting in the Hawaiian Government copy.

In the Zoology of the 'Voyage de l'Uranie,' Quoy and Gaimard, Paris, 1824, p. 656, is a description of the polyps of *Heliopora* (*Pocillopora*) *cærulea*.

The expanded polyps have radiated tentacles, and are said to entirely hide the corallum when they are in an expanded condition. Experiments proved that communication between the animals is somewhat imperfect, since a stimulus applied to any part of the colony caused only the polyps in that immediate neighbourhood to retract themselves.

In the plates of the 'Voyage de l'Uranie,' pl. 96. figs. 5, 6, 7, *Heliopora* is figured, showing in fig. 5 the appearance of the coral in the fresh state, but without any representation of the polyps.

December 9, 1875.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

"On the Development of *Lepas fascicularis* and the 'Archizoëa' of Cirripedia." By R. VON WILLEMÖES-SUHM, Ph.D., Naturalist to the 'Challenger' Expedition.

The materials for this paper were obtained during the 'Challenger's' cruise from Japan to the Sandwich Islands in 35° lat. N., when very curious *Nauplii*, some of them 12 millims. long, were caught, which were identified at once as belonging to the nauplian form to which Dohrn has given the generic name of "Archizoëa." In the daytime these larvæ were scarcer, but at night so common that large bottles could be filled with them. The question (which had been left open by Dohrn) to which cirriped these extraordinary *Nauplii* might belong was solved when large quantities of *Lepas fascicularis* were seen passing the ship for more than a week. It was then possible to keep these barnacles alive and to bring up in our globes such stages of the large *Nauplii* as had also been taken on the surface. Then, again, when catching the surface-animals, free-swimming pupæ were found, which were seen to settle on dead *Velolla* and assume the form of *Lepas fascicularis*, so that the whole development of this species could be worked out.

Reasons are given why this barnacle belongs to the species *Lepas fascicularis*; and a description is given of some parts of the mouth, which slightly differ from those described by Darwin in the same species.

I. Development of the egg and of the youngest Nauplius.

The conclusions to which an investigation into the development of the ovum, and into the changes which occur in it after its formation up to the time when the *Nauplius* comes out, has led are the following :—

1. The youngest eggs, seen in the cæca of the ovarian tubes, are transparent cells with nucleus and nucleolus.

2. The germinal vesicle, as well as the ovum, grows by taking up elements of yelk.

3. All the ova found in the ovary of a barnacle are in the same stage of development. When mature ova are to be seen in the tube, small undeveloped ova may be seen here and there in the cæca, which act very likely as mother cells for further breeding-purposes.

4. The spermatozoa, when fully developed, are simple hair-like filaments.

5. The mature ovum, as contained in the breeding-lamellæ, shows no trace of the vesicula germinalis or of its nucleolus. Some highly refractive granules may be seen here and there among the yelk-globules. The ovum is oval in form.

6. The segmentation is very irregular, but seems to be complete.

7. As soon as the segmentation begins, large transparent cells are seen separating themselves from the yelk-globules, and increasing in number as the segmentation goes on.

8. These cells form a blastoderm round the yelk. No primitive streak could be seen; but its presence is not denied, as the object is not favourable for these observations.

9. The blastoderm loses its cellular structure and gives way to a granular skin. On both sides of a longitudinal groove three pairs of appendages begin to be visible.

10. The test of the ovum extends as the embryo develops. The latter is very likely still enveloped by a thin blastodermic cuticle, which is clearly visible at the ends of the tail and antennæ when it comes out.

11. The development of the *Nauplius* in the ovum of this *Lepas* shows very much the same stages as those described by Buchholz in *Balanus improvisus*.

II. *The Nauplius stages.*

1. The *Nauplius* of *Lepas fascicularis* has, on leaving the egg, a length of 0.35 millim. It moults at least five times, and has before throwing off for the last time the Naupliial appendages a length of 12 millims.

2. The first stage of the *Nauplius* has been seen by Darwin, who describes it, and also by Burmeister.

3. After the first two moults the *Nauplius* gets a large dorsal spine and enters a series of stages, one of which has been described in another *Lepas* by Dohrn as *Archizoëa gigas*.

4. Reasons are given why *Archizoëa gigas* is nearly certain to be the *Nauplius* of *Lepas australis*, a species closely allied to *Lepas fascicularis*, and representing it south of the equator. *Archizoëa gigas* was caught, together with the large *Cyprides* of *Lepas australis*, during the 'Challenger's' antarctic cruise.

5. The tail and the caudal spine of the newly hatched *Nauplius*

are pushed in like the tubes of a telescope, and covered by a thin cuticle, which may be the blastodermic one. The same envelopes also the lateral horns, but has not been seen at the end of the appendages. The carapax is as yet quite smooth, with the lateral horns hanging down.

6. After the first moult the tail and its spines, which have been pushed out, have a considerable length, and the lateral horns are erected. Only a single pair of small spines is to be seen on the carapax. The glands inside are unicellular.

7. The *Nauplius* after the second moult has, besides the dorsal spine, a series of processes all round the edges of the carapax, to which the unicellular glands send their ducts. Besides the œsophagus, two glands, which formerly were indicated by an agglomeration of cells, become visible. These glands are very likely those which, in the *Cypris* stage, terminate in the sucker of the antennæ, and are known under the name of cement-glands. Mouth and anus are present. One pair of movable spines on the tail. First "*Archizoëa* stage."

8. Length of *Nauplius* in the fourth stage 6 millims. Three or four movable spines on the tail, with the six of the next stage shining through the chitinous coverings. The glands of the carapax are in connexion with nerves, and present a large network. No nerve-terminations on the lateral horns or on the feelers. All the processes of the carapax, as well as the lateral horns, have openings at the top for letting out the secretions of the glands.

9. Length of *Nauplius* in the fifth and last stage 12 millims. Six movable spines on the tail.

Large masses of fat are assembling in the carapax, and the *Cypris*-shell is forming underneath it. The first pair of appendages develops inside the antennæ of the *Cypris*, the sucker being formed in the fourth joint, the second of the future antenna. Large compound eyes become visible on both sides of the central eye.

10. The carapax of the *Nauplius* has now a diameter of 2 millims. The appendages are very much like those of *Archizoëa gigas*, in which Dohrn, however, has taken the third pair of appendages for the second, and the second for the third.

11. A specimen of the supposed larva of *Lepas australis* (Dohrn's *Archizoëa gigas*) is figured in the stage just before the metamorphosis into the *Cypris*-stage takes place; the two large compound eyes are already developed.

III. The *Cypris* or *pupa* stage.

1. The *Cypris* of the Atlantic (*C. fascicularis*) has been already described by Claus, who has established the homology of its parts with the Copepods.

2. Darwin has described the very large *Cypris* of *Lepas australis* (length 3 millims.), which is in every way similar to that of the present species—a further proof of the probability of the suggestion that Dohrn's large *Nauplii* are the larvæ of that species.

3. Our *Cypris* has a length of 1.3 millim.

4. A description is given of the antennæ with the suckers and their glands, the development of which from the glands in the labrum has been mentioned already. The parts of the mouth (small labrum and three pairs of maxillæ and maxillipeds) and the natatory feet, as well as the caudal appendages with the anus at their base, are figured and described. The organs of sense, the digestive organs, and the shell-gland, which is now very conspicuous, offer scarcely any thing that has not been seen already by Darwin and Claus in the *Cyprides* of the different species of *Lepas*.

IV. The metamorphosis of the *Cypris* into the young *Lepas*.

1. The pupæ are chiefly caught at the very surface of the sea, where they swarm round the dead *Veilellæ*, on which they settle. They rarely take to a colony of old barnacles.

2. Soon after settling the new cirri are formed underneath the natatory feet, the head grows out, the eyes are absorbed, and under the *Cypris*-shell the primordial valves of the young *Lepas* appear, which persist during its whole life. The *Cypris*-shell, with the old natatory feet, is then thrown off.

3. The young *Lepas* begins to form the complete shell, and fastens itself more and more by the copious secretions of its glands, which run through the outdrawn and enlarged head into the fixing-antennæ.

4. The cirri of the young *Lepas* develop a larger number of joints, the shell begins to lose its transparency, the body inside turns over a little, as has been described by Darwin, and the young *Lepas* is complete.

Conclusion.

1. As the young stages of the Lepadidæ are pelagic, it is only possible to work out their development at sea, and there at certain seasons. We found only once before the large *Nauplii* of *Lepas australis*. The development of no one of the Lepadidæ has hitherto been known in full; and it seems that even the adult larvæ of our commonest barnacles, such as *L. anatifera* and *L. anserifera*, are as yet unknown.

2. The *Nauplius* stages of *Lepas fascicularis* have not a different morphological value from those of *Balanus* and other genera; therefore there is no reason for giving to this stage a particular name. The term "*Archizoëa*" may remain as a remembrance of Dohrn's interesting discovery, but cannot be applied to the larvæ of other Lepadidæ.

H.M.S. 'Challenger,' Honolulu,
July 28, 1875.

“Preliminary Remarks on the Development of some Pelagic Decapods.” By R. VON WILLEMÖES-SUHM, Ph.D., Naturalist to the ‘Challenger’ Expedition.

Since we left Australia I have investigated the metamorphoses of some Crustacea which have been constantly caught by us on the surface of the tropical and subtropical parts of the Pacific. Though these investigations will be continued, I have now arrived at certain results which I think will not be uninteresting to zoologists. The genera to which these remarks refer are *Amphion*, *Sergestes*, and *Leucifer*.

Amphion Reynaudi has been on our lists as an animal “*incertæ sedis*” (Milne-Edwards) for nearly forty years, until Dohrn proved that a full-grown specimen of it, which he dissected, was in possession of branchiæ and of an ovary, therefore no doubt a mature form. He also described one of its young stages, which has the number of appendages of a *Zoëa*, but in which caudal appendages are already developed.

On our voyages in the ‘Challenger’ we have caught several specimens of *Amphion* and of its larvæ; and I am now able to produce drawings, not only of the *true Zoëa* with a simple telson, but also of all the intermediate stages between it and the adult form with two, three, four, five, and six pairs of walking-legs. Of the full-grown *Amphion* I have examined three specimens, two of which are undoubtedly males, as the testes (and the branchiæ) were plainly visible, the former opening into the last pair of legs.

There is now no doubt that *Amphion* is not a larva, nay, even that there are several species and perhaps genera of this remarkable form. We have caught two very interesting mature animals which are certainly closely allied to *Amphion*. One of these has enormously long eye-stalks, which, having a length of 7 millims., are just as long as the whole animal’s body. Another form has got very long eye-stalks too, but is especially remarkable for the antepenultimate joints of its pereiopods, being large paddle-shaped organs, terminated by a very small end-joint. Both have got, like *Amphion*, a central (Naupliar) eye and eight pairs of branched legs; but their body is more *Sergestes*-like and less flat than that of *Amphion*. They certainly both belong to the same genus, and may be called *Amphiones* until more than one specimen of each has been obtained.

To me these Amphionidæ are especially interesting, as I can compare them with the larvæ of *Sergestes* and *Leucifer*, the former of which have also got eight pairs of branched legs and the central eye which persists in the Amphionidæ. There are good reasons for the statement that the larvæ of *Leucifer* and *Sergestes* pass through an *Amphion*-stage; and this, it seems to me, throws a good deal of light on the relations and systematic position of *Amphion* itself.

Dohrn, to whom we owe so many fine discoveries concerning

the pelagic Crustacea, has described *, under the name of *Elaphocaris*, a small and very spiny *Zoëa* caught in the harbour of Messina. He calls it the larva of a Decapod without fixing its position. This small larva was often seen by me in the Atlantic; but I only lately found out that *Elaphocaris* is the larva of a species, or rather of some species, of *Sergestes*. There is, however, one species of this genus in which the *Zoëa* is not an *Elaphocaris*, but a larger, less spiny form, similar, however, in all other respects to the former. Of the species which develops with an *Elaphocaris*-stage in the Western Pacific, I have collected numerous specimens of all the stages, from the youngest *Zoëas* up to the mature animal. The mode of development is very simple. After the first moulting the larva gets six more branched legs and loses many spines. It enters the *Amphion*-stage, then moults, throws the branched legs off, gets branchiæ, and becomes a young *Sergestes*. Only after this last moulting the central eye, hitherto present, disappears.

And very similar to that of *Sergestes* is, the development of *Leucifer*. Here the earliest *Zoëa* of a species from the Western Pacific has got at first no eyes, then sessile ones come out, and the animal then presents the form which Dana has called *Erichthina demissa*, and which Claus suspected to be not a Stomatopod but a Schizopod larva. After the second moulting this *Erichthina* gets stalked eyes and very long setæ on all its appendages, becoming a rather long, very delicate *Zoëa*. It now enters the *Amphion*-stage, but never gets more than four pairs of pereopods, and loses another pair of these when it moults for the youngest *Leucifer*-stage, in which two pairs of pereopods are absent.

The next question, after having found this out, was, of course, whether *Amphion*, *Sergestes*, and *Leucifer* leave the egg as a *Zoëa*, or whether there is a preceding *Nauplius*-stage. My own impression is that in the two first-named genera this is not the case, as the youngest *Zoëas* which I caught had all the same size, and as none of them was without the large lateral stalked eyes. As for *Leucifer*, the question appears to me to be doubtful; for it is, from what I have seen, quite possible that my youngest *Zoëa*, which has only got a central eye, may be preceded by a *Nauplius*. Of course the simplest thing would be to get the eggs; but there is the difficulty, for *Amphion* is caught very rarely, and has never been obtained at any other time but between 8 and 12 P.M., when it is extremely difficult by lamplight to find out the youngest stages. *Sergestes* larvæ are commoner, appearing also in the daytime, and *Leucifer* is sometimes caught in abundance. I hope, therefore, that I shall succeed in completing my researches about this question, especially as far as the latter two genera are concerned.

H.M.S. 'Challenger,' Honolulu, Sandwich Islands,
July 30, 1875.

* V. Siebold und Kolliker, Zeitschrift für wissenschaftliche Zoologie, Band xx. p. 662, tab. 31. fig. 28.

GEOLOGICAL SOCIETY.

November 3rd, 1875.—John Evans, Esq., F.R.S., President,
in the Chair.

“On some new Macrurous Crustacea from the Kimmeridge Clay of the Sub-Wealden boring, Sussex, and from Boulogne-sur-Mer.” By Henry Woodward, Esq., F.R.S., F.G.S.

The first species described by the author belonged to the fossorial family Thalassinidæ, six species of which, belonging to four genera, are now found on the British coasts. The known fossil species are from the Chalk of Maestricht, the Greensand of Bohemia and Silesia, the Chalk of Bohemia, the Greensand of Colin Glen, near Belfast, and the Upper Marine Series of Hempstead, Isle of Wight. All these are referred to the genus *Callianassa*, which also includes the species from the Kimmeridge Clay described in this paper. The fossil is seen in profile on several sections of the core, and has the enlarged hands of the fore limbs more nearly equal in size than in the living species of *Callianassa*; the carapace and segments of the abdomen are smooth; and the latter are somewhat quadrate in profile, contracted at each extremity, and not pointed; and the caudal plates are oval. For this Crustacean the author proposes the name of *Callianassa isochela*.

The second species described belongs to the genus *Mecochirus*, distinguished by the great length of the fore limbs, which is equal to that of the whole body, the oldest known species of which (*M. olifera*, Quenst.) is from the Lower Lias of Württemberg. It was obtained, together with *Lingula ovalis*, from the Kimmeridge Clay of Boulogne, by Mr. J. E. H. Peyton, after whom the author proposes to name it *M. Peytoni*. In this species the fore legs are very finely punctate, and measure 75 millims. in length. The rostrum is somewhat produced; and the carapace, which is finely granulated, measures 30 millims. in length. The antennæ are long and slender. The abdomen measures 45 millims.; and the epimeral borders of the segments are falcate. The species is intermediate in size between *M. socialis*, Mey., and *M. Pearcei*, M^cCoy, which the author regards as distinct. He also refers to *M. Peytoni* a pair of fore limbs obtained from the Sub-Wealden boring.

“On a new Fossil Crab from the Tertiary of New Zealand.”
By Henry Woodward, Esq., F.R.S., F.G.S.

In this paper the author described a crab obtained by Dr. Hector, F.R.S., Director of the Geological Survey of New Zealand, from the “Passage-beds” of the Ototara series in Woodpecker Bay, Brighton, on the west coast of the south island of New Zealand. The new species belongs to the genus *Harpactocarcinus*, A. Milne-Edw., which includes six species from the Eocene of Southern Europe. Its nearest ally is *H. quadrilobatus*, Desmar.; but its

carapace is much more tumid, especially on the branchial and gastric regions; the surface of the anterior half of the carapace is nearly smooth, and that of the posterior half finely granulated. The rostrum is short and very obtusely tricuspidate; the orbits shallow and rounded; the hepatic margin bluntly toothed, with a stronger tooth at the epibranchial angles; the divisions of the regions of the carapace faintly indicated; and there is a slightly roughened line on the sides of the gastric intumescence. The characters of the jaw-feet and of the chelæ are described by the author; of the latter the right is considerably larger than the left hand. The specimen was a female. For this species the author proposed the name of *Harpactocarcinus tumidus*.

Dr. Hector explained the sequence of formations in the locality from which the above Crab was derived, and stated that the Ototara series is the upper member of his Cretaceo-Tertiary formation, containing some fossils of decidedly Cretaceous type, such as Saurian bones and fragmentary *Inocerami*, and other forms that are associated with decidedly Mesozoic fossils in the underlying strata. On the other hand, the occurrence of Tertiary forms such as *Nautilus ziczac* (or a nearly allied form) connects it with the Eocene, while the gigantic Penguin (*Palæudyptes antarcticus*, Huxl.) and a Turtle indicate a fauna not unlike that at present existing in adjoining areas.

“On a remarkable fossil Orthopterous Insect from the Coal-measures of Britain.” By Henry Woodward, Esq., F.R.S., F.G.S.

The author commenced by indicating the importance of the examination of the Clay-ironstone nodules of the Coal-measures, in which so many valuable fossils have been discovered, including the remarkable insect described in the present paper. The specimen displays the characters of the four wings, only two of which, however, are nearly perfect; and these measure $2\frac{1}{4}$ inches in length and 1 inch and $1\frac{1}{4}$ inch in breadth, the hind wing being the broadest. The author described in detail the characters presented by the venation of the wings, which includes three straight veins running parallel to the fore margin, the third bifurcating near the apex, a fourth much curved vein giving origin to six branches, and having at its base a triangular space, from which arise the other veins of the wing. The body appears to have been about 5 lines broad between the bases of the wings. In front of the wings is the prothorax in the form of two large, rounded, dilated, and veined lobes; it measures 14 lines across and 6 lines in length. In front of these lobes is the head with its eyes, produced in front into a slender process 3 lines long. This insect is considered by the author to be most nearly related to the Mantidæ, the characters of the head and thorax especially being to some extent paralleled in the existing genus *Blepharis*. The author proposed to name the species *Lithomantis carbonarius*, and suggested that *Gryllacris* (*Corydalus*) *Brongniarti* probably belongs to the same genus.

“On the discovery of a Fossil Scorpion in the British Coal-measures.” By Henry Woodward, Esq., F.R.S., F.G.S.

The author commenced by noticing the various European and American localities in which fossil Arachnida have been found in the Coal-measures. Hitherto no true Scorpions have been recorded from the English Coal-measures; but in 1874 the author received from Dr. D. R. Rankin a specimen from the Coal-measures near Carluke, which he regarded as the fossil abdominal segment of a Scorpion; in April last he obtained a fossil Scorpion from the Sandwell-Park Colliery; and in August Mr. E. Wilson forwarded to him several specimens of similar nature in Clay-ironstone nodules from Skegby New Colliery near Mansfield. The specimens are all very imperfect; but the author states that they most closely resemble an Indian form which is probably *Scorpio afer*. He refers the English species provisionally to the genus *Euscorpius*, Meek and Worthen, and proposes to name it *E. anglicus*.

November 17th, 1875.—John Evans, Esq., F.R.S., President,
in the Chair.

“On a new modification of Dinosaurian Vertebræ.” By Prof. Richard Owen, C.B., F.R.S., F.G.S., &c.

The peculiar modification of the Dinosaurian vertebra noticed by the author occurs in *Tapinocephalus Atherstonii* and *Pareiasaurus bombidens*. In the dorsal vertebræ of the former the centra are nearly flat on both fore and hind surfaces, a structure to express which the author proposes the term “amphiplatyan.” The hind surface is very slightly the more concave. The middle of each surface is pierced by a small foramen leading into a cylindrical canal, first slightly expanding and then rapidly contracting to a point, which meets the apex of the similar hollow cone coming from the opposite surface. Similar characters were observed upon the free surface of the anterior sacral and upon that of the posterior of four anchylosed sacrals.

The dorso-lumbar vertebræ of the *Pareiasaurus* had centra relatively longer than those of *Tapinocephalus*. Their articular surface is subundulate, convex along a fourth of the periphery, concave at the centre, where there is an excavation corresponding to that in *Tapinocephalus*, but with a relatively wider aperture, a rather more constricted canal, a shorter terminal cone, and an interval of osseous tissue separating the apices of the cones from the fore and hind surfaces. In what is probably the first cervical vertebra of the same Dinosaur, the centrum is so concave on both surfaces as to become amphicælian.

In these unossified tracts of the middle of the centrum in the two genera above-mentioned the author sees indications of a persistent trace of the primitive “chorda dorsalis;” and he calls attention to the resemblance thus set up between these probably Triassic Dino-

sours and the lower Ganocephalous reptiles of the Carboniferous series, in which, however, the vertebral centra are more widely perforated.

January 19, 1876.—John Evans, Esq., F.R.S., President,
in the Chair.

“On some Unicellular Algæ parasitic within Silurian and Tertiary Corals, with a notice of their presence in *Calceola sandalina* and other fossils.” By Prof. P. Martin Duncan, F.R.S., V.P.G.S., &c.

After noticing the works of Quekett, Rose, Wedl, and Kölliker, which refer to the existence of minute parasitic borings in recent corals, recent shells, and a few fossil mollusca, the author describes the appearance presented by a great system of branching canals about 0.003 millim. in diameter, in a Thamnastræan from the Lower Cainozoic of Tasmania. He then proceeds to examine the corresponding tubes in *Goniophyllum pyramidale* from the Upper Silurian formation. In sections of that Coral one set of tubes runs far into the hard structure; these are straight, cylindrical, and contain the remains of vegetable matter. Neither these tubes, nor any others of the same parasite, have a proper wall; they are simply excavations, the filiform alga replacing the organic and calcareous matter abstracted. In some places the dark carbonaceous matter is absent, and the lumen of the tube is distinguishable by the ready passage of transmitted light. Other tubes run parallel to the wall, and enter by openings not larger than their common calibre. But there are others which have a larger diameter, and in which the cytoplasm appears to have collected in masses resembling conidia; and where fossilization has destroyed much of the continuity of a tube a series of dark and more or less spherical bodies may be seen. In some places, especially in the spaces between the minute curved dissepiments and tabulæ, hosts of globular spores, with or without tubes emanating from them, may be seen. In *Calceola sandalina* corresponding structures exist sometimes, and the method of entry of the parasite can be examined. The author gave two instances, one of which was seen in section. A decided flask-shaped cavity existed in the wall of the shell, opening outwards and rounded and closed inwards. It was crowded with globular spores (oospores); and these, where near the sides, had penetrated the hard shell, and thus gave a rugged and hairy appearance to the outline of the flask-shaped cavity. After noticing minute structures in a Branchiopod included in a Silurian Coral, and in a Lower Silurian Foraminifer, the author asserted, from the results of his late researches upon the algæ parasitic in Corals out of his own aquarium, that the fossil and recent forms are analogous in shape, size, and distribution. He considers that the old parasite resembles *Saprolegnia ferox* in its habit; and as he considers that *Empusina*, *Saprolegnia*, and *Achlya* (members of the Protista) are the same

organisms living under different physical conditions, he names the old form *Palæachlya penetrans*; and he believes that it entered the wall by the spores fixing on to the organic matter, and growing by its assimilation, and that carbonic anhydride was evolved. He considers that this acid, assisted by the force of growth and the movement of the cytoplasm, are sufficient to account for the presence of the tubes. Finally, the author draws attention to the probable similarity of external conditions in the Silurian and present times, and to the wonderful persistence of form of this low member of the Protista.

MISCELLANEOUS.

On some Ornithological Errors in the 'Reliquiæ Aquitanicæ.'

By ALFRED NEWTON, M.A., F.R.S., V.P.Z.S., &c.

THAT Section (xxiii.) of the recently completed 'Reliquiæ Aquitanicæ' which contains the "Observations on the Birds whose Bones have been found in the Caves of the South-west of France, by M. Alphonse Milne-Edwards," &c. &c., includes some errors of a rather grave character—due no doubt, in a great measure, to the fact that the translator of the same was not a professed ornithologist. As, however, these errors, if not corrected, may lead to serious misconceptions on the part of archæontologists who have no special knowledge of birds, I beg permission to notice them in the 'Annals and Magazine of Natural History,' only premising that I do so at the instance of the Author of the section and with the assent of the Editor of the whole work.

Page 226, line 26. "THE TAWNY EAGLE. *Falco fulvus*, Linn." This is the species we know as the Golden Eagle, *Aquila chrysaëtus*. That which we commonly call the "Tawny Eagle" is *A. naevioides*, a southern bird and one not likely to have inhabited Aquitaine at the period when the "caves were filled." On the next page (lines 10, 11) the name "Golden Eagle" is obviously used in a wrong sense.

Page 227, line 14. "THE SCREAMING EAGLE. *Aquila clanga*, Pallas?" This is a new English name for a bird now recognized as distinct from the so-called *A. naevia* or Spotted Eagle of authors. The *A. clanga* is a well-known species in Eastern Europe, and may well have been that of the Reindeer-period in France. "Screaming Eagle" is a name rather applicable to the *Haliaëtus vocifer* of South Africa.

Page 227, lines 20, 21. "Barred-tailed Eagle (*A. fasciata*, Vieillot)" is another new English name for a species long known as Bonelli's Eagle.

Page 228, line 22. "THE COMMON FALCON" is not the common English name for this species, which is the Peregrine Falcon

(*Falco peregrinus*); and an indication to that effect seems wanted.

Page 230, line 1. "THE VULTURE" to English ears would rather signify *Gyps fulvus*; the epithet Black or Cinereous is required, to show which species is really intended.

Page 232, line 6 and elsewhere. "Harfang" conveys no signification to the ordinary English reader: by it is meant the Snowy Owl.

Page 232, line 16. This assertion is wrong, the reverse being the case.

Page 232, lines 34-36. The statement is erroneous as regards the British Isles, in some parts of which the Snowy Owl occurs frequently almost every winter and not unfrequently at other seasons.

Page 233, lines 5, 6. "At Spitzbergen . . . the Snowy Owls subsist on *Lagopus hemileucurus*." This assertion can hardly be reconciled with the fact that when it was written only two examples of this Owl had been recorded as observed in Spitzbergen; and one of these, according to Dr. Malmgren, was probably attracted by Walrus-carcaasses.

Page 236, lines 1-6. It is very questionable whether the Nutcracker ever inhabits Lapland, equally doubtful whether Swedish specimens are larger than those of temperate Europe, and certainly wrong that the *Nucifraga brachyrhyncha* of Brehm is the northern as distinguished from the southern form. If there be any difference between the so-called *N. brachyrhyncha* and the true *N. caryocatactes*, it is most likely sexual, the former being the cock and the latter the hen. The suggestion with which the paragraph concludes is therefore founded on a misapprehension.

Page 236, line 14. The Crossbill which has occurred (but only about half-a-dozen times) in Greenland is *Loxia leucoptera*, an American species; and accordingly the remark is inapplicable.

Page 237, line 10. For "the eastern parts of the north of Europe and Asia" read "the most northern fir-forests of Europe, Asia, and America."

Page 238, line 8. "THE STOCKDOVE. *Columba livia*." *C. livia*, in French *Le Biset*, is the "Rock-Dove" of Englishmen, and, as is well known, the parent of all domestic races. The "Stock-Dove," so called from its often breeding in stocks of trees, is the *C. œnas* of authors.

Page 239, lines 8-14. The Willow-Grouse inhabits a great deal more than "the north" of Europe, besides the greater part of Siberia; and it does most especially "frequent forests," though not lower than the subalpine or subarctic zone. Its geographical distribution is very different from that of the Snowy Owl, which is not a forest-bird at all.

Page 239, lines 16 *et infra*. My views in the paper ('Proceedings of the Academy of Natural Sciences of Philadelphia,' 1871, p. 96) to which reference is made are much misrepresented.

Therein I never used the word "subspecies," and I expressly stated that I counted *Lagopus scoticus* "as a species," though I was persuaded (as I still am) that "it is only *L. albus* modified to suit an insular climate"*. Furthermore, *L. mutus*, *L. rupestris*, and *L. hemileucurus* were not considered by me to have any such very near relationship to *L. albus* as I conceive *L. scoticus* to have.

Page 239, line 24. The "certain uniformity of tints" spoken of exists, except in the female, at one time of the year only, and even then is not applicable to *L. scoticus*.

Page 240, footnote. For "seems to entertain" read "entertains."

Page 241, lines 7, 8. The Black Grouse is far less "common in the mountains of Sweden and Norway" than it is in the lower districts.

Page 244, line 5. The statement that the Wild Swan "inhabits the Polar regions" gives a very incorrect impression; for most of the Wild Swans that visit Western Europe are bred in Iceland, altogether outside the Arctic Circle, while the species found in the Polar regions of America are most likely quite distinct from those which inhabit the Old World.

In noticing these errors I have omitted any reference to some others which have been already corrected in the concluding portion of the 'Reliquiæ Aquitanicæ' (p. 292); and I may perhaps be allowed to add that my sole object has been to contribute to the utility of that work. I certainly impute no blame to its learned Editor or to my distinguished friend M. Alphonse Milne-Edwards.

On the Verminous Pneumonia of Domestic Animals.

By M. E. BUGNION.

M. E. Bugnion communicated to the meeting of the Swiss Society of Natural Sciences, held at Andermatt in September last, some observations on the pneumonia produced in domestic animals by the presence of parasitic worms in the lungs, which seem to be of much practical interest. He insisted especially upon the different forms assumed by the disease according as it is caused by adult *Strongyli* or by ova and embryos. Up to this time he has observed:—

1. A *lobular form*, produced by adult *Strongyli* coiled up in the bronchi.

2. A *diffused form*, caused by ova and young larvæ of Nematodes scattered by thousands in the tissue of the lungs.

3. A *nodular or pseudo-tubercular form*, produced by the accumulation of the ova at certain limited points of the lung.

The first form was studied in the calves and heifers of the Jura, where this disease sometimes acquires an epizootic character. During the great slaughter ordered by the Government of the Canton de Vaud on the pastures of Neuvaz (Jura) in September 1874, on

* See also 'Encyclopædia Britannica,' ed. 9, vol. iii. p. 757.

account of contagious peripneumonia, M. Bugnion only ascertained fourteen cases of the latter disease in 170 head of cattle, while at least sixty (for the most part young animals) were affected with verminous pneumonia. This had a strongly marked lobular character and appeared throughout to be of recent date. On cutting into the bronchi, great numbers of filiform worms (*Strongylus micrurus*), measuring as much as three inches long, were to be found, generally coiled up in an accumulation of yellowish mucus. The bronchi occupied by the parasites are precisely those which correspond with the hepatized lobules.

The diffused form was observed in goats at the Veterinary College at Zurich. In one of these animals which died on the 22nd of May, 1875, the lungs no longer contained any adult *Strongyli*; but there were thousands of elongated ova about one tenth of a millimetre in length, and a great number of little worms very like *Trichinæ* and invisible to the naked eye. These little parasites irritate the pulmonary tissue like so many foreign bodies, and cause a sort of diffused infiltration which is generally of great extent. The microscope shows considerable desquamation and proliferation of the endothelium of the air-cells, as observed by Prof. Böllinger ("Zur Kenntniss der desquamativen und käsigen Pneumonie," Arch. für exp. Path. und Pharm. Bd. i. 1873). The *Strongylus* of the cow is expelled from the lungs before oviposition takes place, and the young are developed elsewhere; but that of the goat (*S. filaria* or *rufescens*?) deposits its ova in the lung, and it is in that organ that the young larva passes through at least the first phases of its existence. Instead of disappearing in the winter without leaving any traces, this verminous pneumonia of the goat thus becomes a very serious chronic disease.

The author has studied the nodular form in a cat poisoned with strychnine. All the lobes of the lung presented, both at the surface and in the interior, a great number of perfectly circumscribed whitish tumours, in each of which the microscope revealed a myriad of rounded ova containing small rolled-up worms, embryos, or vitelline masses in all stages of segmentation. Here, again, these little foreign bodies, forming numerous colonies in the interior of the pulmonary tissue, had caused a most distinct desquamative pneumonia, although restricted to certain perfectly circumscribed parts. This observation in every respect confirms that of Henle upon which Leuckart threw doubt ('Die menschlichen Parasiten,' ii. p. 104). Other identical cases have been reported by Legros (Gaz. Méd., Paris, 1867, p. 131), Villemin (Recueil de Méd. Vét. 1867, p. 75), and Colin (Ann. de Méd. Vét., Brussels, 1867, p. 12). Similar nodosities also occur in the lungs of the goat, sheep, and pig. These animals present sometimes the diffused pneumonia, at others the small pseudo-tubercular tumours, according as the ova of Nematodes are scattered here and there or united in colonies at particular points.—*Bibl. Univ., Archives des Sciences*, December 15, 1875, p. 324.

Nidification of the Indian Rainbow-Fish.

By M. PAUL CARBONNIER.

The rainbow-fish (*Colisa vulgaris*, Cuv. & Val.) is met with in the tanks and ditches of the country watered by the Ganges. Its length never exceeds 4 centimetres. It is one of the prettiest of known fishes. One is agreeably surprised with the exuberance of colour that nature has bestowed upon this little animal; but its most important peculiarity, from a scientific point of view, is its mode of nidification.

As spawning-time approaches, the male, spreading his brilliant fins, plays round the female, showing her his bright colours; with his long ventral filaments he pats and touches her in all directions, until, overexcited by his caresses, she takes to flight. I believe that all these graceful movements of the male fish, all these amorous proceedings, influence the physical condition of the female and aid the maturation of the ova.

The male fish then commences the preparations for oviposition. Seizing a little *Conferva* in his mouth, he carries it to the surface of the water. The plant, from its greater density, would fall back very rapidly to the bottom; but our little workman sucks in a few bubbles of air, which he divides and places immediately beneath the plants so as to prevent them from descending. He repeats this process several times, and thus, in the first day, forms a floating island 8 centimetres in diameter. The bubbles of air are not coated with a greasy liquid as in the case of the *Macropoda chinensis*; all those which approach sufficiently to touch, unite together and fuse into one.

The next day the male continues his provision of air, which he now accumulates towards the central point. These bubbles exert a pressure from below upwards, the consequence of which is the elevation of the vegetable disk, which, issuing from the water, becomes converted into a sort of dome floating on the surface.

The nest being completed outwardly, the fish busies himself with giving it a firmness which may protect it from shipwreck. With this view he creeps upon it in all directions, and glides over its walls to smooth the surfaces; he forcibly presses this felt with his muzzle and his chest; if one of the twigs is too prominent he seizes it and removes it, or, by means of successive pushes with his head, forces it into the interior. It is by turning and pressing the wall from all sides that he succeeds in rounding it nicely.

The protective roof being finished, the male plays about the female, shows her the brilliancy of his dress, touches her with his appendages, and seems to invite her to follow him. The female then soon enters the nest. While she is feeling its walls and examines its arrangement, the male, bent horizontally under the entrance, turns spirally upon himself, throwing towards the summit of the edifice the lustre of his many-coloured tints.

Speedily the female approaches the male with confidence; she applies her head near the extremity of his anal fin, and thus tra-

verses it as far as the origin of the filaments; then she bends into a semicircle. The male fish, by a like inflexion of his body, embraces her, turns her over, and presses her side, an operation the result of which is a first emission of ova. These, from their lightness, tend of themselves to rise; but, with a foresight which cannot be too much admired, the male in pressing the female forms, by means of his dorsal fin, a concave fold, a receptacle in which the ova undergo the contact of the fecundating principles. Soon after, there is a new visit of the female, and a fresh approximation of the male, until the ovaries are completely evacuated.

The spawning over, the female quits the conjugal roof, leaving to the male the care of rearing the family, a task of which he acquires himself with a truly paternal zeal. Collecting with his mouth the ova scattered through the plant, he raises them into the nest and arranges them in orderly fashion; if they are too much agglomerated, he separates them by a movement of the head and compels them to remain in the same plane; then he issues from the nest, and sets himself with great activity to contract the entrance. When this operation is completed, he goes away and swims round his edifice to examine the whole,—and not without anxiety; for he often goes to fetch fresh bubbles of air, which he places intentionally under doubtful points or under menaced parts.

After seventy hours of incubation the male, foreseeing that the ova require fresh care and quite a different medium, ascends in the nest and pierces its summit; the air-bubbles escape and the dome immediately flattens upon the water, imprisoning all the embryos, the existence of which begins to be manifest.

Fearing lest the young should escape his care, he sets to work to make a new barrier for them. For this purpose he follows and traverses the outer margin of the floating carpet, and pulling at it with force, separates it from the felt, thus obtaining a sort of pendent fringe where stray young ones will not be able to pass; then, having got rid of all anxiety from this side, he takes his young in his mouth and removes them to short distances, always conveying those of the circumference towards the centre.

If some of the young fish venture to descend vertically, he goes in search of them, and carries them back to the protective dwelling. This surveillance lasts until the embryos, having undergone their complete evolution, have acquired strength and agility. Their numerous and frequent flights announce to the male the end of his troubles, which comes about eight or ten days after the sinking of the nest.

The same pair of fish gave me three ovipositions during the summer of 1875, each consisting on the average of 150 ova.

The embryos of the rainbow *Colisa* undergo a series of transformations analogous to those which I first indicated as occurring in *Macropoda chinensis*. Want of time and the dread of affecting the existence of animals which are still rare prevented my following this investigation with all the attention that the subject deserves; but I propose to resume it hereafter.

All my observations on the Indian *Colisa* were made in Paris, in

small aquaria containing about 15 litres, the temperature of the water being kept at 23°–25° C. (=73°·4–77° F.).—*Comptes Rendus*, December 6, 1875, p. 1136.

Zoological Notes made during a Residence at Scheveningen.

By M. P. HARTING.

In these Notes we find some particulars as to the membrane of the egg of *Cyanea*, the otoliths of *Cyanea* and *Chrysaora*, the nervous system and organs of the senses of an *Encope*, and some interesting researches upon the chromatophores of the embryos of *Loligo vulgaris*. The observations made by M. Harting upon these last organs lead to some results which differ in certain points from those arrived at by Harless, Brücke, and, more recently, F. Boll.

The embryos of *Loligo* which furnished the Dutch naturalist with the most favourable objects of study were only from 3 to 4 millims. long. In living individuals of this size the body is sufficiently transparent to allow of the employment of transmitted light, and show clearly the relations of the chromatophores to the tissue surrounding them.

When the chromatophores are in a contracted state, they present the appearance of small, nearly black globules, from 0·020 to 0·030 millim. in diameter, and consequently invisible to the naked eye. They are therefore without influence on the ground of the general colour of the animal, which is milk-white. When they extend, the chromatophores begin to show the colour which is proper to them—that is to say, yellow, brownish or reddish yellow, and more or less reddish violet; and their transparency increases with the degree of expansion at the same time that the colour becomes brighter.

M. Harting did not observe the chromatophores in course of division; he believes that the increase in the number of these organs takes place by the appearance in the clear spaces of new chromatophores which are at first yellow and afterwards pass to other colours. With the exception of a very small number of yellow chromatophores of very small size, which the author regards as being in course of formation, the diameter of these organs in the expanded state varies from 0·150 to 0·200 millim.; so that they have from 7 to 10 times the diameter and from 50 to 100 times the surface of the contracted chromatophores. When the vitality of the animal is still great, the contraction and expansion take place in a very rhythmical manner, and may arrive at the number of ten to twelve changes of state per minute. When life begins to fail in the embryo out of its envelope, the movements slacken; they afterwards cease completely; and when the animal is dead, nearly all the chromatophores remain in a state of expansion. This fact is scarcely explicable in accordance with the views of those naturalists who, like Harless and Boll, assume the existence of contractile fibres of muscular nature inserted in the walls of the chromatophores, and producing expan-

sion by means of a traction exerted upon these pigment-sacs. Under the old explanation expansion would be the active and contraction the passive phase; and, indeed, a stellate form has been described as the result of the dragging produced upon certain points. M. Harting has never seen this last appearance; he has only sometimes recognized the existence of processes resembling small diverticula.

According to M. Harting, all the chromatophores of the embryos of *Loligo* are situated immediately beneath the epidermis, in the layer which will afterwards become the dermis, and which then presents the ordinary structure of still amorphous connective tissue. Each of them is placed in a small flattened cavity, in which it can effect its movements of contraction and expansion. Without pronouncing any decided opinion, M. Harting thinks it probable that there is a very delicate parietal membrane. He was unable to ascertain the existence of a nucleus; but this negative observation is not of much value, as F. Boll says expressly that the nucleus is very difficult to distinguish in *Loligo*.

Although M. Harting did not succeed in recognizing muscular fibres inserted upon the periphery of the chromatophores, he nevertheless ascertained the existence of fibres of another kind, from twelve to twenty of which radiate round each chromatophore. Each of these fibres terminates towards the chromatophore by an inflated part containing an ellipsoidal nucleus. Under a very high power the terminal inflation shows four or five longitudinal striæ, which may be traced into the slender part of the fibre, and which perhaps indicate that the radial fibres are themselves composed of a certain number of much more delicate fibres. M. Harting has never seen these fibres continued into those of a neighbouring chromatophore; but in proportion as they depart from the chromatophore they become paler and paler, and seem to lose themselves in the midst of the surrounding granular tissue. It is nevertheless possible that they may change their level and be continued into the muscular layer. According to M. Harting, these fibres do not unite to form, as Boll supposed, a wall round the chromatophore; they are, on the contrary, isolated and independent of each other. M. Harting's opinion is that the power of expansion and contraction resides in the protoplasmic substance of the chromatophore, and not in the fibres or cells which surround it. He thinks that the fibres are of nervous nature, and that under their influence the chromatophore, by its own activity, executes the movements of which it is the seat. By examples derived from what is observed in the cells of the walls of the heart in the embryo of *Loligo*, in many Infusoria and Gregarina, and in the chromatophores of the chameleon, he shows that analogies are not wanting in favour of this view.—*Niederländisches Archiv für Zoologie*, vol. ii. 1875; *Bibl. Univ., Bull. Sci.* December 15, 1875, p. 432.

On the Scientific Exploration of the Caspian Sea.

By M. OSCAR GRIMM.

During the past year (1874) I have been able to investigate the southern portion of the Caspian. I resided two months at Bakou, and passed one month on board a steam-schooner which was placed at my command by the Grand-Duke Michael Nicholajewitsch. I then went from Bakou to Krassnowadsk, and from the latter point to the eastern shore in the Balchanic gulf, in which the mouth of the Oxus was formerly situated, by the island of Tscheleken. Afterwards I went south to Astrabad, thence to Enzili, to Lenkoran, and again to Bakou.

Everywhere I fished and dredged down to a depth of 150 fathoms, which enabled me to procure a very considerable number of animals, among which are six new species of fishes (a *Gobius* and 5 *Benthophilus*), twenty species of Mollusca (*Rissoa dimidiata*, *Hydrobia caspia*, *H. spica*, *H. stagnalis* with two varieties, *Eulima conus*, *Neritina liturata*, *Lithoglyphus caspius*, *Bythinia Eichwaldi*, *Planorbis Eichwaldi*, sp. n., *Cardium edule* and var. *rusticum*, *C. caspium*, *C. crassum*, *C. trizonoides*, *Adacna vitrea*, *A. edentula*, *A. plicata*, *A. læviuscula*, *Dreissena polymorpha*, *D. caspia*, *D. rostriformis*, and some other terrestrial and fluviatile Mollusca), a Bryozoan (*Bowerbankia densa*, Farre, in which the colonial nervous system may be admirably seen), and about thirty-five species of Crustacea, among which we find the family Gammaridæ in particular represented by colossal forms and *Idothea entomon* in considerable quantities. Then there are twenty species of worms (*Sabellides octocirrata*), numerous Turbellaria, two sponges (*Reniera flava*, sp. n., or perhaps a variety of *R. alba*, O. Schm., and another *Reniera* in the larval state), and, lastly, thirteen Protozoa, among which are six new species.

The most interesting gatherings were made at a depth of 108 fathoms, a level at which an enormous quantity of Crustacea and Mollusca live. At least this is the case on the western shore, while on the eastern, where the Arabo-Caspian steppe is continued beneath the sea, there is scarcely any animal life in the sand. The same poverty also occurs in the bays of Astrabad and Enzili. The western shore, on the contrary, with its high mountains and abundance of animal life, is reflected, so to speak, in the waters, where we find a depth of 517 fathoms with a comparatively rich fauna. To prove this assertion I need only cite one fact—namely, that in one haul of the dredge made at a depth of 108 fathoms, at 0° 12' west of Bakou, in 39° 41' N. lat., I obtained about 350 specimens of Gammaridæ belonging to four or five species, 150 specimens of *Idothea entomon*, 50 *Mysides* of colossal dimensions, 6 species of fish (determined by Kessler as *Gobius bathybius*, *Benthophilus leptcephalus*, *Grimmi*, *armatus*, *granulatus*, and *ctenolepidus*, quite new species), and, lastly, a multitude of large specimens of *Hydrobia caspia*, *Dreissena rostriformis*, &c. It must be added that this did not constitute more than about a fifth part of the animals brought up by the dredge.

I have been able to study in the Caspian 120 species of animals,

of which about 80 have been found for the first time by me. The total number of animals of the Caspian at present known must be more than 150. If this fauna is poor in comparison with those of other seas, such as the Mediterranean and even the Black Sea, my researches prove that it is much richer than it has hitherto appeared; and the assertion of Von Baer, that "whoever chooses to be led away by his *mihismus* to establish new species must elevate slight varieties to the rank of species," unfortunately* appears not to be justified. This is especially evident if we consider that this sea has even now been but little examined, particularly in its deepest parts, where animal life seems to be manifested most intensely. The water of the Caspian being poor in saline constituents, it is in the deep parts that its composition most nearly approaches that of sea-water.

I intend giving you only the most general results of my researches as they appear at present before the study of the animals collected has been terminated, and even, I may say, at the moment when I am commencing it.

In its fauna the Caspian presents the characters of a great half-salt lake which possesses its own peculiar species of animals, and also contains others which occur in other seas. The former (*e. g.* the new *Gobius* and *Benthophili*) originate from living or already extinct species, or they result from slight modifications of allied species living in other seas, as is the case with *Coregonus leucichthys*, *Calietis caspia*, Eichw. (which is a good species), *Petromyzon Wagneri*, Kessl., *Tintinnus mitra*, sp. n., and *Reniera flava*, sp. n. The other animals (that is to say, those which occur also in other seas) possess a great tenacity of life, since they still prosper where their less robust ancient colleagues have long since died out: in this category we place *Rotalia veneta*, *Sabellides octocirrata*, *Laguncula repens*, *Mysis relicta*, and *Idothea entomon*.

These species common to different seas show the affinities of the Caspian Sea to the Aral Lake, the Black Sea, and the Arctic Ocean; but the affinities with the glacial sea seem to be more recent than those with the Black Sea; for in the latter certain species, such as the seals, *Coregonus leucichthys*, and others which are common to the Caspian and glacial seas, are wanting. We may suppose that in the Tertiary epoch there existed in Europe and in the neighbouring parts of Asia a vast closed basin of fresh water. By an upheaval of the crust of the earth, due to the action of the volcanic forces which still make themselves felt energetically in the region of the Caspian, this was separated into some smaller basins, which are the existing Black Sea and the Aralo-Caspian basin. The latter in its turn was afterwards divided into two, just as we still see small salt lakes separate from the Caspian. At the same time the water of the glacial sea penetrated into the basin of the Caspian, which still had a slight connexion with the Black Sea, so that only a small number of animals could arrive there from the glacial sea. Hence we find

* I say "unfortunately," because I do not like new species, and yet find myself compelled to establish a considerable number.

that the primitive forms of the Caspian are freshwater animals (*e. g.* *Dreissena polymorpha*), and then that the emigrants from the glacial sea which reached it are marine animals for the most part inhabiting great depths. Hence, also, we recognize that the Caspian in its fauna presents more affinities with the glacial than with the Black Sea, which, again, has become richer in animals under the influence of the Mediterranean.

The Caspian has not only received species from the glacial sea, but has also furnished it with some—as, for example, a species of sturgeon, which seems to be *Acipenser ruthenus*, and lives in the rivers of Siberia. I regard the Sturgeons as belonging to the ancient Aralo-Caspian basin, and as having emigrated, as has been said, into the glacial sea, and perhaps even to America, where, as is well known, the nearest relatives of the *Scaphirhynchi* of the Aral exist. On the other hand we may presume that the place of origin of the Acipenseridæ was the Indian Ocean, and that they were derived from the Selachia, with which, especially when young, they have many points in common (*e. g.* their teeth).

I shall only add a few remarks. The Oxus of the ancients unquestionably fell formerly into the Caspian Sea. In this sea the abundance of animal species is replaced by an abundance of individuals; and the greater number of the species of Mollusca described by Eichwald as subfossil have been found by me in the living state, and are represented by individuals as large as their fossil relatives. Lastly, the deepest parts of the sea have been found to be most abundantly populated with species of animals quite different from those which inhabit the regions having only a depth of a few fathoms.—*Zeitschr. für wiss. Zool.* vol. xxv. p. 322, 1875; *Bibl. Univ., Bull. Sci.* December 15, 1875, p. 427.

On Fossil Remains of Reptilia and Fishes from Illinois.

By E. D. COPE.

John Collett, the accomplished assistant of Prof. Cox of the Geological Survey of Indiana, recently submitted to my examination a number of vertebrate remains from some point in Illinois. The specimens were taken from a blackish shale, and consist of separate vertebræ and other elements of the skeleton, often in a fragmentary condition. Although the absence of information as to the mutual relations of the pieces renders the identification difficult, yet the interest attaching to them, in consequence of their peculiar forms and the locality of their discovery, renders it important to determine their zoological position. Mr. Collett informs me that all the specimens were found near together, and at the same horizon, by Dr. Winslow. Much credit is due to Dr. Winslow for the painstaking labour bestowed in procuring and cleaning the specimens, and for his liberality in presenting them to the geological collection.

A remarkable peculiarity of all the vertebræ of the series is the longitudinal axial perforation of the centrum. They present the character observed in *Archegosaurus* and other stegocephalous Batra-

chia, but which also exists, according to Günther, in the living Rhynchocephalous lizard the *Sphenodon* of New Zealand. The bones of the limbs and scapular arches are so decidedly reptilian, and so unlike those of any Batrachia with which we are yet acquainted, that I am disposed to refer them to the former class. And as there are several points in which the fossils resemble the order Rhynchocephalia, I refer them provisionally to that neighbourhood. They constitute the first definite indication of the existence of animals of that type in the western hemisphere.

Associated with these saurians were found teeth of two species of fishes, which are important in evidence of the position of the beds in which they occur. One of these is a new species of *Ceratodus*, Agass., and the other a *Diplodus*. The former genus is characteristic of the Triassic period in Europe, one species having been found in the Oolite. It still lives in North Australia. In both these respects the Rhynchocephalian lizards present a remarkable coincidence. They also belong to the horizon of the Trias in Europe; and the only living species is found in New Zealand. Thus it would seem that a fragment of this fauna, so ancient in the northern hemisphere and so remarkably preserved in the southern, has been brought to light in Illinois. It must be added, in reference to the geological age of the fossils, that the genus *Diplodus*, Ag., has not yet been discovered above the Carboniferous, and that one genus of the Rhynchocephalia belongs to the Permian in Germany. We therefore await further material before venturing to decide whether they belong to Triassic or Permian time.

Cricotus heteroclitus, Cope.

Generic characters.—This genus is indicated primarily by caudal vertebræ; other parts of the skeleton found with it probably belong to the same animal; so I describe them in this connexion, awaiting further discoveries to confirm or disprove such reference. The pieces include parts of two femora, of tibia?, ulna?, metapodial and phalangeal bones, ribs, and other pieces.

The caudal vertebra best preserved is stout, discoidal in form, and deeper than wide. It resembles in form that of an herbivorous Dinosaurian, but differs otherwise. The articular faces are deeply concave, the posterior most strongly so; and the middle is occupied by a large foramen, whose diameter is about equal to that of the centrum on each side of it. The lateral borders of the posterior articular face are expanded backwards, and articulate with a bevel of the corresponding edge of the anterior articular extremity. In this way the vertebra combines the mechanical relations of the bi-concave with the opisthocælian structures. The neural arches are narrow and directed backwards; their bases are firmly coossified with the centrum; no zygapophyses appear on the portion of the neurapophyses preserved; and it is probable that they were weak if existing. On the inferior surface of the centrum two shallow pits occupy considerable space, and indicate the existence of large, free chevron bones. No transverse processes. In one vertebra the floor

of the neural arch is deeply excavated; in the other it is plane and marked with a median groove.

Of the remaining bones it may be observed that the articular faces were evidently capped by cartilage, and do not present the smooth condyloid character common to so many reptiles. They are, indeed, not so smooth as the dense layer of the shafts and surrounding portions, which rises in a fine bounding ridge round the surface formerly capped by the cartilage. The articular end of a bone may be the proximal end of the femur. The section of the shaft resembles that of a T-rail—the lesser expansion representing the base of the trochanter, and the greater that of the head. Seen proximally, the head is transverse and truncate, as in the great trochanter of many mammals, while the trochanter is smaller, oval in section, and oblique to the head. There are two articular facets on the head: the larger extends across the inner side; the smaller is subround, and is directed inwards or towards the trochanter; the two are separated by the ridge of a right angle.

A supposed distal end of a metapodial bone displays a shallow trochlear face of not much antero-posterior diameter. A phalange is of remarkable form, resembling that of an herbivorous Dinosaur in its short wide proportions. The articular faces are slightly trochlear in their character; and the inferior is directed inferiorly at an angle of 45° to the axis of the shaft. The form indicates a digitigrade terrestrial form. The proximal end of a rib exhibits the section of the shaft and the head. The latter has a broad, tubercular articular surface, and a smaller capitular surface on the narrow produced head. The section of the shaft is lenticular.

This genus appears to combine some Dinosaurian characteristics with those in which it resembles the Rhynchocephalia. This association of diverse features is confirmed by those observed in the genus *Clepsydrops*, Cope, described below.

Specific characters.—The surface of the sides of the centrum is marked with a few coarse shallow longitudinal grooves, which run into shallow reticulations of weak raised lines. The neurapophysis is sharp-edged in front, and with some ridges externally at the base.

The edge of the posterior articular face is excavated opposite to the chevron-facets. The latter are large, separated by a flat surface, and bordered externally by a raised edge from the polished dense layer of the lateral face.

	metre.
Diameter of centrum, vertical021
" " transverse019
" " longitudinal011
Width of neural canal006
" of neurapophysis004

The superficial layer of the other bones is smooth or striate and rugose near articular extremities. The distal end of the head is oblique, and the side below it concave for a short distance. The very short shaft of the phalange is concave, almost emarginate on one margin. The borders of the tubercular head of the rib are thin and broadly flared outwards at the sides.

	metre.
Transverse proximal diameter of femur	·024
Antero-posterior diameter of head of femur	·018
Transverse diameter of shaft of femur	·015
Vertical diameter of shaft of rib	·008
" " rib at tubercle	·016
" " rib at head	·006
Transverse diameter of tubercle of rib	·008
Proximal width of phalange	·014
Proximal depth of phalange	·007
Length of same phalange	·010

The remains indicate an animal more robust than any existing lizard, but probably not so long as some of the larger *Varani*.

Clepsydrops Colletii, Cope.

Generic characters.—This genus reposes on a series of vertebræ, which includes cervicals, dorsals, and caudals; associated with these are proximal ends of ribs, a coracoid bone, and some phalanges, which are provisionally referred to the same. They bear the same relation of size to the vertebræ that the corresponding bones do to the vertebræ of the *Cricotus heteroclitus*, and have a proportionately more slender form, like the vertebræ in *Clepsydrops*. They belong in any case to an allied form.

The vertebræ on which the genus reposes are more elongate than the corresponding ones of *Cricotus*. They are deeply biconcave, the articular cavities being funnel-shaped and continuous, thus perforating the entire length of the centrum. In a dorsal vertebra the cavities communicate by a very small orifice, while in the posterior the median contraction of the canal is less marked. The posterior cavity is more gradually contracted than the anterior; in the latter the excavation is, in most of the vertebræ, but slight (except beneath the floor of the neural arch), until it falls rather abruptly into the axial perforation. In an anterior (?) dorsal it is as widely excavated at the border as the posterior funnel. Another peculiarity is the absence of processes of the centrum; and a small capitular articulation is seen sessile on the border of the cup of two of the dorsals.

The axis has a singular form, owing to the tubular perforation which continues the posterior excavation to the anterior face of the centrum. There are three articular faces—a larger subround inferior, and two smaller superior, which border the neural canal in front and below, and are separated from each other and the inferior face by the perforation in question. The anterior face slopes obliquely backwards and downwards, and is convex in transverse section. There is no facet for the free hypapophysis of the odontoid; but it appears that the inferior articular face was applied exclusively to the centrum of the atlas, as in *Sphenodon*. But the axis differs from that of the latter genus in the absence of a coossified odontoid process. Either that element is altogether wanting, or it consists of two pieces, interrupted in the middle by the notochordal foramen, and in correspondence with the superior articular facets. There is no true hypapophysis of the axis: and the only indication of lateral

processes is a small articular facet on each side on the lower part of the rim of the posterior funnel. These may have been related to rudimental cervical ribs. The neural arch is broken off.

The dorsal vertebræ have their sides somewhat contracted: in one specimen the inferior face is rounded; in another (which I suppose to belong to a different part of the column) it is longitudinally acute. In this and another dorsal, where the parts are exposed, the floor of the neural canal is interrupted by a deep fissure, which has a triangular shape with the apex downward, when seen in profile. This is due to the fact that the opposite halves of the centrum are united by the circumferences of the articular cups, which have in profile an \times shape. The diapophysis does not project far beyond the base of the neural arch, and is compressed.

The caudals are elongate, and resemble, in the forms of the centrum and neural arch, those of *Laelaps*. The neural spines are not preserved, but, if present, were directed well backwards, bearing the posterior zygapophyses, since the arch stands only on the anterior three fifths of the centrum. Chevron-facets are not distinct; but two emarginations on the rim of the posterior face of one of the vertebræ indicates their existence; in other centra even these notches are wanting. The tail was evidently tapering. There is no indication of the transverse fissures seen in *Sphenodon* and many *Lacertilia*, nor are there any diapophyses on the caudal vertebræ preserved.

Two vertebræ accompanying the above are similar in general characters, and appear to belong to the sacrum. If truly such, they indicate a structure different from that seen in *Lacertilia* and *Crocodylia*, and present some resemblance, perhaps only superficial, to the *Dinosauria*. The centrum is much compressed; and the articular extremities present a wide plane border below the notochordal perforation. The corresponding part of the centrum presents no indication of diapophyses. Neural arch lost.

Some heads of ribs of appropriate size are compressed, and exhibit a small tuberosity, which is perhaps a rudimental capitulum. They are much more lizard-like than those of *Cricotus*.

The phalanges are of more slender form than those of *Cricotus*, and more like those of lizards, although less slender than usual among that order. The shafts are sometimes little, sometimes much depressed. The distal condyle of one of the latter is not emarginate. An ungual phalange is subconic, flat below, and with a shallow groove above one of its lateral borders.

A coracoid bone supports the greater part of the glenoid facet, and exhibits also a facet for the scapula; these are flat, and not excavated. Its form is that of an irregular right-angled triangle, the base anterior and the outer angle truncated by the glenoid facets; its inner margin is thickened and truncated as though it had been articulated with a mesosternal or opposite coracoid bone. This may not be a correct interpretation of its appearance; for if so, the arrangement would differ equally from that of *Sphenodon*, *Lacertilia*, and *Salamanders*, and resemble that of the *Sauropterygia*. And it is not to be denied that there are other points of resemblance to the coracoid of that order. There is an anterior marginal facet as though

for a clavicle, and a short oblique postero-internal one, as though adapted for a small sternum. There is a shallow notch on the inner border anteriorly, corresponding to one of those of the *Lacertilia*.

This genus is more typically Rhynchocephalian than *Cricotus*.

Specific characters.—There is a shallow fossa in the entering angle between the superior and inferior articular facets of the front of the axis; and the centrum of the same is obtusely keeled below. The border of the anterior articular face of the dorsal vertebra with keeled centrum is undulate. The obtuse inferior face of another dorsal is rugulose, and the edge of the articular face is not undulate. The inferior faces of two caudals are marked with two fine parallel grooves, while in another caudal and the sacrals (?) the same is smooth. There are some longitudinal ridges on the upperside of the larger caudal. The coracoid is concave on its inferior side, convex on its superior; the inner and anterior borders are thickened by flaring of the edges. Surface smooth. The posterior edge is thin, and is notched just behind the glenoid facet. The proximal facets of the phalanges are shallow, simple, and more or less transverse.

	metre.
Centrum of axis, length	·006
" " width at middle behind	·008
" " depth (oblique)	·010
Centrum of sharp-keeled dorsal, length	·014
" " " depth behind	·012
" " " width behind	·012
Centrum of rounded dorsal, length	·012
" " " depth behind	·011
" " " width behind	·0105
Width of neural canal of rounded dorsal	·004
Centrum of larger caudal, length	·014
" " " width	·0085
" " " depth	·008
Length of base of neural arch of larger caudal	·008
Smaller caudal, length	·0105
" " " depth of centrum	·007
" " " width of centrum	·007
Width of rib-head	·010
Coracoid, length	·024
" " " width	·019
Diameter of glenoid facet (transverse)	·009
Diameter of inner border (vertical)	·006
A phalange, length	·010
" " " depth proximally	·004
" " " width proximally	·007

This species was of smaller size than the *Cricotus heteroclitus*. It is dedicated to John Collett, of Newport, Indiana, of the State Geological Survey.

Ceratodus Vinslovii, Cope.

Represented by a tooth in good preservation, lacking only a fragment of one end and a portion of the inner margin of the base. The crown of the tooth is in general outline an oval, wider at one

end than the other; the inner border gently convex and entire; the outer border is marked by six shallow notches, which are separated by as many sharp compressed projections. The emarginations and denticles are the termini of corresponding grooves and ridges, which radiate from a smooth space along the inner margin of the crown. From this plane the grooves gradually deepen to the margin; the separating ridges are acute, and without irregularity or serration. The base or root of the tooth is quite wide; externally it extends beyond the border of the crown at the notches, and has projections corresponding to the denticles, from which it is separated by a horizontal notch. On the inner side the base extends like a shelf beyond the posterior half of the crown, and is produced backwards beyond its posterior border. The inferior plane is concave in transverse section; the crown is plane in all directions.

Length of crown preserved	metre.
Width of crown	·021
Length of root preserved	·013
Depth of tooth internally	·022
Depth of tooth internally	·005
" externally	·003

This *Ceratodus* resembles the species described by Agassiz under the names of *C. parvus* and *C. serratus* from the English Trias, but differs from them in the shortness of the tooth-like processes. In none of the described species do I find such a development of the basis on the inner side.

This species is of interest as introducing the genus to North America. It is dedicated to Dr. Winslow, to whom we are indebted for its discovery.—*Proc. Acad. Nat. Sci. Philadelphia*, September 28, 1875.

Formation of Nitrites by Bacteria.

The presence of nitrites in spring-waters, which has usually been ascribed to the oxidation of ammonia therein, is now stated by Meusel to be produced by the reduction of nitrates by the agency of *Bacteria*. In proof of this he shows:—that such water which contained *Bacteria* and nitrates, but neither ammonia nor nitrites, gave after standing four days the reactions of nitrous acid; that anti-septics, such as salicylic acid, phenol, benzoic acid, alum, and much salt even, prevent or hinder the production of nitrites; that aqueduct-water containing pure nitrates, which alone does not show the production of nitrites even in presence of *Bacteria*, has this change effected upon the addition of glucose, gum, dextrin, cellulose, starch, &c., in the course of from two to fourteen days; that freshly distilled water, boiled with glucose and nitre, shows no nitrites even after standing for weeks, because *Bacteria* are absent; and that putrefying albuminates reduce nitrates to nitrites. The decomposition of cellulose by *Bacteria* in presence of nitrates proves that nitre is not only direct food for plants, but that it also performs by its oxygen an important function in the soil. The author believes that these facts have important bearings in agriculture and in medicine.—*Silliman's American Journal*, January 1876.

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XIX.—*On the Polytreмата (Foraminifera), especially with reference to their Mythical Hybrid Nature.* By H. J. CARTER, F.R.S. &c.

[Plate XIII.]

Synonymy of Polytrema miniaceum.

- Millepora miniacea*, Linn. 1788, Syst. Naturæ, ed. Gmel. vi. p. 3784; Esper, 1797, vol. i. tab. xvii.
Millepora rubra, Lamk. 1816, Anim. sans Vert. vol. ii. p. 202.
Polytrema corallina, Risso, 1826, Hist. Nat. Europ. mérid. vol. v. p. 340. no. 91.
Polytrema miniaceum, De Blainville, 1834, Man. d'Actin. p. 410, and p. 673, pl. lxix. fig. 4.

Polytrema miniaceum, De Blainville, 1834.
Pl. XIII. figs. 1-6.

The true nature and position of this organism in the animal kingdom was first recognized and pointed out by the illustrious Dujardin, who, in 1841, placed it in his third family of Rhizopoda (Hist. Nat. des Zoophytes Infusoires, p. 259)—conjecturally, it is true (but such is at once the modesty and sagacity of this author that his conjectures may almost be taken as facts); while its pseudopodial extensions are illustrated by those of his *Vorticialis strigilata* = *Polystomella* (op. cit. pl. i. fig. 15). I need hardly add that the genera of his Rhizopoda are respectively *Arcella*, *Diffugia*, *Trinema*, *Euglypha*, *Gromia*, *Miliola*, *Cristellaria*, and *Vorticialis*, to which

we may now add not only the whole of the Foraminifera, but also Ehrenberg's Polycystina, now called Radiolaria.

Ever since 1858, when the late Dr. J. E. Gray published a paper entitled "On *Carpenteria* and *Dujardinia*, two genera of a new Form of Polyzoa with attached Multilocular Shells filled with Sponge, apparently intermediate between Rhizopoda and Porifera" (Proc. Zool. Soc. part xxvi. 1858, pp. 266-271), I have been ever doubtful of this supposed fact being any thing more than *in appearance*, as the title just mentioned indicates, while the author (my dear old friend, alas! only "dear" now to memory) entirely repudiated the notion during the latter part of his life.

Subsequently, according to the late Prof. Max Schultze, to whose paper on *Polytrema* I shall often have to allude ('Annals,' 1863, vol. xii. p. 411, translated by W. S. Dallas, F.L.S., from Wiegmann's 'Archiv,' 1863, p. 81), "At Dr. Gray's request, Carpenter then more fully investigated the structures arranged in the genus *Carpenteria*, and published a memoir in the 'Philosophical Transactions' for 1860 (vol. cl. p. 564 *et seq.*), in which he also mentions the *Polytrema miniaceum* of De Blainville as an organism which possesses a foraminiferous structure of the calcareous shell, and is most nearly allied to the genus *Tinoporos* (p. 561). Carpenter found the sponge-spicules constantly in the chambers of the Polythalamian named after him, and intimates his adhesion to Gray's view that it is a transition form between Foraminifera and Sponges."

I have not access to this "memoir;" but as Carpenter's 'Introduction to the Study of the Foraminifera' (Ray Soc. Publ. 1862) was published *after* it, we must take the more cautious phraseology used there respecting the nature of *Carpenteria*, which is as follows (p. 189), viz. "We seem fully justified in regarding it [*Carpenteria*] as a very interesting link of connexion between Foraminifera and the Sponges." Thus Carpenter was never very hearty in his assertion; for the word "seem" indicates that he had still some misgiving as to the fact.

Prof. Max Schultze, however, after having carefully gone into the arguments for and against the question, concludes his article with the following paragraph:—

"For this reason I cannot regard the conditions in *Carpenteria* otherwise than as in *Polytrema*, and therefore believe that the boundary between Polythalamia and Sponges, which has hitherto been considered as a very sharp line, must still be maintained in all its integrity" (*l. c.* p. 418).

Up to his writing this Max Schultze had not seen Carpenter's 'Introduction;' but after he had done so he added a

“Supplement” (*l. c.* p. 419), in which the opinion just stated was not retracted, and the following inserted respecting the separation of *Carpenteria* from *Polytrema*, viz. :—“Carpenter had no inducement to discuss the question whether *Polytrema* produces spicules and is thus allied to *Carpenteria*, as his specimens contained *no spicules in their interior*. Nevertheless he mentions having seen specimens with the surface entirely covered with a parasitic sponge, the spicules of which, however, penetrated scarcely if at all into the interior of the chambers. By this means Carpenter establishes a sharp distinction between *Polytrema* and *Carpenteria*.”

If, then, hereafter it shall appear that the presence of spicules in *Polytrema* is a common although it may not be a constant occurrence, I might say with Prof. Max Schultze (p. 419), “Perhaps my observations on *Polytrema* which indicate the remarkable affinity between that genus and *Carpenteria* may serve to shake Carpenter’s faith in his opinion.”

In 1870 Dr. Carpenter, with his wonted generosity, gave me some specimens of *Polytrema*, which, after examination, led me to the views expressed in the ‘Annals’ of that year (vol. v. p. 391), viz. that under the circumstances it was not strange “that the spicules which to-day are matted among its [*Polytrema*’s] pseudopodia, on its surface, should in a few days after be found in the interior of its calcareous structure.”

These “views” I can now substantiate from the possession of specimens which present the features about to be noticed in the following description of *Polytrema miniaceum*.

POLYTREMA, gen., Risso, 1826.

Test fixed, solitary or grouped. Composition calcareous. Structure cancellous, presenting a polygonally divided surface with foraminated interstices, and internal cavities which communicate with the exterior by one or more apertures. Cavities often containing few or many siliceous spicules entire and fragmentary, derived from different kinds of sponges. .

Polytrema miniaceum, sp., De Blainville, 1834.

Pl. XIII. figs. 1-6.

Test fixed, calcareous, solitary. General form massive, rising from an irregularly circular or lobed, root-like, expanded base, passing into a round stem, which soon divides into a head composed of a variable number of expanded short branches, that speedily terminate in more or less compressed divisions, each of which ends in an irregular row of subsquare

apertures, respectively margined by an inflated round rim extended upwards on one or two sides opposite into the form of a lip or lips, so as to present *en profil* a serrated or cock's-comb appearance (fig. 6). Colour coral-red or pink. Surface uniformly even, except where interrupted by the branches, whose apertures (fig. 6, *c c c*) in many instances are more or less filled with sponge-spicules entire and fragmentary, together with grains of sand and other minute objects, forming a mass which is continuous with strings of the same material extended in an irregular network between the apertures generally (fig. 6, *m m m*); which network is frequently intersected by the most delicate, straight, cobweb-like threads, the remains of dried pseudopodia (fig. 6, *s s*). Presenting a variety of surface-patterns according with the age of the structure, locally and generally, viz. :—at first, or in the earliest period, a foraminated groundwork in which there may be a few unforaminated dimples or depressions (fig. 6, *g g g*); then the dimples may be united by limited, branched, linear, unforaminated areae, somewhat narrower than the foraminated part, so as often to present together a submeandriniform appearance (fig. 6, *h h*); or the dimples may be expanded into circular foraminated areae, surrounded respectively by an unforaminated ring, the whole being set in a foraminated groundwork (fig. 6, *i*); or, lastly, over the thickest parts of the fully developed test, the foraminated groundwork may give place to a subhexagonal or polygonal unforaminated reticulation, whose interstices *only* are foraminated (fig. 6, *k*). Internal structure cancellous in appearance, but originally consisting of subconcentric (imbricative or eccentric) foraminated laminae supported on *detached hollow* pillars, whose positions respectively are for the most part indicated by the “dimples” and circular depressions externally, each lamina thus forming a continuous cavity between itself and the next following inwards, like the roof and pillars of a crypt (fig. 3). Presenting, in horizontal sections at different distances from the base, subconcentric layers diminishing in number towards the truncated neck; and in a vertical section, the same in a conical form, interrupted above at the truncation of the neck. Finally (*i. e.* in the old state) losing the foraminated portion of the lamina except on the surface; the subhexagonal network alone remaining internally, which, together with the *hollow* pillars now become solid, forms a continuous netted mass or labyrinthic reticulation, in which it becomes difficult, for want of the foramination, to trace the subconcentric layers inside the surface-one (fig. 6, *e, t t*). Cavernous dilatations or cavities of the internal structure (fig. 6, *v v v*), in continuation with each other, exist about the axis of the spe-

cimen, which, arising in the confines of the test, finally communicate with the apertures at the ends of the branches; hence the masses of spicules and grains of sand which they often contain (fig. 6, *vvv*) can be easily explained; together with other spicules, which, having become incorporated during growth, more or less traverse the test generally—the whole of the structure internally being lined with sarcode, which, according to Max Schultze (who had recent specimens to deal with, *l. c.* p. 411), is in the form of chambers opening into each other by stolon-like constrictions, through which they not only intercommunicate but are successively produced ('Annals,' 1863, vol. xii. pl. vii. figs. 4–8). Still, although it is easy to see how these chambers communicate with the cavernous dilatations or cavities in the midst of the reticulated structure in the *old* specimens, where the sarcodic lining has become thickened and dried into a chitinous layer, it is not so easy to see how it takes place in the younger specimens, where the foraminated interstices have not become absorbed and the sub-concentric layers (fig. 3, *aaa*) of which the test is formed apparently permit of no other communication between their cavities. Size of largest specimens (which, for the most part, have their branches broken off) 3-24ths inch in diameter and 2-24ths inch high.

Hab. Marine, on solid objects, chiefly stony coral.

Loc. Mediterranean; Red Sea; West Indies; Mauritius; Torres Straits; Australia; Polynesia.

Obs. There are two forms in which *Polytrema miniaceum* is found, viz. massive and branched; but the former appears to me to differ from the latter merely in the branches having been broken off, in which the remaining portions thus truncated have provided themselves with the form of apertures above mentioned (fig. 6, *bb*). The branches, which seldom undergo a second division beyond a divided grouping of the apertures at their extremities (fig. 6, *aaa*), vary in number from a few to a great many, in which case the specimen sometimes presents a head of branches almost as closely approximated as those of a cauliflower.

Following the mode of growth in a specimen of *Polytrema miniaceum* not more than 1-80th inch in diameter at the base, and about 1-83rd inch high (fig. 4), it may be observed at this period to present a circular patch or base of cancellated structure (fig. 4, *a*), rising up in the centre into a short cylindrical process (fig. 4, *b*), the whole of which is thickly though minutely foraminated on the surface, and more or less divided and dimpled by an unforaminated network of lines, which give to the interstices shapes varying from circular to submeandriniform,

simple or branched; while internally this structure is supported on processes which rest on a thin chitinous layer that adheres to the object on which the specimen may be growing. Thus constituted, the foraminated surface and cancellated structure extend upwards into the short cylindrical process mentioned, which, presenting a single tubular aperture with round inflated rim, terminates the young *Polytrema* in this direction (fig. 4, *d*). But as the upper part of this cylindrical process consists of a single thin foraminated layer of a tubular form, it is very delicate, and is thus often broken off down to where the interior begins to pass into the cancellated structure, and thus becomes stronger (fig. 4, *e*). Here we may observe, on looking endwise into the *truncated* end, that the cylindrical process is divided into three or more portions (fig. 5), each of which is successively larger than the foregoing one; so that the last (which nearly embraces all the rest, and thus occupies two thirds of the circle on one side, while the three others occupy the other third) completes the circle as it grows above them into the delicate foraminated tubular layer, which ends in the single aperture above mentioned. It is thus in the "*truncated* end" that we seem to be able to trace a resemblance to the spiral growth and successive enlargement of the primary chambers manifested in the Foraminifera generally, more especially in those which belong to the discoid type. As the young *Polytrema* increases in size, new circumferential layers are added until a mass is produced which passes into a thick round stem with several branches (fig. 1). Hence the original *single* axis becomes divided into as many as there are branches, each of which is but a repetition of the original one in point of development.

Although the "*truncated* end" of the cylindrical process (fig. 5) in the young *Polytrema* seems, by its multilocular structure and arrangement, to indicate a spiral mode of growth, I have never been able to recognize a spiral arrangement of the lines presented by the base of a *Polytrema*—although on one occasion a *subsequent* concentric arrangement of these lines seemed to indicate a spiral beginning, as such an arrangement often follows a spiral one in many specimens of the discoid Foraminifera. However, as this did occur, although only in one instance, which has been dry-mounted, I will now briefly describe it.

The specimen, a small branched one, had been overgrown by the horny fibre of *Chalina oculata* (sponge), through the former having previously attached itself to the hard object subsequently selected by the latter. Consequently when the sponge (an insignificant fragment picked up on one of the

“Ebon Islands, Oceania”) was examined, it was found to have torn off the *Polytrema* entire from the hard object, thus protecting its branched head, while the disk of its base is equally well preserved; I have been able to view the latter through a 1-inch object-glass and make the accompanying delineation. The whole disk, which is circular, measures about 5-48ths inch in diameter, of which the figure represents about 2-48ths inch of the centre (fig. 2). This portion, which only in its outer part bears indication of the cyclical arrangement of chambers, not an uncommon sequel (as before stated) to the spiral commencement common to and most obvious in the discoid Foraminifera, presents a *confused* centre (fig. 2, *a*), beyond which come three circular rows of radiating lines (fig. 2, *b*), which, from their quadrilateral interspaces, would, in *Orbitoides dispansa* &c., represent as many chambers of the central plane (‘Annals,’ 1861, vol. viii. pl. xvi. fig. 1, *l*), but here are covered in by a basal chitinous layer of unforaminated sarcode, which was the bond of union between the *Polytrema* and the hard object on which it grew, and which, on having been partly removed over *one* row (fig. 2, *c*), brings into view a continuous, apparently circular, ring-like cavity with foraminated roof sloping in towards the centre of the specimen; so that the resemblance to the chambers of the central plane in *Orbitoides dispansa* does not appear to go beyond the “three circular rows of radiating lines with quadrilateral interspaces.”

Leaving this unique specimen, which only illustrates this point, and going to the superstructures of *Polytrema* generally, we observe that its resemblance to *Orbitoides dispansa* is no longer traceable; for when we come to the continuous conical solid pillars of shell-substance, whose large ends are so conspicuous on the surface of the latter, and are the same in *Tinoporos baculatus* and *Conulites Cooki*, Carter, = *Patellina* (Carpenter), it will be found that there *are* none. The unforaminated as well as the foraminated dimples in the foraminated portion of the surface of *Polytrema* (fig. 6, *g, i*) only indicate, as before mentioned, hollow structures which in the early part of life support the foraminated layers (fig. 3). Hence Dr. Carpenter’s “aggregation of calcareous substance into solid pillars (*bb*) exactly resembling those which have been seen in *T. baculatus* and in *Patellina Cooki*” (Introduction, p. 286) is imaginary. The unforaminated dimples on the surface of *Polytrema* which most resemble the ends of the “solid pillars” alluded to are the ends of short, interrupted, cylindrical pillars, in some parts foraminated at both ends, which, it is true, give support to the spans or arches of the undulating foraminated

circumferential layers, but rest on the convexities of the latter as often as on any other part—that is, so irregularly as to make it impossible to connect them into a continued line of support (fig. 3, *a*, *b*) even like the “solid pillars” of *Orbitoides* &c., which are not only solid but continuous from the circumference to the centre of the test. Thus the structure of *Polytrema miniaceum* is wholly cancellous, and without other support than that which the peculiar arrangement and form of the foraminated layers and their hollow pillars give to the whole mass. It is, in fact, just what Dr. Carpenter has described in “*Parkeria*” without the “labyrinthic structure” (Phil. Trans. 1870, vol. clvii. pt. 2, p. 721); while if the “parallel columnar or tubular processes springing from the internal surface of the spiral lamina” of *Loftusia* (*ib.* p. 745, pl. 79. figs. 1 & 2) are to be considered equal to the foraminated subconcentric walls of *Polytrema miniaceum*, the radial columns of the latter, whose cavities are continuous with this foraminated structure, would appear to be almost identical with those of *Loftusia*.

Be this as it may, in the early part of the life of *Polytrema miniaceum* (that is, during the time the test is being constructed), the object appears to be to combine the greatest amount of strength with the least quantity of material, and thus the radial processes are hollow; while only in the after part of the life of the *Polytrema* they become consolidated, and the tubulation of the concentric layers obliterated, if not removed altogether, *except on the surface*, as before stated.

I also now observe, in a mounted thin horizontal section of *Alveolina meandrina* which I retained when the rest of the specimens of this fossil were given to the Geological Society of London in 1863 (originally coming from the valley of Kelat, not very far from the Bakhtiyari Mountains, in Persia, where the late Mr. Loftus found “*Loftusia*”), that the former presents a cavernous or cancellated structure almost identical with that of “*Loftusia*” and *Polytrema miniaceum*, which structure, in my short description of *Alveolina meandrina* (“Annals,” 1861, vol. viii. p. 381, pl. xvii. fig. 4, *f*), I had erroneously regarded and represented (fig. 4, *f*, 2 & 3) as the “canal-system” in this species, while it now proves to be what is above stated and no “canal-system” at all, as the latter, if there had been any, would be recognized by its tubular form *within* the cavernous structure. My “marginal reticulation” (fig. 4, *f*, 2) and “vertical canals” (fig. 4, *f*, 3) would thus be analogous to corresponding parts in *Polytrema miniaceum*, *Parkeria*, and *Loftusia*, the pillars being mere supports and not indications of the limits of the chambers, which are otherwise marked by the successive curving inwards of the

subconcentric or excentric foraminated layers upon each other, in *Polytrema*, as before stated. There is, however, no appearance of "sand-grains" in this section of the structure of *Alveolina meandrina*, which is so thin as to admit of being examined by a $\frac{1}{4}$ -inch object-glass and transmitted light, when even the tubulation of the spiral or foraminated layers is visible. Of this species I stated (p. 328 *l. c.*), it is "so different from any other existing description, that at first sight it seems doubtful whether it should not form the type of a new genus."

Another point which distinguishes *Polytrema* from almost all the other chambered Foraminifera is the presence of the aperture on the summit of the test, singly in the embryonic form (Pl. XIII. fig. 4, *d*) or in plurality in the full-grown individual (fig. 6, *ccc*). This may reasonably be assumed to commence in the central cell of the disk which forms the base of the embryonic test (fig. 4), and then only has its analogy in *Squamulina scopula*, which appears to arise from the central cell of the submultilocular Rotaline test that forms its foot or means of attachment to some submarine body ('Annals,' 1870, vol. v. pl. iv. fig. 3, *k*). Of course the one-chambered or lageniform Foraminifera do not enter into this category.

Still another point is the branching of the summit (Pl. XIII. fig. 1), which finds its analogue in *Squamulina ramosa* alone, although in *S. ramosa* the branching, instead of stopping at the first degree, may be continued on to the third ('Annals,' 1870, vol. vi. p. 347).

Lastly, we come to the canal-system, of which there seems to be an entire absence. Dr. Carpenter does not mention it; and I have not seen it. There is a fine polygonal linear network to be seen in the centre of the unforaminated subhexagonal reticulation with foraminated interstices which characterizes the surface of an older form of *Polytrema miniaceum*; but this appears to be only a single straight linear canal, about 1-12000th inch in diameter (fig. 6, *l*), which originally communicated with the hollow pillars now, in the older development, become solidified. It is well represented in Max Schultze's figure of an "Acervuline *Planorbulina*" in Dr. Carpenter's 'Introduction' (pl. xiii. fig. 1), and might have been connected with the original formation of the subhexagonal reticulation, which does not appear in the newly developed structure (fig. 6, *fff*); and therefore, whatever this tubular network may be, *it does not come into existence until the former is developed.*

Directing our attention to the internal structure, we find that the cancellated test is lined by a proper membrane (if a structureless sarcodic layer becoming brown and glue- or gum-like

when dry may be so termed), which abuts upon the foramina of the walls and, according to Max Schultze as before stated, is divided into chambers which open into each other by two or more stolon-like constrictions, through which these chambers not only communicate with each other but were successively produced, finally opening into the cavernous dilatations which are in direct continuation with the surface through the apertures at the ends of the branches; besides which, accident seems to form openings in the old test here and there, as it does in the chamber of *Operculina*, through destruction of the foraminated interspaces, which thus also lead directly into the interior.

It can now be understood how the spicules and calcareous grains of sand not only find their way into the cavernous dilatations, and occasionally into the sarcodic chambers themselves, but also become imbedded in the cancellated structure during its exogenous growth, and thus are found to transfix the test generally, after the same manner as small Foraminifera were found by Mr. H. B. Brady to have become accidentally imbedded in *Loftusia* (*loc. cit.* pp. 749 & 750).

For want of fit specimens to demonstrate this, Max Schultze was obliged to have recourse to lengthy arguments beginning with the following premises, viz. :—"Either the siliceous spicules have penetrated accidentally, or they have been taken in as food, or, lastly, they belong to a parasitic sponge" (*loc. cit.* p. 416), finally concluding that the presence of the sponge-spicules in *Polytrema* might be owing to its being infested by a parasitic sponge, and that transition forms between Foraminifera and Porifera have but little probability (*ib.* p. 417).

But now that we have "fit specimens," such arguments are not necessary; for the facts can be told in a few words, viz. that sponge-spicules and minute sand-grains, respectively siliceous and calcareous, together with a heterogeneous assemblage of the tests of minute organisms generally, both entire and fragmentary, may be observed to form dried thread-like filaments more or less netted together (fig. 6, *m m m*), and traceable into the apertures of the *Polytrema* (fig. 6, *c c c*), after which the same kind of material may be found further down in the cavernous dilatations of the test (fig. 6, *e, v v v*), leaving no kind of doubt that the dried thread-like filaments were originally soft pseudopodial extensions of the internal sarcode, which, coming into contact with the minute material mentioned, had thus agglutinated and drawn it into the *Polytrema*.

Although the sarcodic substance cannot be well distinguished in these thread-like filaments, it can be seen with an inch

object-glass and reflected light in the form of delicate cobweb-like extensions, stretching across them from point to point, in connexion with the apertures of the *Polytrema* (fig. 6, *ss*). How these delicate filaments could have survived the boisterous waves of a rocky shore like that of the Mauritius it is almost impossible to conceive, unless they were the dying efforts of the foraminifer (whose sarcodite has great vitality) after the coral detritus adhering to the sponge on which it was found had been finally thrown up upon the beach beyond all further influence of the sea; for such was the character of the sponge which Col. Pike, U.S. Consul at the Mauritius, sent to Dr. Dickie, and the latter to myself, on which I found the little specimen presenting this phenomenon, which specimen is now dry-mounted in a closed cell for preservation and further observation.

All this may be very clear; but still there is Max Schultze's question whether the materials above mentioned got into the *Polytrema* "accidentally or have been taken in as food."

In the first place, it is evident that the calcareous test of *Polytrema* requires calcareous material for its structure; and so far the calcareous element may be disposed of. But what becomes of the siliceous element in the sponge-spicules?

Here it is necessary to remember that siliceous sponge-spicules are not purely mineral and crystalline like grains of quartz-sand, but are a combination of silex and organic matter. Hence, if it can be shown that any organism has the power of extracting this organic matter for nutriment, it may be assumed that the *Polytrema* also may possess this power.

That siliceous sponge-spicules are destroyed by an organism for this purpose I have shown ('Annals,' 1873, vol. xii. p. 457, pl. xvi. figs. 8 & 9); and that there is a cell which can penetrate the walls of the spicule as *Chytridium* does the cell-wall of *Spirogyra* &c. is thus proved.

Still, as regards *Polytrema*, I do not think that this can be the case (certainly not with those spicules which are found imbedded in and transfixing the test generally), but that the masses of spicules (which are chiefly fragmentary) in the cavernous cavities (fig. 6, *vvv*) may be *ingesta*, which by accident have been drawn in by the pseudopodia, and have accumulated there like the hairs forming the "hair ball" of the ox's stomach, or the beaks and other *ingesta* of Cephalopoda, which, under the name of "ambergris," form a similar accumulation in some part of the alimentary canal of the sperm-whale.

The presence of a sponge, too, growing over the surface of

a *Polytrema* is easily explained by the fact that most sponges overgrow every stationary object with which they come into contact; and as all kinds of sponges may do this, so the *Polytrema* may at one time be overgrown by one kind of sponge and at another by another kind, this being, in the matter of difference, purely accidental. But there is only one kind of sponges that can become really parasitic, viz. the Clionida or boring sponges; and these do not grow upon but in their host, and thus in the test of *Polytrema*. Of this I have but one instance in *Polytrema*, although it is common enough elsewhere; and here the usual cavities in the test of the host, together with their circular fenestral openings on the surface, have, by the position and regular arrangement of the spicules, which are *always entire*, at once pointed out their true nature, in contradistinction to the spiculiferous accumulations within the natural cavities of the *Polytrema*. As further means of distinction, it may be added that the *pointed* ends of the spicules in sponges are *always directed outwards*, and the pin-like spicules of a *Cliona*, which are chiefly confined to a bristling coronal arrangement filling the circular fenestral apertures which it has formed on the surface of its host, are arranged after this manner; 2nd, the spicules are entire and *regularly* arranged; 3rd, they are for the most part unaccompanied by grains of sand and other foreign objects. On the other hand, in *Polytrema* the pointed ends of the spicules are sometimes outwards and sometimes inwards (fig. 6, *nn* &c.), there are more fragments than entire forms (fig. 6), and the whole is confusedly arranged and mixed up together with sand-grains and a variety of minute foreign objects (fig. 6, *mmm*).

Then, again, the spicules in *Polytrema*, besides being for the most part fragmentary, are of different forms, although chiefly linear, as the furcate and radiated forms are more difficult of introduction. The latter seems to be proved not only by their absence generally in the interior, but by their appearing sometimes on the surface of the *Polytrema* with one arm fixed in the aperture and the others outside (fig. 6, *p*).

Again, the spicules may belong to different sponges. In one mounted rounded embryonic specimen of *Polytrema* from the Mauritius, whose rounded form had been occasioned by the summit having been broken off, there are several hamates and anchorates together with a linear spicule, all evidently derived from *Halichondria incrustans*; while in the embryonic specimen figured, in which a portion of the side of the summit only is broken away, three linear spicules may be observed, one of which is pin-like and therefore not belonging to the sponge mentioned (fig. 4), and so on. In another mounted but older

structure a fusiform, nodose, calcareous spicule, of a deep purple colour, from a *Gorgonia* projects from one of the apertures (fig. 6, *q*), while in this and another aperture a globo-stellate, from a compound tunicated animal, may be observed (fig. 6, *r r*). So there may not only be spicules of different sponges incepted, but a heterogeneous assemblage of all kinds of minute objects.

As regards the heterogeneous assemblage of minute crude material about the dried pseudopodia, the like may be observed to occur, for the most part, in the bodies of all the genera of Rhizopoda mentioned at the commencement of this communication, disappearing only in the frustules of the Diatomaceæ, where, however, there would still appear to be a "minute pore opening into the interior" of the "large granules," as on the surface of *Aulacodiscus formosus* noticed by Mr. Kitton (Monthly Microscop. Journ., June 1873, pl. xx. fig. 2), but which does not admit nourishment except under the most attenuated form.

Again, although the inception of heterogeneous material is evident in the Polytreмата, it is not so in most of the other known Foraminifera; and the only species of Radiolaria in which (in the dead tests) I have seen it is a *Haliomma* shaped like a *gourde-de-pèlerin* (*Lagenaria*), dredged up plentifully with the sponge *Rossella* &c. in 300 fathoms, $74\frac{1}{2}^{\circ}$ south lat.; so that this may have been a *post mortem* occurrence, although the contents closely resemble those of the Polytreмата and those in the tests of living *Diffugia* and *Euglypha*.

Colour. Although I have never met with a colourless specimen of *Polytrema miniaceum*, or one that did not present the appearance of red or pink coral, especially after getting old, it is often accompanied by small patches of foraminated cells or chambers (varieties of our British species *Planorbulina vulgaris*), which as often present a light brick, roseate, or violaceous hue as they are absolutely colourless. Why the colour should be constant in *Polytrema miniaceum* and not so in these patches of cells, I am not able to explain; but among the sand accompanying the sponges dredged up on board H.M.S. 'Porcupine' in the Atlantic Ocean, around the north of Ireland and Scotland respectively, it is not uncommon to find a Globigerine test (*Spheroidina*?) presenting this colour, although I have never met with even a fragment from there of *Polytrema miniaceum*. The older the *Polytrema* appears to be, the deeper is the colour; and, as with the roseate patches of *Planorbulina*, the last-formed portions appear to be the lightest.

Thus *Polytrema miniaceum* externally differs from all other known Foraminifera in presenting a fixed, calcareous, arbo-

rescent test combined with a pink or crimson colour and superior apertures; while internally it differs from most Foraminifera in possessing a cancellous structure void of the canal-system, but permeated with cavernous excavations communicating with the apertures, and more or less filled with spongespicules and other foreign objects. The ovular and earliest stages of embryonic development I have not seen.

Having ground down a horizontal section of *Polytrema miniaceum* to extreme thinness and mounted it in balsam, I observe that the reticulated structure, together with the foraminated laminae, which have become consolidated as already mentioned, is all pervaded by crooked, branched, anastomosing tubes, which appear to have been produced by the mycelium of a fungus or saprolegneous organism that pervades in like manner the old horny fibre of sponges and the reticulated calcareous structure of old coral, &c.

Polytremabalaniforme, Carter, 1876, = *Carpenteria*, Gray, 1858. Pl. XIII. figs. 7-10.

Test fixed, solitary or grouped (fig. 7). Composition calcareous. General form obtusely conical, open at the summit (fig. 7, *aa*), from which grooves descend in a somewhat gyrate direction to the circumference, so as to leave triangular interspaces which are slightly convex and, extending a little beyond the ends of the grooves, impart a lobed form to the circular base. Aperture single, at the summit (fig. 7, *aa*), spiral in form and smoothly marginate. Colour light grey. Surface uniformly even except where grooved, presenting a subhexagonal network of smooth depressed lines more or less covered by slightly convex foraminated interstices. Internal structure cancellous, like that of *Polytrema miniaceum*, laminate, excavated throughout by compressed triangular cavities sloping from the vertical axis of the cone to the circumference, defined by distinct septa or ridges laterally, supporting the foraminated lamina externally, while they rest on the preceding one internally, commencing in the cancellated structure of the circumference by gutter-like spaces separated by distinct septa like the foregoing, which diminish in number as the triangular cavity becomes narrowed upwards, until ceasing altogether it opens into the hollow central axis. Hollow axis commencing in a point at the centre of the base, and gradually increasing in size upwards till it reaches the aperture at the summit, spiral in form, and receiving the openings of the triangular cavities successively as it progresses upwards. Triangular cavities also commencing at the same point, increasing in size

as they are successively formed between the layers of the spiral lamina, which, winding round the hollow axis and spreading out towards the base, at last ends in completing the evolution of the conical test; septa of the last-formed cavities corresponding with the grooves on the surface. Presenting, in horizontal sections at different distances from the base, sub-concentric layers in a spiral form, diminishing in number upwards; and in a vertical section, the same in a conical form interrupted at the apices by the hollow columella. (For good illustrations of this generally, see Dr. Carpenter's figures alluded to in the "Explanation of the Plate.") Internal cavities lined throughout by a structureless sarcodic layer, which rests on the foramina of their walls, and on becoming dry assumes a brown colour and chitinous aspect; cavities more or less filled with different forms of siliceous sponge-spicules, entire and fragmentary, together with grains of sand (chiefly calcareous) and other minute objects, agglutinated into a mass by a sarcodic (?) substance, which when dry presents a dark brown colour. Test generally more or less transfixt by siliceous sponge-spicules entire and fragmentary, which become incorporated with the calcareous material during its formation. Size about 9-24ths inch in diameter at the base by 1-12th inch high.

Hab. Marine, on the valves of *Mytilicardia calyculata* and other hard objects, *Pecten*, *Porites*, &c. (Carpenter).

Loc. West Indies? Indian Ocean (Carpenter).

Obs. Although the form and colour of *Polytrema balaniforme* are specifically different from those of *P. miniaceum*, the structure generically is the same; that is, the subhexagonal reticulation with foraminated interstices of the spiral layer, giving in the horizontal and vertical sections subconcentric and conical layers respectively, are *mutatis mutandis* the same; while the cancellated structure generally and the large internal cavities containing more or less siliceous sponge-spicules and other minute foreign objects, together with a *superior* opening, are, but for their much larger size in *P. balaniforme* (bearing the proportion of eight to one), almost identical—even to the absence of the canal-system, which Dr. Carpenter unintentionally confirms where he states respecting this system that "the two layers [of the approximated chambers] sometimes separate from each other, as shown in the figures, so as to leave intraseptal spaces; and these form a tolerably regular canal-system, which may be traced throughout the network of ridges that covers the inner wall of each principal chamber," &c. (Introd. p. 188). Now as the canal-system of a Foraminiferous test is formed of distinct calcareous tubes, through which

the sarcode creeps *within* the intraseptal spaces, it is evident that on canal-system was present in this instance, any more than in *Polytrema miniaceum*, where the only network in the interspaces between the chambers appears to me to be that which I have described in *P. miniaceum* as the centre of the lines forming the subhexagonal structure on the surface of the older test (Pl. XIII. fig. 6, *l*), well represented by Max Schultze in his figure of an "Acervuline *Planorbulina*" copied into Carpenter's 'Introduction' (pl. xiii. fig. 1). So this inter-septal space must be something else.

Perhaps the chief point of difference between *P. balaniforme* and *P. miniaceum* is that the hollow pillars supporting the concentric foraminated (spiral?) layers in the latter are represented by solid ridges of test-material in the former, which, radiating *continuously* downwards from the hollow vertical columella as the layers of the spiral lamina increase, give rise to the form and direction of the triangular cavities, which, subdivided by subordinate septa of the same kind, distinctly represent the chambers of a foraminiferous test. Whether the ridges of solid structure have been solid from the commencement, or, like the pillars of *P. miniaceum*, were hollow first and then became solid afterwards, my specimens of *P. balaniforme*, as they are all full-grown, do not enable me to determine.

Furthermore, it is remarkable that, although Dr. Carpenter in his 'Introduction' frequently compares *Polytrema* with *Carpenteria*, he never once mentions *Polytrema* in his generally excellent description and illustrations of *Carpenteria*; while in reference to Dr. Gray's suggestion "that *Polytrema* might be especially related to *Carpenteria*," Dr. Carpenter observes it is "an idea which is not confirmed by examination of the internal structure of those types" (Introd. p. 235). That, however, Dr. Gray was right may be gathered from my descriptions of *Polytrema miniaceum* and *P. balaniforme* respectively.

But when we come to the following passage respecting the presence of sponge-spicules in *Carpenteria* and not in *Polytrema*, viz. "it is a fact of some importance with regard to the presumed spongy character of the body of *Carpenteria*, that, although (as will be presently seen) the openings at the extremities of the branches of *Polytrema* communicate very freely with the chambered interior, I have not been able to find the least trace of the spongy parasite in its substance" (*op. cit.* p. 236), we not only realize the force of Max Schultze's observation before quoted ('Annals,' 1863, vol. xii. p. 419), viz. that "by this means Carpenter establishes a sharp distinction

between *Polytrema* and *Carpenteria*," but that this arose from Carpenter's specimens of *Polytrema*, according to Max Schultze, having contained "no spicules in their interior." How this could be I know not, seeing that the specimens of *Polytrema* which Dr. Carpenter gave me did, as I have stated, contain spicules in their interior ('Annals,' 1870, vol. v. p. 391).

Lastly, Dr. Carpenter observes (for he is the only authority on this subject), "it is not a little curious that there should be a strong external resemblance between *Polytrema* and some of the less regular forms of *Carpenteria*—a resemblance which is increased by the presence of free openings at the extremities of the branches in the former, and by the precise conformity which its arcolation often presents to that of *Carpenteria*. The relation, however, is one of mere isomorphism, as we have seen the internal structure of the two organisms to be essentially different" (*op. cit.* p. 237). To me the "internal structure" is, *mutatis mutandis*, "essentially" the same.

Possessing a view so totally different from that of Dr. Carpenter with respect to *Polytrema* and *Carpenteria*, and so opposed to the suggested hybrid nature of the latter, to which the former must be now added as equally containing sponge-spicules in its internal cavities, and therefore equally presenting a form half foraminiferous and half spongy, it may not be considered useless to endeavour to get rid of this mythical impression altogether by substituting Risso's generic name of "*Polytrema*" for Gray's "*Carpenteria*," and qualifying it by the significant designation of *balaniforme*, in accordance with Dr. Carpenter's well suggested resemblance of the latter to *Balanus*, with which no doubt it has often been confounded.

When writing on the species of Foraminifera which I termed *Conulites Cooki*, Dr. Carpenter states, "The fossil described by Mr. Carter under the new generic name of *Conulites* does not appear to me to differ so essentially from the preceding in general plan of structure as to require being generically separated from it;" and thus my *Conulites* was changed to "*Patellina Cooki*" (*op. cit.* p. 233). I might say the same with reference to *Carpenteria*, had I not stronger grounds to go upon than Dr. Carpenter seems to me to have had in changing my name of *Conulites* to *Patellina*.

Again, when I discovered that the organism which Dr. Bowerbank had placed, and still continues to place, among the British sponges under the name of "*Halysiphysema Tunanowiczii*" (Mon. Brit. Spong. vol. ii. 1864, and vol. iii. 1873, pl. xiii.) was not a sponge but a foraminiferous animal, and published an illustrated description of it ('Annals,' 1870, vol. v.

p. 311, pl. iv.), which I believe all have accepted except Dr. Bowerbank and Prof. Hæckel ('Die Kalkschwämme,' 1872, vol. i. p. 456, footnote), I considered the myth so great that, to do away with the impression here also, I gave it Max Schultze's generic name of *Squamulina*, seeing that its foot or base of attachment consisted of a submultilocular test of this (Rotaline) kind, while the superstructure which grows from the summit of the test, resembling a little brush, was specifically designated "*scopula*"—the internal sarcodic contents and the peculiar form presented by the extended pseudopodia during active life being identical with that of a foraminiferous animal. Now Hæckel regards it as a "polyp, which he names *Gastrophysema*" (!) (*ap.* Lankester, 'Quart. Journ. Micr. Sci.' Jan. 1876, p. 57). It is useless to criticise such vacillation.

When, again, the late Dr. Gray gave the name of "*Carteria*" to the spongy head of *Hyalonema Sieboldii*, under the idea that the latter was a parasitic sponge developed upon the extremity of a glassy cord produced by a polype (Proc. Zool. Soc. 1867, p. 540), I tacitly rejected the myth by not adopting it.

And now for similar reasons I propose to do away with Dr. Gray's name of *Carpenteria* by substituting for it Risso's generic one of *Polytrema*, thereby hoping to get rid *entirely* of the mythical impression conveyed by the former, which has hitherto been that it represents a hybrid, half foraminifer, half sponge.

As has been above stated, there is a sharp line of distinction between the Foraminifera and the Sponges, even if we had not the presence of the spongozoon in the latter to confirm this; but with the latter it is impossible to confound sponges with any of the Rhizopoda, all of which, viz. *Arcella*, *Diffugia*, *Trinema*, *Euglypha*, *Gromia*, together with the Foraminifera and the species of Radiolaria (*Haliomma*, vide p. 197) that I have examined, respectively possess within their test a sarcodic animal substance like that of *Amæba*, which, issuing after the manner of pseudopodia from one or more apertures of the test, and drawing in crude food thereby, whose *egesta* are discharged through the *same* orifices, possess but *one* course for both, like *Actinia* and the polyps generally; while sponges, possessing *two* courses and two kinds of apertures, viz. one for taking in crude food and another for discharging the *egesta*, which is effected by groups of distinct animals (the spongozoa) imbedded in the sponge-structure, are more like the Compound Tunicata in this respect. Hence I have long since stated ('Annals,' 1873, vol. xii. pp. 27, 28) that the "embryos" of some of the Compound Tunicata, as seen in the gelatinous mass, "have very much the appearance

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

This view has been opposed with no small amount of acrimony by Prof. A. Giard, of Lille, who published his "Recherches sur les Synascidiés" (Compound Tunicata) in the first volume of Lacaze-Duthiers's 'Archives de Zool. expérimentale et générale,' and in the second volume (viz. that for 1873, p. 481) dwells on what he considers to be the resemblance between the "Myxospongiaires et des Synascidiés," viz. "mimétisme," whence he suggests for a supposed new species of *Halisarca* the name of *H. mimosa*. Now, it being a matter of opinion whether my likening the embryo of some of the Compound Tunicata to that of the Halisarcida, as above mentioned, is in favour of the "theory of evolution" or that of "mimicry," the question is not worth disputing; "*le jeu ne vaut pas la chandelle.*" But when Prof. Giard comes to translate my words above mentioned, viz. "almost identical" into "Il y a identité complète" (*op. et tom. cit.* p. 490), it is very evident that it is *not* a matter of opinion whether he has or has not falsified my assertion; it may, however, be still a matter of opinion whether Prof. Giard can or cannot read English; and so far it would be only charitable to assume the former. But still the fact remains to cast a doubt unfortunately over the rest of his statements—a doubt which, considering their apparent value, I would most willingly have not entertained.

Returning now to *Polytrema balaniforme*, we observe that the most striking feature, next to its form, is the coarseness of its structure, not only when compared with that of *Polytrema miniaceum*, but with that of all the other large Foraminifera known, together with the comparatively enormous size of its internal cavities and the quantity of sponge-spicules, both entire and fragmentary, agglutinated together in massive accumulation, that they contain. Having had to truncate one of my specimens for structural examination, several fragments of the sponge-spicule accumulations fell out, which, on being decalcified by the aid of dilute nitric acid and mounted, gave almost innumerable forms, one of which (viz. a bihamate, with a serrated crest of recurved spines extending some way backwards on the outer side of each extremity?) is quite new to me (fig. 10). It gave me also the opportunity of examining the calcareous portions under a higher power (viz. $\frac{1}{4}$ -inch object-glass), which were thus found

to have incorporated so many spicules, both entire and fragmentary, as to lead to the idea that the latter had been turned to account for strengthening the structure of the test generally.

Propagation. The circumferential cavities near the base in two of my specimens having been broken open, presented in one instance a great number of free, white, crystalline rough globules of different sizes below the 1000th of an inch in diameter, which, under the magnifying-power just mentioned, showed a radiated structure like those in some of the Compound Tunicata, to which they no doubt belong; while the radii in the fully developed ones being ovoid acuminate, with the sharp end towards the centre, gives a form which cannot be identified with any figured by Prof. Giard (*loc. cit.* pl. xxii.), nor with any that I have found on the south coast of Devon. How these have come where they now are (that is, whether they have been developed there by an embryo of one of the Compound Tunicata, or drawn in by the pseudopodia of the *Polytrema*), I have not means of determining. But at first they looked so much like the oviform bodies common to the chambers of the Foraminifera, while they are so far removed from the large cavities containing the spicules, that, had I not known the ova of Foraminifera to be soft, nucleated, and of a yellowish colour, the white frosted appearance of these globules might not have led to that examination which proved them to belong to one of the Compound Tunicata.

In the other instance the cavities broken open contained several *fixed*, circular, obtusely conical bodies of a yellowish colour, scattered over their surfaces (Pl. XIII. fig. 9, *a b*), and varying in size below the 332nd part of an inch in diameter both in breadth and height, the largest of which *in situ* (when viewed by *reflected* light) presents a lobed form with a dark point in the summit, something like a hole (fig. 9, *a*). The smaller ones (fig. 9, *b b b*) are *not* lobed, but, when mounted *in situ* (that is, on a fragment of the test, fig. 9), and viewed with a high power by *transmitted* light, present a minutely corrugated transparent envelope more or less filled with minute, granular, opaque material, also furnished with a dark point like an aperture at the summit. Whether the "lobed" larger ones are or are not a more developed state of the unlobed smaller ones, or whether or not they are all the same, and all embryos of *Polytrema balaniforme*, there is nothing to determine beyond what has been mentioned, and that for the most part they are based on one or two spicules adherent to the surface of the cavity of the test in which they are situated.

Lastly, a single embryo (fig. 8) was found *outside* the test

of one of my specimens, close to its circumference, on the shell of the bivalve to which it had adhered, and had become developed under the protection of a projecting lamina of the shell. This, which is conical and, when first examined *in situ*, upright, presented a single large aperture of a *spiral form* in the summit, was afterwards removed by a hair pencil and mounted in balsam, where, falling on its side, the aperture of course became undistinguishable, while the body generally presented an elongated conical form about 1-92nd inch long, and 1-138th inch broad at the base (fig. 8).

On examining this with a $\frac{1}{4}$ -inch object-glass and transmitted light, it appears to consist of a transparent yellowish envelope of a chitinous aspect (fig. 8, *c*), in the interior of which is a cylindrical conical cavity extending downwards from the aperture at the summit to near the bottom of the base, surrounded throughout by minute granular opaque material (fig. 8, *g*).

The envelope (fig. 8, *c*) is very irregular in its outline, and, besides the large aperture at the summit (fig. 8, *a*), presents an appearance of several smaller ones on the sides at the ends of conical or wart-like processes respectively (fig. 8, *ee*), *out of one of which projects a minute filament of probably foreign material* (fig. 8, *f*). At the base it is spread out irregularly, being deflected or prolonged in one direction much more than in any other (fig. 8, *b*), while its surface is microscopically granulated throughout, barely visible with the power mentioned.

The cavity (fig. 8, *g*) is, as before stated, cylindrical, apparently corrugated in a spiral manner at its upper part, widest where it ends in the aperture at the summit, and narrowed to a point at the other extremity, where it appears to be turned towards the deflection of the base.

Lastly, the minute granular opaque material which surrounds the cavity appears to be arranged in pouch-like aggregations.

Thus the embryo of *Polytrema balaniforme* (= *Carpenteria*), if this be one (and there does not appear to me to be any reasonable doubt on the subject), does not begin in the form of a "Globigerine type of Foraminifera" approximating "closest to *Rotalia*," as stated by Dr. Carpenter (*op. cit.* p. 188), unless the *lobed* form of the supposed embryos in the broken chambers above mentioned be considered as such; but then the smaller ones, which have been viewed as the preceding stage of development, are *unlobed*, and all have the apparent aperture *superior* and *apical* as in *P. balaniforme*, not inferior and basal as in *Rotalina*. In short, we do not yet know the embryonic form which the ovum of either *Polytrema balaniforme* or *P. miniacum* first takes, any more than we know the

form of the ovum itself. The latter is probably spherical, as in most other Foraminifera; and its earliest embryonic form may also be a spherical cell, as in *Nummulites* &c. ('Annals,' 1861, vol. viii. pl. xvii. figs. 2 o, 12 e, & 15 e); but in the thin Australian *Orbitolites*, of which I have several specimens in which the chambers are charged with embryos, the latter are all *elliptical* elongate.

It is true that in the supposed embryos of the broken chamber in *Polytrema balaniforme* we have a conical fixed form, consisting of a corrugated transparent envelope enclosing minute-granular opaque material, and the appearance of an apical aperture—all of which is found in the single embryo developed just outside the test; yet the more advanced state of the latter and the differentiation of parts, with *the presence of a filament of foreign material projecting from one of its apertures* (fig. 8, f), is much more suggestive of *its* real nature than that of the "embryos in the broken chambers."

Finally, the presence of more than one aperture about the envelope of the single embryo seems to point out that in the fully developed test there may be also more than one, through which the sponge-spicules &c. are drawn into the interior—a fact which the projecting of spicules through certain portions of the surface of the full-grown test seems to indicate, although it is impossible to state this with certainty, from the rough treatment to which my specimens have been subjected having caused a great part of their foraminated areae to be irregularly broken out. Such apertures would of course be subsidiary, and formed, as they are in *Polytrema miniacum*, by an accidental destruction here and there of one of the foraminated interstices of the network on the surface.

Not possessing more than full-grown specimens of *Polytrema balaniforme* (fig. 7) and the early embryonic form above described (fig. 8), I have no means of following its gradationary development further than is indicated by the structure itself of the former, which is above given.

Note on Parkeria.

Through the kindness of Mr. W. J. Sollas, I became possessed of a spheroidal specimen of *Parkeria*, $1\frac{1}{2}$ inch in diameter, from the neighbourhood of Cambridge, on the 1st of February, some days after my MS. on the Polytremita had been sent to the press. This specimen, when it reached me, was in three pieces, consisting of the two halves of the sphere *minus* an entire central slice, which had been ground down to great thinness and mounted for microscopical examination. Most

of the cavities, originally in the interior, had become filled with calcspar; and the rest were empty. When entire, the whole consisted of a spheroidal mass of reticulated structure, with rough papillated exterior, traversed by a large axial space in the form of an elongated cone, whose point, situated close to the circumference on one, extended to the base which occupied a portion of the circumference of the other side. This elongated cone, which attains in the centre a diameter of one third of an inch, and presents an irregularly scalloped line on the surface in the section, diminishes slightly towards the base, and is surrounded on all sides, except the extremities, by concentric layers of chambers ("chamberlets," Carpenter, Phil. Trans. 1869, vol. clix. pt. 2, p. 728), also excavated in the reticulated structure, each chamber being more or less irregularly quadrangular, representing in miniature a *crypt* arising from four columns, whose pillars and arches are formed by the reticulated structure; while all the chambers or "crypts," being piled one upon another in radiating columns, undergo division successively as they extend outwards from the cone, so as to fill the spaces that would otherwise be left towards the circumference, since the chambers, although very irregular in shape, are much the same in size throughout. Hence, when a longitudinal section is made through the centre of the conical space, the reticulated structure is also observed to be in radiating columns, which present a series of floral-like expansions as they successively follow each other in forming the columns of support to the arches of the cryptiform chambers respectively.

As there is an irregularly reticulated structure, so there must be the same form or kind of continuous interstices; and this has been termed by Dr. Carpenter the "labyrinthic system" (*tom. cit.* p. 729); besides which, this labyrinthic system opens into larger spaces of a short cylindrical form, which chiefly occupy the pillars of the crypt-like chambers, and thus possess a more or less radial direction, although they are by no means more continuous or regular in position than those of *Polytrema miniaceum* above mentioned. These are the "radiating tubes" of Dr. Carpenter (*tom. cit.* p. 728).

In consequence of the axial conical space in my specimen being distinguished from the rest of the structure by the presence of a heterogeneous mass of foreign material, among which may be observed innumerable fragments of sponge-spicules and minute Foraminifera, while this is limited in one direction by the closed conical end, and continued to the surface of the test at the other or basal extremity of the axial space, it seems that the latter was the direction of the main

inlet, however much (where empty, as in Dr. Carpenter's specimens) it may be divided into chambers by septal partitions. In short, the space was conical with the base open, and so far like the conical axial cavity of *Polytrema balaniforme*, if not also sometimes "spiral" (*tom. cit.* p. 728, footnote).

When we come to the cavities of the test outside the cone, we find that those of the chambers ("chamberlets") and those of the interstices of the reticulated structure ("labyrinthic system"), including the "radiating tubes," are empty in some and filled up by colourless transparent calcspar in other parts.

Of what, then, was the fibre of the reticulated structure composed? for the whole test was formed of it.

That *Parkeria* was a species of Foraminifera can hardly be doubted; but one of the chief characters of the Foraminifera is their foraminated area, of which the so-called "nummuline tubulation" is an example; and the existence of this in *Parkeria* has hitherto not been demonstrated.

Now this structure, which fills the interstices of the reticulation in *Polytrema miniaceum* as well as in *P. balaniforme*, is so thin that it is often broken away, and moreover, with the exception of the surface, often disappears altogether in *P. miniaceum*, as I have above stated, leaving a simple mass of reticulated fibre in the interior, which, under these circumstances, becomes analogous to that of *Parkeria*.

Thus, if we suppose the reticulated fibre of *Polytrema miniaceum* to have been converted by fossilization into calcspar, and coated with a granular crystallization of a yellowish calcareous material, we should have the same composition as that which appears to me to exist in the fibre of *Parkeria*. Or the reticulated fibre of *Parkeria* might have been always hollow, as the radiating pillars in the young test of *Polytrema miniaceum*, which here, however, afterwards become solidified, also as above stated, in which case the coating might originally have been organic.

Be this as it may, one object in introducing *Parkeria* here (which otherwise appears to have been so well described and illustrated by Dr. Carpenter, *loc. cit.*) is to state that the coating on the surface of the reticulated fibre of this fossil appears to me *not* to be composed of "sand," but of a granular crystallization of calcareous material.

My attention was first called to this by observing that in the composition of the fossilized test of *Parkeria* there were only nine parts of siliceous material in a hundred, the rest being chiefly calcareous material, also that in some parts, according to Dr. Carpenter (*tom. cit.* p. 732), the angular sand-grains were fitted together with "marvellous exactness," and that in my

section of the Kelat fossil (*Alveolina meandrina*), to which I have above alluded as closely allied to Mr. Brady's description and illustrations of *Loftusia*, there was no appearance of sand-grains; I therefore became suspicious of the so-called "arenaceous" composition. Hence I examined my specimen of *Parkeria* with this view, and find that the fibre of the reticulated structure is composed of transparent colourless calcspar, covered with a rough or frosted yellowish granular coat of calcareous material, more or less filling up in larger crystallization of the same form some parts of the labyrinthic interstices (much as stalactite in a limestone cavern, &c.). I therefore infer that the original fibre is represented by the calcspar, and that the granular coating has been added during fossilization. Had the latter been siliceous instead of calcareous, it would probably have presented the usual smooth, or at least prismatic, granular appearance of botryoidal chalcodony, instead of the rough rhombohedral granulation of a calcareous base; so that the "sand-grains" so well represented by Dr. Carpenter in the siliceously infiltrated specimen (*tom. cit.* pl. lxxvi. fig. 1), if also composed of silex like that of the infiltration, should, it seems to me, be viewed as a siliceous pseudomorph of calcareous crystallization.

It is almost impossible to conceive a hard, sharp, granular, angulated surface in any organic cavity where the soft parts in contact with it are in continual motion, as it seems impossible to confound the heterogeneous sand-agglomeration so often witnessed in Foraminiferal tests with the uniformity of this mineral crystallization. In a specimen of *Lituola nautiloidea*, Lam. (*canariensis*, D'Orb., mihi), about one sixth of an inch in its greatest diameter, this contrast is most obvious; while the "labyrinthic" structure is cancellous laminar, like that of bones, and not composed of reticulated fibre like that of plants and *Parkeria*. In *Lituola* the labyrinthic structure is excavated in the test; in *Parkeria* the reticulated fibre, in which the "labyrinthic system" is, is the test itself.

I have alluded to the absence of the foraminated area; but I think I can see one of these on the border of the "conical space" in my mounted section, in which the foramina and their regularity in size (1-1800th inch in diameter) and position are almost identical with those in the interstices of the reticulated structure of *Polytrema balaniforme*, and therefore much smaller and more regular than any thing of the kind presented by the reticulated structure generally of *Parkeria*: hence the openings of the labyrinthic system, as this structure was successively formed on the surface of the concentric layers

of the test, may have thus been faced with a foraminated lamina, like the interstices of the reticulated structure forming the concentric or successive layers of *Polytrema miniaceum* and *P. balaniforme* respectively.

Polytrema utricularis, n. sp. Pl. XIII. figs. 11-16.

Test fixed, calcareous, colourless or whitish grey, gregarious. General form globular, bottle- or sac-shaped (figs. 11-14), with the aperture generally single and more or less superior (fig. 12, *b b b*), supported on a short neck, rounded and inflated at the margin and expanded at the base, where it becomes continuous with the bottle-shaped body (fig. 13, *a a a*). Surface cribriform, commencing a short distance from the neck in a sub-hexagonal bee's-comb-like network, so much in relief that the foramina which fill the interstices at the bottom can hardly be seen except by direct view (figs. 12 & 15). Internal structure consisting of a large, single, unseptate, globular cavity, corresponding with the external form, and surrounded on all sides but the base by the cribriform structure mentioned (fig. 15), which, when viewed in a vertical section, shows that the bee's-comb-like network (figs. 15, *a*, & 16, *a*) rests upon the foraminated layer (figs. 15, *b*, & 16, *b*) in the proportion of two to one, the whole being 3-830ths of an inch in thickness. Cavity lined by a sarcodic layer of a chitinous aspect when dry (fig. 14, *e*), open at the aperture and closed below, where it forms the bottom of the sac-like or bottle-shaped body, which is thus attached to the object on which the species may be growing. Filled more or less with siliceous sponge-spicules and calcareous grains of sand, which, together with other minute objects, are agglutinated by sarcode into a mass that presents a yellowish or dark-brown amber-colour when dry (fig. 14, *b*). Size variable, as the sac-like body varies in form: body of the most regularly formed specimen that I possess about 1-24th inch in diameter, and about the same high, including the neck and aperture.

Hab. Marine. On hard objects (old coral &c.).

Loc. Tropics?

Obs. The utricular body of this species is subject to great variety in form, owing to the various influences that may affect it during growth. When on a free surface, however, it is generally bottle-shaped, globular, with superior aperture. Sometimes the latter is double, as may be seen by the illustration, wherein there are four apertures and only three chambers (fig. 12, *b b b b*). The single unseptate chamber and the prominence of the *reticulated structure* on the surface are suffi-

cient to distinguish it from the foregoing species; while the calcareous composition, *superior* aperture, reticulated surface, with foraminated interstices, and heterogeneous spicular contents of the cavity sufficiently ally it to them to justify its being considered a *Polytrema*. It might be viewed as a transition form between *Polytrema* and *Planorbulina*, but can never be considered a species of the latter, being more like the "rough" *Globigerina*, in which there is a reticulated surface but *only one* foramen at the bottom of each interstice.

Filling up the crevices in the groups of *Polytrema utricularis* is a new species of *Pachastrella* (sponge), which I would propose to designate "*parasitica*," whose skeleton-spicule (fig. 17, *a*) consists of a simple short shaft terminated by three arms, each of which is twice furcated, together with a minute flesh-spicule (fig. 17, *b*) formed of a bacillary shaft like that of *Dercitus niger*, but longer and more thickly and minutely spined. It is the habit of *Pachastrella* to creep into such recesses, and thus to follow closely upon the borings of a *Cliona*; so that in one instance I found *Dercitus niger* together with a *Cliona* in the midst of a thick piece of branched coral which came from Cuba.

Polytrema planum, n. sp. Pl. XIII. figs. 18 & 19.

Test sessile, calcareous, solitary, colourless. General form thin, flat, frondaceous, following in shape the surface on which it may be growing (fig. 18, *b*). Surface even, smooth, tessellated by a polygonal reticulation with foraminated interstices of various shapes (fig. 19); margin irregular; aperture excentric, circular in form, with raised thin margin (fig. 18, *c*). Internal structure cancellous, one layer deep, corresponding with the reticulation on the surface. Chambers or flat cancelli sacciform or utricular at the margin. Contents of the cells sarcodic. Size $\frac{1}{4}$ of an inch in diameter, almost immeasurably thin.

Hab. Marine. On hard bodies (old coral, &c.), spreading *Melobesia*-like, following in form that of the surface on which it grows.

Loc. Australia.

Obs. I have but one specimen of the species, which is on a branch of old coral partly overgrown with *Melobesia* and other algæ, sponge, &c., bearing *Orbitolites*, *Polytrema miniaceum*, and almost every variety of *Planorbulina vulgaris*, together with *Alveolaria* and other minute forms of free Foraminifera. The even reticulation with foraminated interstices hardly raised above the surface, accompanied beneath apparently by a more

or less continuous internal cavity, although very thin, with superior aperture, allies this Foraminiferous test much more to *Polytrema* than to *Planorbulina*, although its marginal cells very much resemble those of the latter. Having only one specimen, and not liking to destroy any part of it, what I have stated concerning the "single" aperture (fig. 18, *c*) and "continuous" internal cavity must be considered provisional. The latter may be in chambers corresponding with the reticulation on the surface, and therefore divided; or it may be supported by pillars, as in *Polytrema miniaceum*, and thus more or less continuous.

On the surface of the specimen is a small group of pink *Planorbulina*-utricles (fig. 18, *d*), which in their form and much larger size, together with their foramina, contrast strongly with that of *Polytrema planum*. I have also specimens of *Polytrema miniaceum* respectively growing upon colourless patches of *Planorbulina*, but never saw *Planorbulina* either colourless or pink growing by the combination of its utricular cells, or in any other way, into the form of *Polytrema miniaceum*; hence I agree with Dr. Carpenter (*op. cit.* p. 209) that Max Schultze's Acervulinida are nothing else but pink varieties of *Planorbulina* (Max Schultze, 'Polythalamien,' 1854, p. 67, pl. xvii. figs. 12-15).

EXPLANATION OF PLATE XIII.

- Fig. 1.* *Polytrema miniaceum*, De Blainville, nat. size.
Fig. 2. The same. Central portion of basal layer, about 2-48ths inch in diameter, viewed from the outside, showing:—*a*, confused arrangement of primary chambers; *b*, three circular rows of radiating lines with oblong quadrangular interspaces; *c*, portion of basal layer reflected, to show foraminated roof of circular cavity. Scale 1-96th to 1-830th of an inch.
Fig. 3. The same. Diagram of horizontal section of fragment, to show relative position of foraminated (= "spiral") layers, *a a a*, and hollow pillars of support, *b b b*.
Fig. 4. The same. Embryonic form, nearly 1-80th inch in diameter at the base and 1-83rd inch high, broken out at the side, showing:—*a*, base expanded and foraminated; *b*, cylindrical stem or process, also foraminated; *c c*, broken edges of foraminated layer; *d*, thin superior or growing portion of the same; *e*, cancellated structure of interior; *f*, siliceous spicules of sponges projecting from the interior. Scale 1-12th to 1-830th of an inch.
Fig. 5. The same. Truncated end of embryonic form, on the same scale, just where the cancellated structure commences, showing the relative position, number, and size of the cavities at this point.
Fig. 6. The same. Diagram of head, to illustrate description: *a a a a*, branches entire; *b b*, ends of branches broken off; *c c c*, apertures of entire branches; *d d*, external or foraminated surface; *e*, internal structure; *f f f*, young foraminated layer; *g g g*, dimples

or ends of pillars of support in foraminated groundwork; *h h*, unforaminated linear areae uniting the same; *i*, larger dimples or circular areae, foraminated in the centre and surrounded by an unforaminated ring; *k*, subhexagonal or polygonal unforaminated reticulation, with foraminated interstices; *l*, fine linear (tubular?) network in centre of unforaminated reticulation; *m m m*, threads composed of an agglomeration of sand, siliceous spicules, and other minute objects, connected with the apertures and with each other; *n n n*, spicules projecting from the apertures of the entire branches; *o o o*, the same, projecting from apertures formed in the ends of the branches broken off; *p*, triradiate spicule arrested in an aperture; *q*, purple spicule of a *Gorgonia*; *r r*, globo-stellates of a Compound Tunicated animal; *s s*, dried pseudopodia; *t t*, cancellated structure of interior; *v v v*, cavities in the same, containing spicules chiefly in a fragmentary condition.

Fig. 7. *Polytrema balaniforme*, Carter (*Carpenteria*, Gray), on a valve of *Mytilicardia calyculata*, nat. size: *a a*, apertures.

N.B. For good illustrations of the test of this species, see Carpenter, 'Phil. Trans.' 1860, vol. cl. pt. 2, pl. xxii. figs. 1 and 5-15; also 'Introduction to the Study of the Foraminifera,' 1862, pl. xxi. figs. 6-18, but not so well executed.

Fig. 8. The same. Supposed embryo, about 1-92nd inch long: *a*, apex; *b*, base; *c*, chitinous integument, micro-granulated; *d*, large spiral aperture; *e e*, small papillary apertures; *f*, one of same, from which a minute filament of foreign substance is projecting; *g*, internal cavity, surrounded by opaque granular material, apparently in pouch-like cavities. Scale about 1-12th to 1-830th of an inch.

Fig. 9. The same, embryos of (?), on fragment of cancellated cavity from near circumference: *a*, lobed form, 1-332nd inch in diameter; *b b b*, unlobed smaller forms. Scale 1-12th to 1-830th of an inch.

Fig. 10. The same. Sponge-spicule; new form of bihamate or fibula, from among spicules of the interior, 1-250th inch long. Lower end restored.

Fig. 11. *Polytrema utricularae*, n. sp., group of three individuals, nat. size.

Fig. 12. The same, superior view, magnified: *a*, utricular bodies; *b b b*, apertures; *c*, polygonal reticulation of surface.

Fig. 13. The same, lateral view, magnified: *a a a*, apertures at the ends of neck-like prolongations of the tests respectively.

Fig. 14. The same, basal view, from which the sarcodic (now chitinous) layer at once of occlusion and attachment has been removed, showing:—*a a a*, cavities of the three individuals respectively, each of which is filled with fragments of spicules, as represented in *b*; *c*, wall at base of test, showing relative position and size of polygonal reticulation and foraminated layers respectively; *d*, apertures on internal aspect of foraminated layer; *e*, sarcodic (now chitinous) layer lining the utricular chamber and prolonged into the aperture—reflected.

Fig. 15. The same, fragment of surface, magnified, to show, *a*, polygonal reticulation, and, *b*, foramina at the bottom of the interstices respectively.

Fig. 16. The same, vertical section of wall of test, to show relative position and size of polygonal reticulation, *a*, and foraminated layer, *b*.

- Fig. 17. Siliceous sponge-spicules characteristic of a *Pachastrella* growing over some of the groups of *Polytrema utricularum*—*Pachastrella parasitica*, n. sp.: *a*, skeleton-spicule spreading into a head 40-6000ths inch in diameter; *b*, flesh-spicule, 5-6000ths inch long.
- Fig. 18. *Polytrema planum*, n. sp., nat. size, on a branch of coral: *a*, coral; *b*, *Polytrema*; *c*, its aperture; *d*, group of *Planorbulina vulgaris*.
- Fig. 19. The same, diagram of a few of the chambers, magnified, to show their variety in form, also foramination and stoloniferous intercommunications.

XX.—On a new Species of *Coris* from the Molucca Archipelago. By Dr. A. A. W. HUBRECHT, Conservator at the Leyden Museum.

THIS species (a specimen of which was among a collection of fishes from the island of Ceram, sent by Mr. Lüdeking) may be distinguished at a glance from any of the known species of the genus by the oblong transverse pearl-coloured spot which descends from between the fourth and seventh dorsal rays. Another feature by which it may be easily distinguished is the (apparently) blue band running from the lips along the throat to the ventrals. The back is crossed by numerous transverse bands, darker than the ground-colour, broader than the interspaces, and not continued on the belly. The lower half of the dorsal fin is dark-coloured, the upper half light; both it and the anal fin have a thin dark-coloured streak running close along the outer margin.

I have named it after Dr. Bleeker, who has introduced into science such a considerable number of new fishes from the archipelago already.

Coris Bleekeri, sp. nov.

D. $2 + \frac{7}{12}$. A. 3 | 12. C. 1 | 12 | 1. P. 2 | 11. V. 1 | 5.

C. corpore oblongo compresso, altitudine 4 circiter in ejus longitudine, latitudine $2\frac{1}{3}$ ad $2\frac{1}{2}$ circiter in ejus altitudine, capite acutiusculo 4 ad $4\frac{1}{4}$ circiter in longitudine corporis; altitudine capitis $1\frac{2}{5}$ circiter in ejus longitudine; oculi diametro $5\frac{3}{4}$ fere ad 6 in longitudine capitis; oculis diametro $1\frac{1}{2}$ distantibus, diametro $\frac{1}{2}$ ad $\frac{3}{4}$ a linea rostro-frontali remotis, linea rostro-frontali declivi convexiuscula vel rectiuscula; labiis carnosis; maxillis subæqualibus, superiore ante oculum desinente $4\frac{3}{4}$ circiter in longitudine capitis; dentibus maxillaribus biseriatis, intracristalibus graniformibus minimis, cristalibus conicis acutis, anticis 2 caninis mediocribus curvatis prominentibus; angulo oris dente prominente nullo; squamis lateribus 76 circiter in linea laterali absque caudalibus minimis; linea

lateralis regione suprascapulari valde curvata, singulis squamis poro vel tubulo simplici notata; pinnis dorsali et anali basi alepidotis; dorsali spinis 2 anterioribus flexilibus ceteris multo longioribus; 1^a $\frac{3}{5}$ circiter in altitudine corporis, spinis ceteris gracillimis leviter pungentibus postrorsum longitudine accrescentibus posteriore ceteris longiore corpore plus duplo humiliore, dorsali radiosa spinis dorsalis posterioribus altiore postice angulata; pinnis pectoralibus acutis $5\frac{5}{8}$, ventralibus acutissimis $7\frac{3}{4}$ ad 8, caudali extensa margine posteriore medio convexa angulis radiis marginalibus parum productis acuta 8 ad $8\frac{1}{2}$ in longitudine corporis; anali dorsali radiosa vix humiliore postice angulata; colore corporis (in spirit. vin.) superne violascenti-roseo, inferne flavescenti-margaritaceo, dorso vittis transversis 16 ad 20 irregularibus plus minusve coalescentibus corpus semicingentibus fusciscenti-violaceis interstitiis latioribus; macula transversa oblonga margaritacea vel lutea, basin dorsalis radiosæ radium 4^m inter et 7^m intrante et pinnam analem non attingente; vitta impari mento-ventrali linea mediana cærulescente; pinnis dilute roseis vel flavescenter roseis, dorsali dimidio inferiore purpurea, dimidio superiore vittula intramarginali nigrescenti-purpurea, anali vitta basali et vitta mediana longitudinali flavis, margine inferiore violascente marginata. Longitudo speciminis unici (in Mus. Lugd. Bat.) 143 millim.

Hab. Ceram, in mari.

Leyden,
February 9, 1876.

XXI.—On the Budding of the *Cuninæ* in the Stomach of the *Geryonidæ*. By B. ULJANIN*.

DURING my sojourn in the winter of the present year at Villafranca and Naples, I had many opportunities of observing specimens of *Carmarina hastata*, Häck., which bore *Cunina*-buds in their stomachs. As the most detailed extant observations on these buds (those of Häckel in his 'Monographie der Rüsselquallen') are very incomplete, I bestowed particular attention upon this supposed *Geryonia*-brood, with the purpose of tracing their still entirely unknown development, and testing more accurately the hypothesis put forward by Häckel as to the genetic connexion of the *Geryonidæ* with the *Æginidæ*. My hopes, however, were only partially fulfilled. I certainly succeeded in observing a tolerably continuous series of the developmental stages of these *Cuninæ*, and in arriving at the

* Translated by W. S. Dallas, F.L.S., from the 'Archiv für Naturgeschichte,' 1875, pp. 333-337.

firm conviction that the *Cuninæ* which sprout in the stomach of the Geryonidæ are nothing but parasites of the *Carmarina*; but I could not manage to rear the young *Cuninæ* up to their full sexual maturity and to refer them to their parent form.

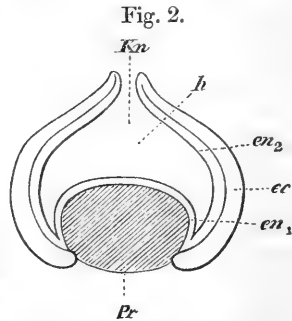
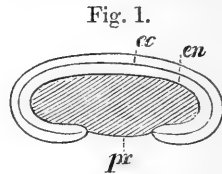
In what follows I briefly sum up the principal results of my investigations, and will hereafter publish a more detailed account of my observations elsewhere.

The youngest stage observed by me (fig. 1) is a larva measuring 0.17–0.25 millim., the body of which consists of a one-layered ectoderm and entoderm.

The two layers pass over into one another, and bound a cavity which opens outwards by an orifice and is almost entirely occupied by a finely granular mass (*pr*), which may sometimes be protruded a little from the orifice during the rather strong contractions of the larva. I have several times fished larvæ of the same structure with the muslin net from the sea at Villafranca, but have still more frequently met with them (sometimes in great abundance) in the stomach and radial canals of *Carmarina hastata*.

With the growth of the larva the cells, both of the ecto- and entoderm, are multiplied. In consequence of the much more rapid growth of the ectoderm, the entoderm splits into two layers, between which a cavity (the body-cavity of the polype) then becomes perceptible. The young animal, which still moves freely in the stomach and radial canals of the *Carmarina* by means of its ciliary coat (it is shown in longitudinal section in fig. 2), consists of the finely granular mass (*Pr*), which is surrounded by a series of cells (*en*₁), the lower layer of the split entoderm, and of the ectoderm (*ec*) with the upper layer of the split entoderm (*en*₂), by which the body-cavity (*h*) of the polype is bounded.

Soon after the cleavage of the entoderm of the larva and the formation of the cavity of the polype (*h*) between the two resulting entodermal layers, the short tentaculiform excrescences which serve to attach the young polype-stock to the *Carmarina* begin to sprout round the orifice of the mouth. Both body-layers of the polype take part in the formation of these



extraordinarily contractile tentacles, which are thickly furnished with numerous small, strongly refractive, round corpuscles (nettling capsules?). An animal in this state of development, such as I once met with at Naples floating with various other pelagic animals among the drift-materials of the surface, but more frequently found still adhering to the *Carmarina*, greatly resembles the peculiar medusoid creature from the bay of Nice described by Leuckart under the name of *Pyxidium truncatum*, especially as the latter, like the young *Cunina*-polypes observed by me, scarcely made any movement, and was only passively carried along.

As soon as the tentaculiform processes in the periphery of the buccal aperture are formed, the young animal attaches itself to some part of the body of the *Carmarina*. Most frequently this takes place on some part of the tongue of the Geryonid, or on the inner wall of the stomach. Sometimes also I found *Carmarinae* more or less closely set with such young *Cunina*-polypes behind the velum, on the subumbrella. It is only very rarely, indeed almost exceptionally, that the *Carmarinae* are burdened with a *Cunina*-polype; but then in general there are two at least, or even more, together. The animals adhere pretty firmly to the Geryonid; but when carefully detached they live for a long time, and even become still further developed in experimental glasses.

After the young *Cunina*-polypes have attached themselves to the Geryonid they are subject to no further important metamorphosis. The young polype grows rapidly, and at the same time changes its originally rather broad and depressed form for a more elongated one. The finely granular mass, which almost entirely occupied the body-cavity of the free-swimming larva and which is also long visible in the polype, constantly becomes smaller as the latter grows, and at last entirely disappears; it is evidently used up as nutriment by the growing polype. Such polypes (bud-cars, *Knospenähren* of Hæckel) as have the form of a much elongated, strongly contractile tube, and are already beset with a number of *Cunina*-buds, are tolerably correctly figured in the plate which accompanies Noschin's memoir ('Mélanges Biologiques,' tome v.).

I will not describe here the process of budding of the *Cuninae* on the polype, as it has already been pretty completely and correctly observed by Noschin and Hæckel. I only remark that the rudiments of the first *Cuninae* are to be observed even on the polypes which are not yet attached. (Such a rudiment is indicated at *kn* in fig. 2.) The important question, to which species the young *Cuninae* belong, and whether they increase

sexually or asexually, could not, as already stated, be decided by me.

At first I thought I was justified in regarding the brood parasitic in the *Carmarina* as belonging to the *Cunina discoidalis*, Kef. & Ehl., which is pretty frequent at Villafranca and Naples; (and the resemblance of the *Cunina* sprouting in the stomach of *Carmarina* to *C. discoidalis* has already been noticed by Noschin;) but subsequently this supposition proved to be unfounded, as the young *Cunina* constricted off from the parasitic polypes became further developed in my aquaria, and then gradually lost their resemblance to *C. discoidalis*, two new marginal corpuscles, with the mantle-lobes belonging to them, being developed upon each segment.

Summing up the conditions here briefly described, it appears:—1, that the *Cunina*-brood which is developed in the stomach of *Carmarina hastata*, Häck., stands in no genetic connexion with the *Geryonid*; and, 2, that the species of *Cunina*, the young of which is parasitic upon the *Geryonid*, is subject during its evolution to an alternation of generations. As is well known, a species of *Cunina* (*C. octonaria*) has already been observed by M'Crady, the brood of which is parasitic, as a proliferant polype, in an *Oceanid* (*Turritopsis nutricola*). As the *Cunina octonaria* of M'Crady certainly belongs to the same group (*Cunina* in Metznikow's sense) as that observed by me, and as this peculiar mode of development has hitherto been observed only in the species of this group, we may suppose that perhaps all the species of this group are subject to an alternation of generations, contrary to what takes place in the species of the group *Polyxenina*, Metz., which are developed directly without alternate generations.

XXII.—*Descriptions of some new Species of Crustacea, chiefly from New Zealand.* By EDWARD J. MIERS, F.L.S., of the Zoological Department, British Museum.

HAVING been intrusted by Dr. Hector, F.R.S., with the compilation of a Catalogue of the species of Podophthalmatous and Edriophthalmatous Crustacea of New Zealand for the New-Zealand Government, I have thought it desirable to publish without delay descriptions of such species as do not appear to have been hitherto recorded: the type specimens of nearly all of these are in the collection of the British Museum, and they will be figured in the Catalogue. I have added descriptions of one or two allied new species from Australia and Tasmania in the collection.

Halimus Hectori, n. sp. Type, B.M.

Moderately convex, broadest behind, with the sides converging from the front of the branchial regions, obscurely tuberculated; there are four low tubercles (two median and two lateral) on the gastric, two in front of the branchial region, one at some distance behind, and two smaller upon the sides of the branchial region. The cardiac region is convex. The upper orbital margin projects considerably over the base of the eyes. There are four obtuse spines, of which two are larger, on the hepatic, and about ten small tubercles on the pterygostomian regions; the spines of the rostrum are straight, scarcely at all divergent. Penultimate joint of the ambulatory legs considerably dilated and squarely truncate at its distal extremity. Abdomen of male 6-jointed.

Length rather more than 2 inches.

Hab. New Zealand.

A single, unfortunately mutilated, specimen has been presented by Dr. Hector to the British Museum. This species is in many respects intermediate between the genera *Acanthonyx* and *Halimus*; but in the convergent sides of the carapace and squarely truncate penultimate joints of the legs it has most affinity with the latter genus. It is remarkable for the absence of spines on the gastric, cardiac, and branchial regions.

PARAMITHRAX.

Under this generic name I have constituted two subgenera, as follows:—

1. PARAMITHRAX.

Anterior legs in the male enlarged; hand compressed; fingers with a vacant space at base when closed; wrist with two longitudinal ridges, the outer usually oblique.

This subgenus includes the *P. Peronii* and *P. Gaimardii* of Milne-Edwards, and the following species:—

Paramithrax barbicornis. B.M.

Pisa barbicornis, Latr. Encycl. x. p. 141 (1825).

Paramithrax barbicornis, M.-Edw. Hist. Nat. Crust. i. p. 324 (1837).

The specimens of this species in the British-Museum collection from New Zealand prove that the description of Latreille, based on a specimen from Australia, refers to the young female.

The males have the anterior legs greatly developed; arm with a series of strong spines above; wrist with two ridges, the inner divided into several lamellate or tuberculiform lobes, the outer uninterrupted except at the base; hands compressed,

fingers leaving a space at base when closed. The carapace, when the hairs are removed, appears covered with numerous wart-like minutely punctulated flattened tubercles.

Length 2 inches, breadth $1\frac{1}{2}$ inch.

Should this species, on comparison with specimens of both ages and sexes from Australia, prove distinct from *P. barbicornis*, it may be designated by the name of *P. Latreillei*.

2. LEPTOMITHRAX, subgen. nov.

Anterior legs in the male elongated, slender; hand and wrist subcylindrical; fingers meeting along their inner edges when closed; wrist simply granulated, without longitudinal ridges.

This subgenus is intermediate between the true *Paramithrax* and *Maia* of the northern hemisphere. From the latter genus it is distinguished by the much narrower interorbital space and the basal joint of the external antennæ, the flagellum of which arises from the orbital margin, and not from within the orbital cavity as in *Maia*. It includes the *Paramithrax Edwardsii*, De Haan, the *Maia australis*, Jacq. & Lucas, and the following species:—

Leptomithrax longimanus, n. sp. Type, B.M.

Carapace triangular; branchial regions convex on the sides; depression separating the branchial from the cardiac, gastric, and hepatic regions deep and well-defined; carapace, arms, and wrists covered with a close velvet-like pubescence, and with small scattered granules. Spines of rostrum long. Antero-lateral margins destitute of spines. Anterior legs very long, about twice as long as the carapace; hand slender, cylindrical, and minutely granulous. Ambulatory legs slender, closely pubescent.

Length $1\frac{3}{4}$ inch, breadth $1\frac{1}{2}$ inch.

Hab. New Zealand.

This species is distinguished by the great length of the anterior legs, and the absence of spines on the antero-lateral margins. The male only is known.

Leptomithrax australiensis, n. sp. Type, B.M.

This species bears a general resemblance to the foregoing; but the carapace is covered with small spinules, and there are three or four larger spines upon the branchial regions. Anterior legs shorter; hand slightly compressed and granulous at base; palm about as long as the wrist. The whole animal is covered with short, stiff hairs, curled at the tips.

Hab. Tasmania.

Neptunus pelagicus.

Under this name two very distinct species appear to have been confounded, which may be diagnosed as follows:—

1. *Neptunus pelagicus.* B.M.

Cancer pelagicus, Linn. Syst. Nat. ed. xii. p. 1042 (1766).

Carapace evenly but not coarsely granulated, with distinct epibranchial lines. Front 6-toothed, the median teeth smaller, but never obsolete. The middle lobe of the upper orbital margin with a small spine at its external angle. Anterior legs very long and slender. Colour (in dried specimens) blue or pink, with irregular spots, blotches, and bands of pale yellow.

This species occurs throughout the Red Sea and Indian Ocean, the East-Indian islands, on the coasts of the Philippines, China, and Japan, the eastern coast of Australia, and at New Zealand, and often attains a very large size.

2. *Neptunus trituberculatus*, n. sp. Type, B.M.

More convex, less coarsely granulated, with the epibranchial lines less strongly marked than in *N. pelagicus*. Three low tubercles placed in a triangle in the central portion of the carapace—one anterior, upon the gastric, and two posterior, upon the cardiac region. Front 4-toothed, the two median teeth being obsolete. Middle lobe of the upper orbital margin commonly without a spiniform prominence. Arms shorter and more robust than in *N. pelagicus*. Colour a dull pink or slate, with numerous regular spots of pale yellow upon the carapace and legs.

This species inhabits the coasts of China and Japan, and is figured by De Haan, in the 'Fauna Japonica,' pls. ix., x., as *N. pelagicus*. It attains to quite as large a size as that species. The *Cancer cedo nulli* of Herbst ('Krabben,' ii. pl. xxxix.) resembles it in having a 4-toothed front; but there is no indication of the three tubercles on the carapace, and the form of the teeth of the antero-lateral margins and front and of the anterior legs is very different.

Elamene Whitei, n. sp. Type, B.M.

Halicarcinus depressus, White, Ann. & Mag. Nat. Hist. xviii. p. 178 (1846), nec Jacq. & Lucas.

Carapace subtriangular. Front between the eyes broad, lamellate, and concave above, projecting considerably beyond

the eyes, which are visible at the sides of the rostrum, and suddenly narrowing towards the extremity, which is acute. A small tooth external to the eyes. Anterior legs in the male very long, rather slender, and hairy, without spines.

Length and breadth rather more than $\frac{1}{2}$ inch.

Hab. New Zealand, Bay of Islands.

The *Elamene pilosa*, A. M.-Edw. N. Arch. Mus. Hist. Nat. ix. p. 322, pl. xviii. fig. 6 (1873), somewhat resembles this species, but differs from it in the form of the carapace and front. In *E. truncata* (A. M.-Edw. *l. c.* p. 323) the eyes are concealed by the rostrum, which is produced below into a lobe separating the inner antennæ.

PETROLISTHES.

PETROCHELES, subgen. nov.

Sides of the rostrum spinose. Lateral margins of the carapace with a series of spines. Anterior legs elongated, slender; arms with spines on the anterior margin.

Petrocheles spinosus, n. sp. Type, B.M.

Carapace depressed, broader behind, almost entirely covered with a close short pubescence; lateral margins with a series of ten or eleven small spines. Front prominent; lateral margins with three or four spinules. Anterior legs closely pubescent, granulous above; arm with a series of four or five spines on the anterior margin; fingers hairy on their inner margins, and not quite meeting at their base when closed. Ambulatory legs with the superior margins spinulous and hairy.

Length of carapace $7\frac{1}{2}$ inches, breadth $1\frac{1}{2}$ inch.

Hab. New Zealand.

A specimen in the British-Museum collection from Australia resembles the foregoing, but has in addition two spines on the carapace at base of front, two longitudinal series of eight spines each on the upper and posterior surface of the arm, and the upper margin of the mobile finger spinulous. For this species I propose the name of *P. australiensis*.

Eupagurus spinulimanus, n. sp. Type, B.M.

Carapace with the median rostral tooth nearly obsolete. Eye-peduncles slender, longer than the front margin of the carapace, their basal scales small, with a short spine at the antero-internal angles. External antennæ with a short spine external to the basal scale, which is slender, linear, ciliated at

the extremity, and shorter than the eyes; flagella alternately annulated with red and white. Anterior legs clothed with short dense hairs; wrist and hand spinulose; wrist with a series of larger spines on its upper inner margin; larger hand ovate, with the spinules arranged in two longitudinal lines reaching to the base of the upper margin of the fingers, and elsewhere scattered; smaller hand with a group of larger spinules in the centre of the upper surface of the palm. Ambulatory legs hairy; hairs more dense on the tarsi, which are slender, longer than the penultimate joint. Antepenultimate joint of legs of second pair with a series of spinules on its upper surface. Colour (in dried specimen) light pink, with here and there spots of a darker colour.

Length of carapace about 1 inch.

Hab. New Zealand.

The abdomen is unfortunately destroyed in the only specimen I have seen. This, however, is evidently a much larger species than *E. novæ-zealandiæ*. From *E. japonicus*, Stimpson, this species differs in its longer, slender tarsi. *E. acantholepis* of the same author has the wrist canaliculate above. *E. constans* has a prominent rostral tooth. In none of these species is mention made of the two series of spinules upon the palm.

Gebia Danai, n. sp.

B.M.

Gebia hirtifrons, Dana, U. S. Expl. Exp. xiii. Crust. i. p. 511, pl. xxxii. fig. 2 (1852), nec White.

Scabrous surface of front part of carapace not reaching more than halfway to dorsal suture, and the points mostly in six nearly longitudinal lines. Hand with the outer surface smooth, no spinules or denticulations, and few hairs on the upper margin, on lower margin small denticulations, and rather hairy; lower finger slender and somewhat incurved; caudal segment not broader than long. Flagella of inner antennæ a little shorter than the last joint of base. Outer antennæ about as long as abdomen. A spine at lower apex of carpus.

Length nearly 2 inches.

Hab. New Zealand, Bay of Islands (*Dana*); south side of Davis Straits (*coll. Brit. Mus.*).

I have given above Dana's description of the species he refers to *G. hirtifrons*, White. A specimen in the British-Museum collection agrees well with it. The front is strongly 3-lobed, the lobes triangular, acute, the middle one the longest. The immobile finger is large; the palm high and compressed.

In the typical specimen of *G. hirtifrons* in the British Museum the front is triangular, hairy, and scabrous, hardly,

if at all, 3-lobed; the hand slender, hairy on its outer surface, and not denticulated below; the immobile finger quite rudimentary; carpus with a spine at its upper apex and one on the inner surface, but none at its lower apex. The specimen was obtained during the Antarctic Expedition, but is without any definite indication of habitat.

Virbius bifidirostris, n. sp. Type, B.M.

Carapace smooth, with two minute spines on each side below the eyes. Rostrum slender, longer than the carapace, and nearly as long as the scale of the external antennæ, with two teeth on the upper margin placed at some distance from one another, and another, minute one near the apex, which thus appears bifid; lower margin with seven teeth. Scale of the external antennæ without a spine at base, but with a small spine at the distal extremity of the outer margin. External maxillipeds about reaching to the end of the peduncle of the outer antennæ; terminal joint dilated, minutely spinulous. First pair of legs very short when directed forward, not reaching to the end of the external maxillipeds. Second pair of legs with the joints of the carpus short, the second the shortest. Terminal segment of abdomen and caudal appendages slender.

Length $1\frac{1}{2}$ inch.

Hab. New Zealand.

Alpheus novæ-zealandiæ, n. sp. Type, B.M.

Rostrum triangular, acute, rising at a considerable distance behind the bases of the eyes, separated from the orbits by a deep and wide groove, and projecting beyond the frontal margin of the carapace nearly to the extremity of the first joint of the inner antennæ. Interocular part of the frontal margin of the carapace straight, without spinules, considerably more prominent than the part exterior to the eyes. External antennæ with a very short spine at base, and another at the end of the last joint of the peduncle; the basal scale about equalling the length of the peduncle. Anterior legs with the larger hand elongate, twisted somewhat outwardly, with an obscure oblique ridge above and below, without grooves or notches, except a short transverse groove behind the base of the mobile finger, which is short, rounded above, and compressed. Wrist of the second pair of legs with the first and second joints long, nearly equal, together exceeding in length the last three joints. Legs clothed with scattered hairs.

Length about 2 inches.

Hab. New Zealand.

This species seems to be allied to *A. gracilipes*, Stm., from Tahiti, which, however, has the larger hand straight and the orbits acute in front.

Idotea elongata. Type, B.M.

Idotea elongata, List Crust. Brit. Mus. p. 95 (1847), sine descr.

Elongate, linear, regularly rounded so as to appear cylindrical from above. Segments of pereion longer than broad, with the epimeral pieces in a lateral view very narrow-linear, and coalescent with the segments, the lines of union indicated by sutures on the sides; beneath greatly developed and sheathing the base of the legs. Head usually coalescent with the first segment of the pereion. Antennæ as in *I. affinis*, the flagella about 22-jointed. Terminal segment of the pleon with a rather deep rounded excavation at its extremity, and with the latero-posterior angles rounded.

Length $1\frac{5}{8}$ inch, breadth not quite $\frac{1}{4}$ inch.

Hab. Auckland Islands.

Distinguished by its very narrow convex body, with long segments and very narrow epimera, which are linear in a lateral view.

Armadillo inconspicuus, n. sp. Type, B.M.

Convex, with the sides parallel, very finely and closely punctate. Head transverse; eyes small. Posterior margins of the segments of the pereion straight; first segment broadest, lateral margins with a groove for the reception of the second segment when the animal is rolled up; following segments of about equal width, sides rounded. Segments of the pleon very short and closely applied to one another, sides truncate; terminal segment very little broader at the base than at the extremity, sides concave. Terminal (lateral) joint of the pleonal appendages minute; basal produced portion of the penultimate joint rounded, not rectangular. The antennæ are imperfect.

Length $1\frac{1}{2}$ inch.

Hab. New Zealand.

Distinguished by the punctulations of the thorax and the form of the terminal segment and caudal appendages.

Cubaris rugulosus, n. sp. Type, B.M.

Moderately convex, rather loosely articulated; surface of the segments uneven, faintly rugose. Head very broad and transverse, front margin revolute. First segment of the pereion with two slight depressions diverging anteriorly on the upper

surface, sides of the segment directed obliquely backward, so that the lower half of the posterior margin forms a distinct angle with the upper half; following segments very narrow transverse, each with an impressed line running parallel to the posterior margin; the second, third, fourth, and fifth segments narrowed on the sides, which have their inferior margins rounded; the sixth and seventh segments broader on the sides, with the inferior margins truncate. Pleon very short, with the segments (the last two excepted) nearly linear-transverse; terminal segment much the broadest at base, with the sides at first suddenly converging and then parallel. Appendages of the penultimate segment with the inner (terminal) joint reaching to the end of the produced portion of the penultimate joint.

Length $\frac{1}{3}$ inch.

Hab. New Zealand.

Porcellio graniger, n. sp. Type, B.M.

Porcellio graniger, List Crust. Brit. Mus. p. 99 (1847), sine descr.

Oblong-oval, moderately convex, granulate, the granules seriate along the posterior margin of each segment, and partly seriate elsewhere. Head transverse, with the antero-lateral lobes narrow and very prominent. Eyes small, black. Segments of the pereion slightly tending backward at their latero-posterior angles. Segments of the pleon very short, smooth on the sides, and with the latero-posterior angles acute, directed backward; terminal segment triangular, acute, concave above, narrowed posteriorly, scarcely reaching beyond the latero-posterior angles of the penultimate segment. Appendages of the penultimate segment very short, reaching a little beyond the apex of the terminal segment; the larger (exserted) ramus ovate. Legs armed with slender acute spines. Colour light chestnut-brown.

Length $\frac{3}{8}$ inch.

Hab. New Zealand.

Very nearly allied to *P. gemmulatus*, Dana, from California, but differs in the much shorter, broader, ovate pleonal appendages, and in the spines of the legs not being laminated.

Porcellio zealandicus. Type, B.M.

Porcellio zealandicus, List Crust. Brit. Mus. p. 99 (1847), sine descr.

Elongate-oblong, finely granulous, the granules seriate on the posterior margin of each segment. Head small, transversely oblong, with the latero-anterior angles not prominent. Segments of the pereion (the last excepted) with the posterior

and lateral margins straight, the latero-posterior angles obtuse; last segment broad, with the posterior margin concave, the lateral margin straight, the latero-posterior angle acute. Segments of the pleon considerably narrower than those of the pereion, short; terminal segment equilaterally triangular, slightly concave above, sides straight. Pleonal appendages with the base shorter than the terminal segment; the longer (exserted) ramus narrow, acute, projecting far beyond the terminal segment. External antennæ very long and hairy.

Length nearly $\frac{1}{3}$ inch.

Hab. New Zealand.

Scyphax intermedius, n. sp. Type, B.M.

Resembles *S. ornatus*, Dana, but with the terminal segment of the pleon broadest at base, covering the base of the appendages of the penultimate segment, then suddenly narrowing, subacute at the extremity, with the lateral margins concave, the part between the bases of the appendages of the penultimate segment being triangular, with a slight depression on its upper surface.

Hab. New Zealand.

The bases of the appendages of the penultimate segment of the pleon are much less widely separated than in Dana's species. But the broad and truncate terminal segment of *S. ornatus* is so unlike the usual form of this segment in the Oniscidæ, that I think there may be some error in the figure and description of Dana.

Ceratothoa lineata, n. sp. Type, B.M.

Moderately convex, nearly smooth, terminal segment faintly punctulated. Head small, narrowed anteriorly, front slightly curved downward. Eyes large. First segment of the pereion longer than the rest, antero-lateral lobes produced slightly forward and obtuse; epimeral pieces (coxæ) of the last four segments of the pereion large. Terminal segment of the pleon large, almost semicircular in outline, rather broader than long, with a faintly marked, raised, longitudinal median line. Rami of the appendages of the penultimate segment slender, projecting slightly beyond the posterior margin of the last segment, outer rather the longest. Antennæ slender. Femoral joints of the ambulatory legs scarcely enlarged.

Length $\frac{5}{8}$ inch.

Hab. New Zealand.

Distinguished by the form and markings of the terminal segments of the pleon.

Lironeca novæ-zealandiæ, n. sp.

Cymothoa novæ-zealandiæ, List Crust. Brit. Mus. p. 110 (1847), sine descr.

Moderately convex. Head small, about as long as broad, widest in the middle, with the sides converging to the back and front, deeply encased within the first segment of the pereion. The seven segments of the pereion of nearly equal width, each with a faintly marked groove produced for a short distance inward and obliquely forward from the lateral margin. Segments of the pleon (the last excepted) very narrow; last segment transverse, surface uniformly and faintly wrinkled, posterior margin with a nearly semicircular outline, entire. Rami of the appendages of the penultimate segment very small, outer slightly the larger. Colour dark brown.

Length $1\frac{1}{3}$ inch.

Hab. New Zealand.

Cirolana Rossii, n. sp. Type, B.M.

Cirolana Rossii, List Crust. Brit. Mus. p. 106 (1847), sine descr.

Convex, smooth. Head quadrangular, broader than long, encased in the first segment of the pereion. Eyes narrow-oblong, black, extending along the sides of the head from the front margin of the first segment of the body nearly to the bases of the antennæ. Segments of the pereion smooth, the first the widest. Last segment of the pleon slightly rounded on the sides, obtuse at the apex. Legs hairy, the hairs more dense on the four last pairs, which are not spinous. Appendages of the penultimate segment ciliate, the outer narrower, acute at the extremity.

Length nearly 1 inch.

Hab. New Zealand; Auckland Islands.

Distinguished from *C. spinipes* of Europe by the narrow oblong eyes, and from *C. hirtipes* in the form of the head, which is broader than long.

ISOCLADUS, n. gen.

Convex, somewhat widening posteriorly. Seventh segment of the pereion in the male with a long median dorsal spine. Terminal segment of the pleon narrowing posteriorly, and acute at the extremity. Appendages of the pleon subequal, of a slightly sigmoid shape, and acute at the extremity.

A genus nearly allied to *Zuzara*, Leach (Dict. Sci. Nat. xii. p. 344, 1818), which differs in having unequal pleonal appen-

dages and the abdomen truncate at the extremity, with a median terminal spine. *Cyclura* of Stebbing (Journ. Linn. Soc. xii. p. 146, 1874) has the appendages of the pleon broad, unequal, and rounded at the extremity.

The genus *Isocladus* includes the *Sphæroma armata*, M.-Edw., and *S. spinigera* of Dana, specimens of which, from New Zealand, are in the collection of the British Museum.

Cymodocea granulata, n. sp. Type, B.M.

Moderately convex, nearly smooth. Head small; frontal lobe very small, obtuse. Lateral margins of the segments of the pereion all with a narrow marginal line, with the postero-lateral angles acute. Antero-lateral lobe of the first segment of the pereion narrow triangular, acute, produced forward beneath and beyond the eyes. Postero-lateral lobe of the last segment of the pereion produced backward, and terminating in a short spine curving upward; posterior margin of the segment nearly straight. Last segment of the pleon broad, convex, granulous, and slightly hairy, with a more distinctly granulated elevation on its upper surface near its base, and with the terminal notch quadrangular, with a narrow median lobe. Rami of appendages of the penultimate segment unequal, the inner not quite reaching to the extremity of the segment; broad truncate at the end, the outer nearly as long again and narrowing to its extremity, which is acute.

Hab. New Zealand; Tasmania; Flinders Island.

Cymodocea convexa, n. sp. Type, B.M.

More convex than *C. granulata*, and not so narrow in front. Head larger. Seventh segment of the pereion without a postero-lateral lobe or spine on each side. Terminal segment of the pleon very large, more convex in its anterior half, which has usually four obscure tubercles in a transverse series; posterior notch wider, and not so deep as in *C. granulata*, with the median lobe triangular. Appendages of the penultimate segment not reaching nearly to the posterior emargination; rami subequal, obtuse at the extremity.

Length nearly $\frac{1}{2}$ inch.

Hab. New Zealand.

The *C. tuberculosa* of Stebbing, from Australia, differs from the two foregoing species in the tuberculated segments of the pereion.

XXIII.—On a new Genus of Arachnida of the Section Arthrogastra. By A. STECKER*.

IN an entomological excursion which I made some time ago in the Bohemian Riesengebirge, for the purpose of collecting Chelifers, I found amongst other things in the so-called Riesengrund, about a [German] mile north of Gross-Aupa, a remarkable small Arachnid, which, at first glance, I took for a species of the Chernetidæ. On my return home I examined more closely the material collected by me; and to my great surprise the above-mentioned diminutive Arachnid proved to belong to a new genus of the family Cyphophthalmidæ, described in 1868 by Dr. Joseph †. I was the more delighted at this, because this family was previously represented only by the single cave-genus *Cyphophthalmus*, Jos., and therefore was with perfect justice regarded as belonging exclusively to the cave-fauna. Dr. Joseph, indeed, remarks in his Supplement ‡ that the Cyphophthalmidæ occur most frequently at the entrance of the caves, and therefore are not true cave-animals; but, so far as we know, no one has succeeded in finding these little creatures anywhere else.

I collected the new genus in the leafy forests of the Riesengrund under stones, in shady, moderately damp places, the soil of which was partly covered with decaying fallen leaves, and where, amongst other things, numerous species of *Chthonius* and *Obisium* occurred—consequently almost under the same conditions as Dr. Joseph found the *Cyphophthalmi* in the Luëger grotto; and I am now convinced that the Cyphophthalmidæ are not confined to caves, but that they have a much wider distribution than has hitherto been supposed. Notwithstanding all my endeavours, I have obtained only twelve specimens; these, however, have enabled me to dissect and carefully investigate the new genus, which I shall name *Gibocellum*. This brief memoir is therefore to be regarded only as a preliminary notice; as my space is small, I refrain from reporting in detail on the interesting anatomical and histological results obtained during the dissection, and will publish these elsewhere.

Externally *Gibocellum* indisputably appears to be very nearly allied to *Cyphophthalmus*; the distinctly segmented abdomen, the eyes curiously placed on obliquely ascending

* Translated by W. S. Dallas, F.L.S., from a separate impression of the paper in the 'Sitzungsb. der kön. böhmischen Gesellsch. der Wiss.' Heft vi., 1875. Communicated by the author.

† Berl. entom. Zeitschr. xii. 1868, pp. 241 *et seqq.* pl. i. figs. 1–12.

‡ *Ibid.* pp. 269 *et seq.* pl. i. figs. 13–17.

conical tubercles, and the strongly developed chelicera, do not leave us long in uncertainty as to where our animal has to be ranged in the system of the Arachnida. This close relationship, however, becomes still plainer when we subject the animal to a thorough microscopical examination; but then also the histological and anatomical differences, which will be indicated in the following description, come forth clearly and distinctly.

The *skin* of the two genera presents notable differences. In *Cyphophthalmus* the chitinous mass is in many places so accumulated that the cuticular layer acquires a thickness and resistency unusual among Arachnida, and, as Dr. Joseph remarks (Nachtr. p. 270), gradually assumes a similarity to the carapace of the Chelonia. Frequently also the otherwise soft and extensible cuticular deposits of the interspaces of the individual abdominal segments become so strongly chitinized that the whole animal is regularly enclosed in a sort of chitinous shield, by which, however, as a matter of course, not only is a limit set to the increase of the volume of the body, but the observation of the more delicate organs existing in the abdomen is rendered difficult. Under high powers the cuticle, like that of the Chernetidæ*, appears to be furnished with rows of circular chitinous granules, regularly dispersed in the lamellæ; the number of these becomes much smaller in the interspace of the abdominal segments.

From this formation of the cuticle the skin of *Gibocellum* differs essentially. Even with the aid of high powers I have not yet succeeded in observing the chitinous granules in the brownish cuticular lamellæ. Only on the cephalothorax and in the cuticle of the superior abdominal rings are there a few irregular accumulations of chitine, such as we have had the opportunity of observing also in several genera of Chernetidæ† (*Chthonius*, *Megathis*, *Obisium*). The chitinization, therefore, is here also to be regarded as only partial, and greatly reminds us of the cuticular formation of *Phalangium opilio*‡; and by this means also the already mentioned unusual extensibility of the cuticle is attained.

The pore-canals, so characteristic of the dermal skeleton of the Arthropoda§, occur very sparingly; the cause of this is

* See the figure of the cuticle in the Chernetidæ in my memoir, "Ueber neue indische Chernetiden," in Sitzungsber. Akad. Wiss. Wien, 1875, p. 5, pl. 2, figs. 5 & 6.

† Stecker, *loc. cit.* pl. 2.

‡ F. Leydig, "Zum feineren Bau der Arthropoden," Müller's Arch. für Anat. und Phys. 1855, pp. 381-384.

§ Valentin, Repertorium für Anat. und Phys. Bd. i. 1836.

precisely the extremely small chitinous layer of the integuments of the body. The finer canals are branched here also; and the contours at their extremities forming elegant designs are also present*. The chitinous membrane or the matrix is slightly yellowish, and, in comparison with the cuticular layer, very little developed. Whilst in the scorpions, many Chernetidæ, and the genus *Cyphophthalmus* there is a very thick chitinous membrane, and the secretion takes place so rapidly that within twenty-four hours (therefore nearly in the same time as stated by C. Schmidt †) a considerable chitinous layer composed of spindle-shaped cells is secreted from the matrix, the cell-layer in *Gibocellum* is the result of a very limited process of secretion. As in the Chernetidæ and Opilioneæ, so also in *Gibocellum*, the places of insertion of the abdominal muscles, which were characterized by Treviranus as stigmata ‡, show two rows of scar-like depressions. The two large glandular tubes opening on the back of the cephalothorax in the Phalangiidæ, which were observed by Latreille §, Treviranus ||, Meade ¶, Tulk **, and Leydig ††, but first correctly understood by H. Krohn ††, are also present in *Gibocellum*. The pigment-layer, however, is dark olive-brown, not, as in *Cerastoma cornutum* and *Phalangium parietale*, tile-red; the cells of the epithelium communicate by excessively fine ducts, repeatedly convoluted in the folded intima, with the internal cavity; the fine ducts issue from the vacuoliform cavities of the individual cells.

In *Gibocellum* the *cephalothorax* is also completely amalgamated with the abdomen. On its surface there are two roll-like elevations (G), originating between the eyes situated at the lateral margins of the cephalothorax, and continued in a curved line nearly to the middle of the cephalothorax, where they finally disappear entirely; these seem to represent the horseshoe-shaped cephalothoracic furrow of *Cyphophthalmus* (Joseph, *loc. cit.* p. 242), or the so-called "procurva" on the

* Siebold, *Vergleichende Anatomie*, p. 520; Leydig, *loc. cit.* p. 384.

† Zur vergleichenden Physiologie der wirbellosen Thiere. Brunswick, 1845.

‡ Vermischte Schriften naturh. und phys. Inhalts Bd. i. 1816, pp. 15 *et seqq.*

§ Considérations générales sur l'ordre naturel des animaux composant les Classes des Crustacés, des Arachnides et des Insectes, &c. Paris, 1810.

|| *Loc. cit.* p. 25.

¶ *Annals & Mag. Nat. Hist.* ser. 2, vol. xv. p. 395.

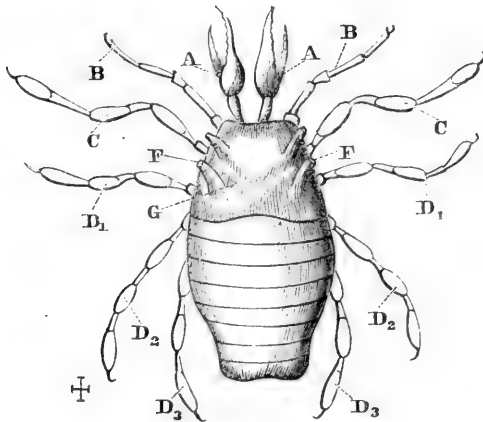
** *Ann. & Mag. Nat. Hist.* ser. 1, vol. xii.; Froriep's 'Notizen,' Bd. xxx. (1844) p. 144.

†† *Loc. cit.* p. 433.

‡‡ *Archiv für Naturg.* 1867, pp. 79 *et seqq.*; *Ann. & Mag. Nat. Hist.* ser. 4, vol. i. pp. 87 *et seqq.*

cephalothorax of some Chernetidæ *. These may be regarded, as already noticed by Dr. Joseph (*loc. cit.* p. 242) and myself (*loc. cit.* p. 3), as an indication of a separation of the head from the thorax; in this case the portion between the elevation and the anterior margin of the cephalothorax would have to be designated the cephalic part; and the other part, extending between the ridge and the hinder margin of the cephalothorax, as the pro-, meso-, and metathorax. Seen from the ventral side, therefore, the chelicera and the first and second pairs of maxillary palpi are attached to the head, and to the thoracic part the three pairs of legs. Dr. Joseph's definition of the cephalic division as "only reaching to the anterior margin of the first hypopodia" seems to me in some degree unsatisfactory, as we may understand by the anterior margin of the first hypopodia either the hypopodia of the second pair of maxillary palpi (representing the first pair of legs), or the pectoral piece of the first pair of legs (representing the second pair of legs).

The four *eyes* (F), placed on obliquely ascending conical tubercles, are situated on the sides of the cephalothorax, so that



the first pair rises nearly at the end of the first third of the cephalothorax, consequently between the pectoral pieces of the first and second pairs of maxillary palpi; and the second pair about in the middle of the margin of the cephalothorax, and therefore between the second pair of maxillary palpi and the first

* L. Koch, 'Uebersichtliche Darstellung der europ. Chernetiden,' Nürnberg, 1873, p. 11; A. Stecker, "Ueber zweifelhafte Chernetiden-Arten, welche von A. Menge beschrieben wurden," Deutsche entom. Zeitschr. Bd. xix. (1875) Heft 2.

pair of legs. The conical tubercles, which bear at their summits a compound eye furnished with a simple cornea like the eye of *Phalangium**, are to be regarded as chitinous processes of the dermal skeleton, and at the same time as protectors of the optic nerve, which is dilated in them in a cup-like form. The remarkable position of the eyes of the Cyphophthalmidæ, which occurs nowhere else among the Arachnida, led Dr. Joseph † to the supposition that the Cyphophthalmidæ are not true cave-animals, as in these the optic nerve is usually rudimentary or frequently reduced to nothing. We can only confirm Dr. Joseph's supposition, as the species of *Gibocellum* not only occurred under stones, but were also seen running briskly about upon them ‡. The optic nerves also present no reduction.

The strongly developed chelicera (A) project from under the anterior margin of the cephalic portion, and are directed forward parallel to each other. The stem of the chela is elongate ovate, and densely clothed with hairs on its surface. The fingers slightly resemble in form the fingers of the palpal chelæ of the Scorpions and Chernetidæ; there are also upon each of them four or five long movable bristles, perhaps a structure homologous with the olfactory rods of the Arthropoda first discovered by Leydig §. Thus between the optic nerves in *Gibocellum* a pair of nerves originate from the supra-oesophageal ganglion, and run parallel to each other into the chelicera (*nervus antennarum*). In the stem of the chela the nerve-trunk breaks up into fine terminal tufts, which are connected by an extremely fine nerve-thread with the setæ, indicated by us as olfactory organs; in this way, I believe, the deep morphological significance, both of the setæ and of the chelicera, becomes manifest and distinct. These olfactory setæ appear to me possibly to correspond to the pectinately arranged olfactory bacilli discovered by me in Chernetidæ ||, which also issue from a tubercle on the stem of the chela. The homology between the chelicera of the Arachnida and the antennæ of

* On the eye of *Phalangium*, see F. Leydig, 'Das Auge der Gliederthiere, neue Untersuchungen zur Kenntniss dieses Organs.' Tübingen, 1864.

† "Ueber das Zusammentreffen von theilweisem und gänzlichem Lichtmangel mit Lageveränderung, Verkleinerung &c. der Sehorgane," Sitzungsber. der naturw. Sektion der Schles. Gesellsch. für vaterl. Cultur (10 Nov. 1875).

‡ Of the twelve specimens that I collected, ten were captured under stones, and two running freely about.

§ "Ueber Geruchs- und Gehörorgane der Krebse und Insekten," Archiv für Anat. und Phys. 1865, p. 265.

|| "Ueber neue indische Chernetiden," *loc. cit.* pp. 3 & 9, pl. 2, figs. 3, 4, 7-9, 11.

insects, which was indicated by Latreille * and others, seems to me to be still further proved by this.

The densely hairy *first pair of maxillary palpi* (D) differ essentially from the first pair of palpi in *Cyphophthalmus*. The difference consists, in the first place, in that in *Gibocellum* we only count five instead of six joints; but this may be explained by the second joint in *Gibocellum* being completely amalgamated with the third. Thus the third joint in *Gibocellum* represents the fourth joint of *Cyphophthalmus*; only in the latter it is filiform, and in the former strongly thickened and dilated like a shovel. The last two joints are similar in form; the last joint in *Gibocellum* is furnished with a claw and with a thick obtuse hooklet. Looked at superficially the first pair of maxillary palpi may be compared to that of the Phalangiidæ; from the chelate palpi of the Didactyla (Scorpionidæ, Chernetidæ) and the Solifugæ (Galeodeæ) they are distinguished by the absence of the cheliform last joint. As regards their morphological significance, they seem partially to replace functionally the antennæ, which are here converted into chelicera, inasmuch as they are supplied on the one hand with a much ramified nerve-trunk (*nervus pedum maxillarum*), and on the other with numerous setæ furnished with nerve-terminations (*tactile setæ* of the insect-antenna). With respect to the palpal nerve within the body, I may add that, although it originates from the infræesophageal ganglion, I am inclined to ascribe to it a deeper significance, inasmuch as I am of opinion that I can transfer the function of the insect-antennæ, in so far as these fulfil the sense of touch, to the first pair of maxillary palpi of the Arthrogastra; this may be easily explained both from the extremely fine nervous fibrillation in these appendages of the body, and also from the mode of life of the animals. But that the first maxillary palpi at the same time function as olfactory organs, as Erichson † has shown to be the case with the antennæ of insects, does not appear to me probable. I believe that *the chelicera of the Arthrogastra, besides their cofunction as buccal organs (for the division and crushing of the food that is to be sucked out), may be indicated as olfactory organs, and the first pair of maxillary palpi as tactile organs.* Menge, also, appears to me to have understood the function of the palpi in the same way ‡, although he has not distinctly expressed this.

* "Observations nouvelles sur l'organisation extérieure et générale des animaux articulés &c.," Mémoires du Muséum, tome viii. p. 169.

† Dissertatio de fabrica et usu antennarum in Insectis. Berlin, 1847.

‡ "Ueber die Lebensweise der Afterspinnen," Neueste Schriften der naturf. Gesellsch. in Danzig 1850; "Ueber die Scheerenspinnen (Chernetidæ)," *ibid.* 1855.

As to the construction of the buccal apparatus I can say very little, as the investigation of these parts in such small animals was attended with great difficulties, seeing that in the dissection of the specimens at my disposal, I considered chiefly the internal organs (nervous system, cephalothoracic glands, alimentary organs, &c.), and therefore was unwilling to derange the position of these organs by the forcible separation of the parts of the mouth. In order to get a correct notion of the structure of these parts, which are not fully visible in any direction, I must obtain more abundant materials, so as to sacrifice them at pleasure to the knife. Hence I can only give an account of the following points:—

The *maxillary pyramids* observed by Dr. Joseph in *Cyphophthalmus*, and the hook-like curved processes amalgamated with them, appear to be absent in *Gibocellum* *. The second pair of maxillæ also is not constructed as in *Cyphophthalmus*, in which the hypopodia run out upwards into a sharp process, and thus, according to Dr. Joseph, aid in the retention of the prey; but, as in the Chernetidæ and Scorpions, these organs meet in the middle line of the body, and are not removed further towards the sides (that is, outwards) as is usually the case in the Arachnida. As in the Araneina, an unpaired mentum is superadded, which is pushed in between the masticatory pieces of the first pair of maxillæ, and thus forms an inferior buccal flap.

The second pair of *maxillary palpi* (C) are formed in precise conformity with the three pairs of true legs (D_1 , D_2 , D_3). Both in the second pair of maxillary palpi and in the three pairs of legs of *Gibocellum* six joints may be distinguished; and these may be referred without difficulty to the sharply defined parts in Insects, as coxa, trochanter, femur, patella, tibia, and tarsus. The coxæ, indeed, in our genus are firmly soldered to the pectoral pieces, which meet in the middle, so that they are quite immovable; but they are clearly enough defined in their contours by a tolerably deep furrow (constriction); in *Cyphophthalmus* the coxæ are completely amalgamated with the hypopodia, but their contours are still indicated by spherical processes. Here, probably, the coxæ have in time become by some retrogression united with the pectoral plates of the palpi into a single whole; and, indeed, we have examples enough of such retrogressions. It may, however, be remarked

* Both the description and figures of these remarkable buccal organs, as given by Dr. Joseph (*l. c.* pp. 244, 245), leave me in doubt upon many points; and I must admit that, in spite of all my endeavours, I have at present no clear notion of the position and function of the maxillary pyramids and the hook-like curved processes—in short, of the nature of the buccal organs in *Cyphophthalmus*.

that in *Cyphophthalmus* we have to do, not with any coxal process of the hypopodia, but with distinctly developed coxæ, although by retrogression amalgamated with the pectoral pieces. The different joints nearly resemble those of *Cyphophthalmus*. A long trochanter is followed by a clavate femur; on the femur follows a tibia furnished with a visible patella; and lastly comes a two-jointed tarsus. The claw-joint is strongly hairy, thickened into a cushion on the sole, and soldered to the first tarsal joint; it differs essentially from the small movable claw-joint of the Chernetidæ (A. Stecker, Ueber indische Chernet. p. 9, Taf. iii. fig. 6). Each claw-joint bears a simple, moderately curved, acute claw. The legs of the *Cyphophthalmidæ* differ from those of the *Phalangiidæ* and *Chernetidæ*, in the first place, by their two-jointed tarsus (in the *Phalangiidæ* the tarsus is four-jointed, in the *Chernetidæ* the claw-joint is rudimentary), and secondly in the number of the claws (in the *Phalangiidæ* the two hinder pairs, and in the *Chernetidæ* all the pairs of legs are furnished with two powerful and often curiously formed claws).

The abdomen is distinctly segmented; eight abdominal segments may be distinguished. The chitinous layer of the upper abdominal half-rings is not, as already remarked, shield-like as in *Cyphophthalmus* and many *Chernetidæ* (*Chernes*, *Chelifer*), but is most nearly comparable to the cuticle of *Chthonius*. The inferior half-rings of the abdomen nearly resemble the upper ones; each of them is furnished at its hinder margin with a row of plumose setules*. The first ventral half-ring represents an obtuse-angled triangle, with the obtuse angle directed forward. It is furnished with an elliptical *genital aperture*, from which a very long penis, comparable to that of the *Chernetidæ*, protrudes. The difference in the position of the genital aperture is that in *Cyphophthalmus* the genital aperture occurs between the posterior margin of the metathorax and the anterior margin of the first ventral half-ring, in *Gibocellum* in the first ventral half-ring, but in the *Chernetidæ* between the posterior margin of the second and the anterior margin of the third ventral half-rings. In all *Chernetidæ*, moreover, we distinguish two ram's-horn-like male transferrers†, the structure of which resembles that of the tracheal stems, so that by their means the penis can be greatly elongated.

* I have figured such setules of similar structure in the memoir "Ueber indische Chernet. l. c. Taf. 2. figs. 5c & 6c.

† A monograph on the anatomy of the *Chernetidæ* is now ready for printing. It contains many figures of the internal organs of these little creatures; and I believe that I shall be able to publish it in the course of next year.

On the lateral margins of the second and third ventral half-rings the orifices of the *tracheæ* are visible. We distinguish therefore, as in the Pseudoscorpiones, two pairs of stigmata*, one pair belonging to the second, and the other to the third segment. Their function is divided between them as follows. The first pair gives origin to two great tracheal stems uniting below the hypopodia of the last pair of legs into one great trunk, which goes into the cephalothorax and is there much ramified. The second pair of stigmata, which occur in the third abdominal segment, bear a structure analogous to the tracheal lungs†, which occurs also in other *Arachnida* (*Segestria*, *Dysdera*, *Argyroneta*) in the form of tracheal tufts, and is also represented in the Chernetidæ (*Chthonius*, *Obisium*). The individual tracheæ pass without ramification through the whole abdomen. The flat tracheæ originating from a transverse cleft of the spinnerets, discovered by C. Siebold‡, do not exist in *Gibocellum*. The stigmata also are differently formed. The second pair of stigmata resemble in structure the stigmata of the larvæ of Lamellicorn beetles; for here also there is a chitinous plate perforated like a sieve. The only difference is that in the Lamellicorn larvæ the plate is perforated only at the periphery, but here over the whole surface.

The *spinning-glands* are present. Dr. Joseph, indeed, was unable to observe them in *Cyphophthalmus* (*l. c.* p. 246); but I am of opinion that they occur in that genus also, and were overlooked in consequence of their peculiar position. The spinnerets, as in the Chernetidæ, are not placed at the extremity of the abdomen, but on the posterior margin of either the first (*Gibocellum*) or second (Chernetidæ) abdominal segment. In *Gibocellum* we distinguish two pairs of small spinnerets, which are furnished with three different glands (*glandulæ aciniformes*, *tubuliformes*, and *ampullaceæ*), in combinations of two and three. In their structure they resemble the Arachnidan spinning-glands discovered and described by Lyonet§, Wasmann||, Blackwall¶, Meckel**, Ceffinger††, and others.

* In *Cyphophthalmus* there is only one pair, opening in the acute lateral angles of the first ventral half-segment.

† R. Leuckart, "Ueber den Bau und die Bedeutung der sog. Lungen bei den Arachniden," *Zeitschrift für wiss. Zool.* i. 1849, pp. 246 *et seqq.*

‡ Siebold, *loc. cit.* p. 535.

§ *Mém. du Mus. d'Hist. Nat.* 1829, tome xviii. p. 387, pl. 19. figs. 6-12.

|| *Archiv des naturw. Ver. in Hamburg*, 1840, p. 20, figs. 31-40.

¶ *Trans. Linn. Soc.* vol. xviii. p. 220 (1841).

** Müller's *Archiv für Anat. und Phys.* 1846, pp. 1-74, Taf. 1-3; the Spinning-apparatus, "Arachnidium," pp. 50-56, figs. 38-49.

†† *Archiv für mikr. Anat.* Band ii. pp. 1-12, Taf. 1 (1866).

As regards the *digestive apparatus*, the buccal cavity opens first into a narrow œsophagus, which afterwards widens and passes directly into the stomachal part; upon the stomach, as in the Phrynidæ, Chernetidæ, and Scorpionidæ, no cæca can be distinguished. The portion of the intestinal tract following the stomach, the small intestine, forms an elongated spacious tube, separated by a constriction from the rectum, which is dilated as in the Scorpions and Acarida, but in its pyriform shape resembles the rectum of many Hemiptera. As regards the structure of the stomach and small intestine, we distinguish in them a *membrana propria*, on the inner surface of this the digestive cells, and on its outer side the *tunica muscularis*. In the *tunica muscularis* the stratum of transverse muscular fibres which give the whole organ a transversely striped appearance may be recognized without difficulty. The digestive cells are spherical or cubical, and have a diameter of 0·03 millim. The stomach and small intestines strikingly resemble the corresponding parts of the digestive apparatus described by Dr. L. Landois* in Hemiptera (*Cimex lectularius*). At the commencement of the small intestine two Malpighian vessels of considerable length open into it. They differ remarkably from the Malpighian vessels of other Arachnida, inasmuch as they become much ramified at once in the middle, to make their appearance again after a time as simple looped canals. They run in many convolutions through the liver. On the upper lateral diverticula of the stomach a small oval salivary gland is attached on each side by fibrous bands; their structure agrees with that of the spherical glands of the different Hemiptera (*Cimex*, *Capsus*) described by Léon Dufour† and Landois (*l. c.* p. 216). I was not fortunate enough, however, to observe the discharge of these salivary glands; they probably discharge by a much convoluted canaliculus into the long œsophagus, and serve for the stupefaction of the prey. Besides these we find two pairs of ducts on the intestinal tract, which perhaps serve to unite the liver with the intestine; such hepatic discharges have already been described and figured by Dugès‡. The accessory glands discovered by Lubbock§ and Krohn|| in *Phalangium opilio*, discharging in the anterior half of the abdomen upon the

* Zeitschr. für wiss. Zool. 1863, Bd. xviii. p. 206.

† "Recherches Anatomiques et Physiologiques sur les Hémiptères," Mém. prés. à l'Acad. Roy. de France, tome iv. (1833), pp. 129 *et seqq.*

‡ Annales des Sci. Anat. 1836.

§ Phil. Trans. 1861, p. 610.

|| Archiv für Naturg. xxxi. (1865), p. 41, Taf. 3A; Ann. & Mag. Nat. Hist. 1865, ser. 3, vol. xvi. p. 149.

upper wall of the sheath of the penis, formerly regarded as testes, I was unfortunately unable to detect in *Gibocellum*, although I am convinced that they occur in this animal.

The nervous system in *Gibocellum* consists of two large ganglia situated in the cephalothorax (supra- and infracesophageal ganglia, cerebral and thoracic ganglia), which send off the nerve-trunks—the supracæsophageal ganglion the *nervi antennarum* and *optici*, and the thoracic ganglion the nerves of the two pairs of maxillary palpi, the three pairs of legs, and the abdomen. The two large abdominal nerve-cords unite after a time, as in *Phalangium*, to form two pyriform ganglia, and then immediately run off into the abdomen. The cerebral ganglion is distinctly paired as in the Galeodeæ* and Phalangiidæ; the thoracic ganglion has a radiate form. The first two pyriform ganglia appear to me to represent the cephalothoracic ganglia discovered by Newport† in the scorpions. A complex visceral nervous system is also demonstrable in *Gibocellum*. The H-shaped chitinous skeletal plate observed by Treviranus‡, Tulk§, and Leydig||, closely applied to the nervous centre, and serving for the attachment of the muscles, was clearly observable in *Gibocellum*. It lies here close to the ventral nervous mass, and has the form of a Russian *i* (I/I)¶. The animal runs forwards and backwards, and also in a curved line obliquely sideways; I observed no leaping-movements like those of the Chernetidæ (*Chthonius*).

From all that I have been able to state with regard to the new genus, it appears that *Gibocellum* may indisputably be ranged in the family Cyphophthalmidæ discovered by Dr. G. Joseph. The differences existing between the two genera in comparison with other characters which these genera possess in common are not of sufficient importance to allow us to found new families (or orders) upon them. But as I have already elsewhere** grouped the Chernetidæ as an order, I must also indicate the Cyphophthalmidæ as an independent order of Arachnida. As regards the systematic position of this order, I have already several times had occasion in this memoir to

* Ann. des Sci. Nat. sér. 3, tome viii. p. 227.

† Phil. Trans. 1843, pp. 243 *et seqq.*

‡ Verm. Schriften nat. und phys. Inh. 1816, i.

§ *Loc. cit.* p. 325.

|| Arch. für Anat. und Phys. 1862, pp. 196 *et seqq.*

¶ A detailed monograph, entitled "Anatomisches und Histiologisches über *Gibocellum*, eine neue Arachnide," with five plates, will appear in the course of the present year.

** "Zur Kenntniss der Chernetidenfauna Böhmens," Sitzungsber. der kön. böhm. Ges. der Wiss. 1874, and "Ueber die geogr. Verbr. der europ. Chernetiden," in Arch. für Naturg. 1875, p. 159.

show clearly the near relationship of the *Cyphophthalmidæ* on the one hand with the *Phalangiidæ*, and on the other with the *Chernetidæ*; and I believe that I have demonstrated it.

I now divide the third section of the *Autarachnea*, *i. e.* the section *Arthrogastra*, in accordance with their affinities, into 3 subsections and 6 orders, as follows:—

III. ARTHROGASTRA.

1. *Solifugæ*.
- a. *Galeodæ*.
2. *Opilionea*.
- b. *Phalangiidæ*.
- c. *Cyphophthalmidæ*.
3. *Didactyla*.
- d. *Chernetidæ*.
- e. *Phrynidæ*.
- f. *Scorpionidæ* (the most highly organized order of *Arthrogastra*)*.

The order *Cyphophthalmidæ* may be defined as follows:—

Ordo *Cyphophthalmidæ*, Joseph.

Corpus oblongo-ovatum; cephalothorax cum abdomine coalitus, non divisus, abdomen annulis octo compositum. Antennæ chelatæ tribus articulis compositæ. Palpi duo filiformes, apice unguiculo uno armati. Pedes octo antrorsum vel retrorsum gressorii, simplici unguiculo terminati. Oculi in gibbis conicis, ex utroque thoracis latere prominentibus positi. Respiratio trachealis.

(Body oblong-ovate; cephalothorax coalescent with the abdomen, not separated; abdomen of eight segments. Chelicera three-jointed. First pair of maxillary palpi filiform, with one claw at the apex. Eight legs, fitted for walking forwards and backwards, furnished with a simple claw at the apex. Eyes placed upon conical tubercles, arising upon both sides of cephalothorax. Respiration tracheal.)

In accordance with the external habit of the two genera, the whole order is divided into two families (*Cyphophthalmine*

* As we refer the *Pantopoda*, *Tardigrada*, and *Linguatulina* to the *Pseudarachnea*, we have as the first section of the *Autarachnea* the *Acarina*, as the second the *Araneina*, and the third section is then formed by the *Arthrogastra*.

and *Gibocellinae*) essentially differing from each other. The most important distinctive characters are:—

Family A.
(*Cyphophthalminae*.)

Body ovate, convex above, flat beneath, entirely covered with a granulated chitinous shield.

First pair of maxillary palpi 6-jointed, filiform, each in union at the point of insertion with a pyramidal body (maxillary pyramid).

?

The coxæ of the second pair of maxillary palpi and of the three pairs of legs completely coalesced with the pectoral pieces.

Two eyes, placed upon obliquely ascending conical tubercles.

One pair of stigmata.

Spinning-glands not present(?).

Species: *Cyphophthalmus duricornis*, Jos., *C. corsicus*, Sim., *C. cimiciformis*, Cambr.*; *Stylocellus sumatranus*, Westw.†

Family B.
(*Gibocellinae*.)

Body elongate-ovate, moderately convex above and beneath, not coriaceous.

First pair of maxillary palpi filiform, 5-jointed, without(?) maxillary pyramids.

All the hypopodia meeting in the middle line of the body.

The coxæ of the second pair of maxillary palpi and of the three pairs of legs firmly soldered to the pectoral pieces, but yet indicated in their contours by a deep furrow.

Four eyes, placed in the same way upon conical tubercles.

Two pairs of stigmata.

Spinning-glands at the commencement of the abdomen.

Species: *Gibocellum sudeticum*, mihi.

For the new genus, which I name *Gibocellum* (a synonym of *Cyphophthalmus*), from its having its eyes upon conical tubercles, I establish the following diagnosis:—

GIBOCELLUM, gen. nov.

Cephalothorax triangularis, supra convexus umbone semicirculari insignis, qui ex apice retro posito paulatim ortus et antrorsum divergens intra gibbos oculigeros in inferiorem thoracis superficiem transit. Hypopodia omnia parum convexa, coxis inconcusse adhærentibus, anticorum pedum oblonga, angustissima, alterorum clavata, tertiorum prope pernæformia, posticorum maxima, incrassata, cyathiformia. Stigmata quatuor in angulis secundi et tertii arcus abdominalis lateralibus conspicua. Glandulæ araneariæ ad basin abdominis apparent.

The specific name I derive from the locality of the new Arachnid (the Riesengebirge, a part of the Sudetes), and give the following diagnosis of it:—

* Ann. & Mag. Nat. Hist. 1875, ser. 4, vol. xvi. pp. 383-389.

† Thesaurus Entom. Oxon. 1874, p. 200.

Gibocellum sudeticum, sp. nov.

Oblongo-ovalis; cephalothorax rufescens, singulis pilis rigidis ob-
 tectus, antennis chelatis testaceis, rubentibus, pilosis, cephalo-
 thoracem subæquantibus, palpis macilentibus, paululo longioribus,
 pilosis; hypopodia palporum securiformia; pedes flavescentes,
 trochanteribus conspicuis, femoribus tibiisque clavatis, tarsis parum
 incrassatis; pedes antici (pedes maxillares) longissimi; abdomen
 viride brunneum, superficie inferiore setis plumosis obsitum.
 Long. corp. 2.5 millim.

BIBLIOGRAPHICAL NOTICES.

The Geological Record for 1874. An Account of Works on Geology, Mineralogy, and Palæontology published during the Year.
 Edited by WILLIAM WHITAKER, B.A., F.G.S. 8vo. London: Taylor and Francis, 1875.

IF the denizens of the nethermost pit can contemplate the doings of the inhabitants of this world of ours, we should think the fate of a "Recorder" could hardly excite even their envy. Working through paper after paper and book after book, often in search of a minute modicum of valuable grain hidden in bushels of inane chaff, compelled to read and digest articles in which they can take scarcely any interest, and to give something like a notion of their general bearings, is bad enough; but when we consider also that the Recorder's work is never finished, but always growing under his hands, he seems almost as much deserving of pity as the fabled Sisyphus, or the daughters of Danaus, with whom the ancients peopled part of the infernal regions. No one who has not personal experience of the business of "recording" can have the smallest notion of the labour involved in it; and most certainly the students of any science ought to feel deeply indebted to those who will take the trouble to summarize its literature for their benefit.

The 'Zoological Record,' which now covers the literature of ten years, and the well-known reports on zoological literature which have appeared for a much longer period in the 'Archiv für Naturgeschichte' furnish the student of zoology with a digest of the contributions to that science in the publications of each year; but in respect of geological literature we have no similar systematic reports; for the notices of memoirs which appear regularly in Leonhard and Bronn's 'Jahrbuch,' in the 'Zeitschrift für die gesammten Naturwissenschaften,' and in 'Silliman's Journal,' valuable as they are, do not afford any thing like a connected view of the current literature.

Under these circumstances geologists ought to give an enthusiastic welcome to Mr. Whitaker's 'Geological Record,' the first issue of which embraces the literature of Geology, Mineralogy, and

Palæontology published during the year 1874. The names of the contributors are a sufficient guarantee that the different articles, all of which are signed with the initials of the writers, have been well and carefully prepared; and the general arrangement, which we presume to be the work of the chief editor himself, is as satisfactory as, considering the nature of the subjects to be treated of, could reasonably have been expected. The report is divided into a certain number of great sections, such as "Stratigraphical and Descriptive Geology," "Physical Geology," "Mineralogy," "Petrology," "Palæontology," &c., and these, again, into subsections on various grounds; and under each subsection are the references to and analyses of the different books and memoirs relating to it, arranged in the alphabetical order of the authors' names. An excellent Index, occupying 19 pages of three columns each, furnishes a further guide to the contents of the book, and will to a very considerable extent take the place of those cross-references which would have been indispensable had the editor attempted to classify his materials in such a manner as would satisfy all the requirements of all his readers.

In choosing this simple method of arrangement, we think that, except in the department of Palæontology, Mr. Whitaker has exercised a wise discretion. Geological books and memoirs, especially those belonging to his first section, or those on Stratigraphical and Descriptive Geology, may generally be looked at from half a dozen points of view; and the effect of any attempt to embrace the whole of these would be a complexity of arrangement that could only lead to confusion; so that the system here adopted of an alphabetical order under certain broad headings (geographical in the section above-mentioned) is certainly the most judicious that could be adopted.

But with regard to Palæontology the case is different; and we hope that in future years Mr. Whitaker may be able to make a change in the treatment of this department of his work. In the present volume this section is divided into three subsections—the Palæontology of the Vertebrata, of the Invertebrata, and of Plants; and under each of these heads the various publications appear in the alphabetical order of their authors' names. Now, without for one moment denying the great importance of a digest even of this kind, we cannot but think that its value would be immeasurably increased if the subjects, or at least the new genera and species referred to, could be classified after the fashion of those in the 'Zoological Record.' These things *are* capable of being reduced to an intelligible system; and although doubtless the process would involve considerable labour, it seems to us that a method of carrying it out might easily be organized. The advantage to students of palæontology would be immense.

We trust that Mr. Whitaker and his excellent coadjutors will not think that these remarks are dictated by a mere carping spirit of criticism, bent upon discovering something to find fault with. No doubt there are people who would pronounce the nectar of Jupiter's best bin too sweet or too dry, or perhaps corked, and detect

false notes in the music of the spheres if they could hear it; but gentlemen of this amiable turn would probably inform Mr. Whitaker that his whole book was got up on a wrong principle, and overwhelm him with a recapitulation of what they regard as errors of omission and commission of the most formidable nature. Far from us be any such uncharitableness. To us the 'Geological Record,' as it stands, seems to be a work for which all naturalists are laid under a debt of gratitude to the editor and his *collaborateurs*; and in the few lines of criticism in which we have indulged upon one of its departments, we have been animated solely by the desire to see it rendered even still more useful during that long career which we sincerely hope lies before it.

Deep-sea Researches on the Biology of Globigerina.

By G. C. WALLICH, M.D. 8vo. London: J. Van Voorst, 1876.

IN this pamphlet Dr. Wallich discusses in considerable detail the known facts in the life-history of the *Globigerina* and the inferences that have been founded upon them. He describes the various observations that have been made of the occurrence of these minute Foraminifera at great depths in the ocean, where their shells are now forming, in certain places, a chalk-like deposit of great extent—a circumstance which gives them a remarkable interest from a geological point of view. Quite recently the observations made by the naturalists of the 'Challenger' expedition have added considerably to this interest by leading them to the conclusion that not only limestones but ferruginous clays have been produced by these little creatures, which they suppose to be pelagic animals, living only in the superficial strata of the water, and sinking to the bottom after death, where their shells produce calcareous deposits at certain depths, whilst at greater depths the carbonate of lime forming the shells is dissolved before they reach the bottom, leaving only the small percentage of oxide of iron and alumina contained in them to form a deposit of red clay. That there are many difficulties connected with this view no one can deny; and Dr. Carpenter has endeavoured to get over these by a theory of his own, according to which the *Globigerinae* actually live and breed at the bottom, but pass a portion of their lives at the surface of the ocean.

From the time of his researches in the 'Bulldog' in 1860, which first really demonstrated the occurrence of living organisms at great depths in the sea, Dr. Wallich has always maintained that the *Globigerinae* forming the well-known "ooze" of the Atlantic seabed lived on the spots where they and their remains are found; but whilst he is no doubt much pleased at having Dr. Carpenter for once on his side, he does not by any means adopt that gentleman's opinions as to the whole history of *Globigerinae*. Unlike Dr. Carpenter, he maintains that the spined *Globigerinae* found abundantly at the surface of tropical seas have nothing whatever to do with those that form the deposits at the bottom; and it seems to us that the arguments adduced by him go very far towards proving, if, indeed,

they do not absolutely prove, his case—namely, that the surface and bottom *Globigerinæ* are perfectly distinct forms, and that the latter are never to be found off the bottom.

It is impossible for us here to follow the author through the long series of statements put forward by him in support of his view; and we must conclude this brief notice by simply stating that his little pamphlet furnishes a most useful *résumé* of the present state of knowledge on this interesting subject, even apart from the argument which constitutes the foundation of the whole. The book is illustrated with a plate copied from the author's 'North-Atlantic Sea-bed.'

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

December 16, 1875.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

“ Preliminary Observations on the Locomotor System of *Medusæ*.”
By G. J. ROMANES, M.A., F.L.S.

I. *Movements of the Medusæ.*

The movements of some of the *Medusæ* (e. g. *Sarsia*) appear to be as *voluntary* as are those of insects. Some of the discophorous species of naked-eyed *Medusæ**, when threatened with injury, manifest peculiar movements, which are quite distinct from the ordinary locomotor contractions. These movements consist in a very strong and protracted systole, followed by a slow and gradual diastole. This spasm-like series of movements is never performed by any *Medusa* except when the animal is being injured or threatened with injury.

II. *Fundamental Observations.*

§ 1. In the case of all the naked-eyed *Medusæ* which I have this year been able to procure (viz. thirteen species belonging to six of the most divergent genera) I find it to be true that excision of the extreme periphery of a nectocalyx is followed by immediate, total, and permanent paralysis of the entire organ. The severed margin, on the other hand, continues its rhythmical contractions as vigorously as when it was still *in situ*, and this for many hours after the operation. Among hundreds of observations I have only met with one exception to the otherwise uniform result of this operation. The exception occurred in an individual belonging to the species *Staurophora laciniata*.

* I adhere to Forbes's classification only because I have not happened to meet with any individuals of the family *Lucernariadæ*.

§ 2. In the case of the covered-eyed Medusæ I have not found the result of the operation just mentioned to be so uniform as it is in that of the naked-eyed Medusæ. Nevertheless this result, although varying greatly in different species and in different individuals of the same species, is, upon the whole, analogous to that which is so remarkable in the case of the naked-eyed Medusæ; that is to say, in the majority of instances excision of the margin of a gonocalyx is followed by a paralysis as immediate and total as is the paralysis similarly caused in a nectocalyx; but the two cases differ in that (a) this is far from being *invariably* the case, and (b) the paralysis of a gonocalyx, even when total for a time, is seldom *permanent*. After periods varying from a few seconds to half an hour or more occasional contractions begin to take place, or the contractions may be resumed with but little change in their character and frequency.

These remarks apply to gonocalyces in general; but they do not apply in equal degrees to all the genera of covered-eyed Medusæ: *i. e.* different genera of covered-eyed Medusæ manifest, in their constituent individuals, different average degrees of paralysis when subjected to the operation we are considering. Of all the species I have come across, *Aurelia aurita* most resembles the naked-eyed Medusæ in the degree to which the locomotor centres are aggregated in the margin of the swimming-organ; for in the case of this species it frequently happens that the paralysis caused by excision of the margin is permanent.

§ 3. In the genus *Sarsia* I find that excision of the eye-specks alone causes a greater degree of paralysis than does excision of the intermediate portions of the margin alone; for while the former operation is usually sufficient to cause temporary and sometimes permanent paralysis, the latter operation never causes either. That all parts of the marginal tissue between the eye-specks, however, are capable of originating impulses to contraction, is proved by the fact that the smallest atom of this tissue, when left *in situ* after all the rest of the margin has been removed, is frequently sufficient to animate the entire nectocalyx.

§ 4. In the covered-eyed Medusæ I find that the concentration of the marginal supply of locomotor centres into the marginal bodies is even more decided than it is in the case of *Sarsia*. Indeed I have no evidence to show that any part of the margin of a gonocalyx, other than the eight lithocysts, has any function of spontaneity to perform; so that all the remarks made in § 2, while stating the effects of removing the entire margin of gonocalyces, are equally applicable to the effects of removing the lithocysts alone. I may add that in the case of *Aurelia aurita*, which from its flattened shape admits of the fairest experiments being made in this connexion, all the spontaneity of the margin, and so in many cases of the entire animal, is without question seated exclusively in the lithocysts*.

* In no case, either among the naked- or the covered-eyed Medusæ, is the polypite affected by removal of the periphery of the swimming-organs.

III. *Stimulation.*

§ 1. All the tissues of all the Medusæ are keenly sensitive to all kinds of stimulation. When a swimming-organ is paralyzed by the operation above described, it invariably responds to a single stimulation by once performing that movement which it would have performed in response to that stimulation had it still been in an unamputated state.

§ 2. (a) To electrical stimulation, both of the direct and of the induced current, the severed margins and the swimming-organs from which they have just been removed are responsive. There is an important difference, however, between the two cases, in that while the severed margins continue responsive to induction-shocks after they have ceased to be affected by make and break of the direct current, the reverse is true of the mutilated swimming-organs—these continuing responsive to make and break of the direct current after they have ceased to be affected by strong induction-shocks, or even by Faradaic electricity with the secondary coil pushed to zero (one cell).

(b) By means of a DuBois-Reymond induction-apparatus and of needle-point terminals (the needle being passed through a small piece of cork as a support, and the cork being fixed to stage-forceps on the mechanical stage of a Ross microscope), I was able to investigate the distribution of excitable tracts in *Sarsia*. I found that there is an uninterrupted increase of excitability from the apex to the base of the nectocalyx, that the positions occupied by the radial tubes are tracts of comparatively high excitability, that the eye-specks are the most excitable portions of the margin, and that of the eye-specks the vesicular half is more excitable than is the pigment half.

(c) When the marginal rim of any Medusa is removed in a continuous piece, with the exception of one small part, the result, of course, is a long strip of marginal tissue, which is free at all points save at the end which is left attached *in situ*. Upon now irritating the distal end of this marginal strip, a wave of contraction may invariably be seen to start from the point at which the irritation is applied, and with some rapidity to traverse the entire strip. When this contractile wave arrives at the proximal or attached end of the strip, it delivers its influence into the swimming-organ, which thereupon contracts in exactly the same manner as it does when itself directly irritated. Of course spontaneous contractions are always originating in some portion or other of the severed strip; and these give rise to contractile waves and to contractions of the swimming-organ just in the same way as do the disturbances originated by stimuli. In such of the discophorous species of naked-eyed Medusæ, however, as respond to stimulation by the peculiar spasmodic movements of the nectocalyx already described, the difference between the effects upon the nectocalyx of contractile waves which originate in the severed strip spontaneously, and those which there originate in answer to stimula-

tion, is of a very marked character; for the spasmodic movements of the nectocalyx are as easily and as certainly excited by irritating any part of the severed strip as they are by irritating the substance of the nectocalyx itself.

From this description it will readily be seen that a Medusa, when thus operated upon, supplies all the conditions required for conducting experiments in electrotonus: the animal in this form is, for all practical purposes, a nerve-muscle preparation. Accordingly I have spent a great deal of labour over this part of my subject, but with no very satisfactory results. In the case of *Staurophora laciniata*, however, I have sometimes obtained decided indications of kathelectrotonus, but never any of anelectrotonus. I cannot yet speak decidedly with respect to Pflüger's law.

(d) α . The excitable tissues of Medusæ, although somewhat capricious in the comparative sensitiveness they show to make and break of the current, upon the whole conform to the rules which are followed by the excitable tissues of other animals.

β . Different species of Medusæ manifest differences in the degree of their sensitiveness to electrical stimulation. In all cases, however, the degree of sensitiveness is wonderfully high.

γ . When the constant current is passing in a portion of a strip of a severed margin, the nectocalyx sometimes manifests uneasy motions *during the time the current is passing*; this, however, is perhaps due to variations in the intensity of the current.

δ . When the intrapolar portion of the severed margin of *S. laciniata* happens to be *spontaneously* contracting prior to the passage of the constant current, the moment this current is thrown in such spontaneous contractions usually cease, and are seldom resumed until the current is again broken, when they are almost sure to recommence. This inhibitory effect may be produced a great number of times in succession.

ϵ . *Exhaustion* of the excitable tissues may be easily shown by the ordinary methods. Exhausted tissue is much less sensitive to stimulation than is fresh tissue, and, so far as the eye can judge, the contractions are slower with the period of latent stimulation prolonged.

ζ . *Tetanus* produced by Faradaic electricity is not of the nature of an apparently single prolonged contraction (except, of course, such of the naked-eyed Medusæ as respond to all kinds of stimuli in this way), but that of a number of contractions rapidly succeeding one another. There is hence no appearance of *summation*.

η . When the swimming-bell of *Sarsia* has had its margin removed, and so (as proved by hundreds of experiments) has been entirely deprived of its locomotor centres, nevertheless, in response to electrical stimulation, instead of giving a single contraction to make or break, it may begin a highly peculiar motion of a flurried, shivering character, which lasts without intermission for periods varying from a few seconds to half an hour. I never but once saw a similar motion in a perfect animal; and this was in the

case of a specimen which was being poisoned with iron-rust. The motion may, I think, be explained by supposing that the various systems of muscles are contracting without co-ordination; but why they should sometimes do this in response to electrical stimulation, and why, when they do this, they should continue the action so long, these questions I cannot answer. In no other genus of the Medusæ have I ever seen a similar or corresponding action performed; and even in the genus *Sarsia* its occurrence is comparatively rare. It never begins spontaneously, and it appears to be most readily evoked by submitting the paralyzed nectocalyx to a number of shocks, either from the direct or the induced current, in somewhat rapid succession. When it does occur it is always continuous, *i. e.* it never spontaneously recommences after having once ceased. When its period of duration is prolonged, the shivering motions become feebler and feebler, until they eventually fade away into quiescence. The animal is then quite insensible to all further stimulation: the tissues appear to have died from exhaustion. These shivering motions may also be caused in *Sarsia* by slightly acidulating the water in which the mutilated nectocalyx is suspended.

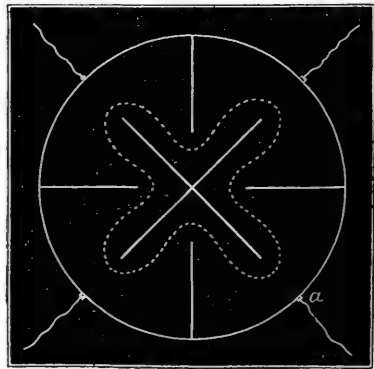
§ 3. In their behaviour towards chemical stimuli, the excitable tissues of all the Medusæ conform in every respect to the rules which are followed by the nervo-muscular tissues of higher animals. Both the severed margins and the mutilated swimming-organs, as well, I may add, as severed polypites and tentacles, respond to applications of various acids, solutions of various metallic salts, alcohol, ether, glycerine, &c. Fresh water is quickly fatal to Medusæ.

§ 4. My observations upon thermal stimulation are, for the present, reserved.

IV. Section.

§ 1. The extent to which the swimming-organs of Medusæ may be mutilated without suffering destruction of their physiological continuity is in the highest degree astonishing.

(a) Suppose the annexed diagram to represent *Sarsia* in projection, the lines being cuts. It is evident that a stimulus originating at any point *a* in the margin cannot radiate its influence throughout the nectocalyx, except by traversing the course of the dotted line;



yet in a specimen so cut the spontaneous contractions are as synchronous over the entire nectocalyx as they are in uncut specimens. Further,

if the margin be now removed, the paralyzed bell will respond to stimuli applied at any part, just as readily and simultaneously over its whole extent as it would do were there no system of interdigitating cuts present.

(b) If the margin of *Sarsia* be removed in a continuous strip, with the exception of one end left attached *in situ*, and if the section be then continued in the form of a spiral having two or more turns from the base to the apex of the cone, the contractile waves originating in the free portions of the severed margin pass into the spiral upon reaching its point of origin, and then run round and round the spiral from the base to the apex of the cone. If the marginal strip be now removed altogether, the paralyzed bell will respond to stimuli applied to any part of the spiral.

(c) If seven lithocysts be removed from the gonocalyx of *Aurelia aurita*, and if the remaining one be made the point of origin of a spiral section, which is then carried round and round the disk-shaped gonocalyx, the result is a long strip of contractile tissue, the contractile waves always originating in the lithocyst at the end of the strip, and then running along the strip until they deliver themselves into the remainder of the gonocalyx, which thereupon contracts. The length and width of such contractile strips are very important factors in determining whether the waves pass all the way along the strip or become blocked at some point in its length. Nevertheless these are very far from being the only factors, there being immense individual differences in the endurance of the contractile tissue under this form of section. Sometimes the waves will become blocked when the strip is only an inch or less in length; while at other times the waves will pass freely from end to end of a contractile strip which is only an inch wide and a yard long.

§ 2. How are the impulses transmitted from the locomotor centres of Medusæ to the contractile tissues of their swimming-organs? Have we any evidence of more or less definite lines of discharge being present? or must we conclude that the contractile tissues are, throughout their extent, of a functionally homogeneous nature?

(a) The fact that the contractile tissues endure such severe section without losing their physiological continuity, appears to settle this question in favour of the last-mentioned alternative. Nevertheless there is a weighty body of evidence to be adduced on the other side. In the first place, the extreme variations in their tolerance of spiral section which are manifested by different individuals of the species *Aurelia aurita* appear to be irreconcilable with the hypothesis of the tissue concerned being functionally homogeneous. But the following invariable fact is still more difficult to reconcile with this hypothesis, viz. *at whatever point in a contractile strip that is being progressively elongated by section the contractile wave becomes blocked, the blocking is sure to take place completely and exclusively at that point.* In view of these facts, therefore, at the present stage of my inquiries, I provisionally accept the hypothesis of more or less definite lines of discharge being pre-

sent in the swimming-organs of *Medusæ*. I have hitherto failed, however, to detect any such lines histologically.

(b) After the waves have become completely blocked in a contractile strip, it sometimes happens that the blocking is overcome, the waves again passing into the remainder of the gonocalyx as freely as they did before the section reached the point at which the blocking occurred. Sometimes, under these circumstances, the strip will admit of being further elongated for some distance before the waves are again blocked; and occasionally it happens that the second blockage is also thrown down. I have once seen four such successive blockages successively overcome.

It will be seen that these facts militate against the supposition of lines of discharge being present. I think, however, that there is a theory by which these facts admit of being satisfactorily reconciled with that supposition. But this whole subject awaits further and extensive investigation.

(c) Pressure exerted upon any transverse line in a contractile strip causes blocking of the waves at that line. If the pressure be slight, the blocking will be temporary; but if severe or long-continued, the blocking will probably be permanent. Even the slight strains caused by handling contractile strips in the air are often sufficient to show the rate of the waves, and sometimes to block them.

V. *Additional Facts tending to show the identity of the Locomotor Centres of Medusæ with Nervous Tissue in general.*

§ 1. Having placed several hundred *Sarsisæ* in a large bell-jar, I completely shut out the daylight from the room in which the jar was placed. By means of a dark-lantern and a concentrating-lens, I then cast a beam of light through the water in which the *Sarsisæ* were swimming. From all parts of the bell-jar the *Sarsisæ* crowded into the path of the beam. The presence of a visual sense in the case of this genus is therefore unquestionable.

Having removed twelve vigorous specimens from the large bell-jar and placed them in a smaller one, I excised the so-called eyespecks from nine of the number. The three un mutilated individuals sought the light as before; but the other nine swam hither and thither without paying it any regard. I conclude, therefore, that the visual faculty is lodged exclusively in the marginal bodies.

Lastly, I brought a heated iron, just ceasing to be red, close against the glass side of the large bell-jar; but no one of its numerous occupants approached the heated metal. Therefore the rays by which the *Sarsisæ* had been affected in the previous experiment were the properly luminous rays, and not the calorific ones.

§ 2. (a) The anæsthesiating influence of chloroform and ether is most decided, both in the case of the naked- and of the covered-eyed *Medusæ*. The first indications of approaching torpor are (a) decrease in the rate of the pulsations and (b) diminution of their vigour. These indications rapidly become more and more marked,

o that shortly after they first set in the period of diastole is very much prolonged and the systoles, when they occur, are of the feeblest character. Eventually the pulsations altogether cease; and shortly after this stage of perfect quiescence has been reached, the Medusa is quite insensible to all stimulation. Recovery in normal sea-water is very rapid, occupying only a few seconds in the case of *Sarsia*; but, like the reverse process of anæsthesiation, it is clearly of a gradual nature.

(b) Morphia is as decided in its action upon Medusæ as is chloroform. The processes of anæsthesiation and of subsequent recovery are very similar to those just described, except that both processes occupy a somewhat longer time.

(c) Strychnia exerts a very marked influence upon Medusæ. Of the species I have met with *Cyanea capillata* is the most suitable for showing the effects of this poison, from the fact that, in water kept at a constant temperature, the normal pulsations of this animal are as regular as are those of a heart. Shortly after a solution of strychnia has been added to the water in which a specimen of *C. capillata* is contained, unmistakable signs of irregularity in the pulsation of the animal supervene. This irregularity then increases more and more, until at last it grows into well-marked convulsions. The convulsions manifest themselves in the form of extreme deviations from the rhythmical character of the normal contractions, amounting, in fact, to nothing less than tonic spasms. It is further of importance to remark that the convulsions are very plainly of a paroxysmal nature—prolonged periods of uninterrupted convulsions being every now and then relieved by shorter periods of repose, during which the Medusa remains perfectly motionless in a fully expanded form. *C. capillata* will live for many hours when under the influence of strychnia, but eventually death supervenes. The animal dies in full diastole.

(d) Curare was administered by the following method. I placed the Medusa in a flat-shaped beaker filled to the brim with sea-water. This beaker I then placed in a large basin filled with sea-water up to the level of the water in the beaker. Having next divided the Medusa across its whole diameter, with the exception of a small piece of marginal tissue to act as a connecting-link between the two resulting halves, I transferred one of these halves to the water in the basin, leaving the other half still in the beaker. Lastly, I poisoned the water in the beaker with successive doses of urari solution. The species best suited for this experiment is *Staurophora luciniata*.

The effects of curare thus administered are most marked and beautiful. Previous to the administration of the poison both halves of the divided Medusa are, of course, contracting vigorously—the contractile waves now running from the half in the basin to the half in the beaker, and now *vice versâ*. But after the half in the beaker has been effectually poisoned all motion in it completely ceases, the unpoisoned half, however, continuing to contract independently. If the poisoned half be now irritated, by nipping with

the forceps or otherwise, it does not itself move, but the other or unpoisoned half immediately responds to the stimulation. If *S. laciniata* be the species of Medusa employed, this result is particularly well marked, from the fact that the unpoisoned half responds to the stimulation by performing the highly distinctive spasmodic movements already described. I have also satisfied myself that curare asserts its peculiar influence upon individuals of the covered-eyed Medusæ. In all cases overpoisoning paralyzes the excitable as well as the motor system. The strength of the solution I used was 1 in 2500, and in this solution the poisoned half required to soak for half an hour.

(e) If any sized portion of a contractile strip cut from the gonocalyx of *A. aurita* be immersed in a sea-water solution of any of the above-mentioned anæsthesiating substances, the contractile waves in the poisoned portion of the strip are first progressively slowed and finally blocked. Upon now restoring the poisoned portion of the strip to normal sea-water, the contractile waves again begin to pass, and eventually do so as freely as before.

If any of the nutrient tubes which cross such a contractile strip transversely be injected with a solution of any of the narcotic poisons, the contractile waves become blocked at the line occupied by that tube. If a discharging lithocyst be similarly injected, it ceases its discharges. From the effects of chloroform and weak solution of morphia, however, it recovers in the course of a night. Alcohol so injected at first causes an increase in the frequency and potency of the discharges, and afterwards progressive torpor. In time, however, the torpidity wears away, and finally the Medusid returns to its normal state.

GEOLOGICAL SOCIETY.

February 2nd, 1876.—John Evans, Esq., F.R.S., President,
in the Chair.

“Evidence of a Carnivorous Reptile (*Cynodracon major*, Ow.) about the size of a Lion, with Remarks thereon.” By Prof. Owen, C.B., F.R.S., F.G.S., &c.

The specimens described by the author consist of the fore part of the jaws and the left humerus of a reptile obtained from blocks of Triassic(?) rock from South Africa, forwarded by the late Mr. A. G. Bain, F.G.S. The upper jaw displays a pair of enormous canine teeth, much resembling those of *Machairodus*, being of a very compressed form, with the hinder trenchant margin minutely toothed. There is no dentated border to the fore part of the crown. No teeth can be detected in the alveolar border of the right ramus of the lower jaw, which extends about an inch behind the upper canine. In the symphyseal parts of the lower jaw the bases of eight incisors and of two canines are visible, the latter rising immediately in front of the upper ones, to which they are very inferior in size, and being separated by a diastema from the incisors. In this character,

as in the number of incisors, the fossil resembles *Didelphys*; and in structure both canines and incisors resemble those of carnivorous mammals.

The left humerus is $10\frac{1}{2}$ inches long, but is abraded at both extremities. It presents characters in the ridges for muscular attachment, in the provision for the rotation of the forearm, and in the presence of a strong bony bridge for the protection of the main artery and nerve of the forearm during the action of the muscles, which resemble those occurring in carnivorous mammals, and especially in the Felidæ, although these peculiarities are associated with others having no mammalian resemblances. The author discusses these characters in detail, and indicates that there is in the probably Triassic lacustrine deposits of South Africa a whole group of genera (*Galesaurus*, *Cynochampsu*, *Lycosaurus*, *Tigrisuchus*, *Cynosuchus*, *Nythosaurus*, *Scaloposaurus*, *Procolophon*, *Gorgonops*, and *Cynodracon*), many of them represented by more than one species, all carnivorous, and presenting more or less mammalian analogies, for which he proposes to form a distinct order under the name of Theriodontia, having:—the dentition of carnivorous type; the incisors defined by position, and divided from the molars by a large lanianiform canine on each side of both jaws, the lower canine crossing in front of the upper; no ectopterygoids; the humerus with an entepicondylar foramen; and the digital formula of the fore foot, 2, 3, 3, 3, 3 phalanges.

The author further discussed in some detail the remarkable resemblances presented by these early Reptiles, in some parts of their organization, to Mammals, and referred to the broad questions opened out by their consideration. He inquired whether the transference of structures from the Reptilian to the Mammalian type has been a seeming one, due to accidental coincidence in species independently created, or whether it was real, consequent on the incoming of species by secondary law. In any case the lost Reptilian structures dealt with in the present paper are now manifested by quadrupeds with a higher condition of cerebral, circulatory, respiratory, and tegumentary systems, the acquisition of which, the author thought, is not intelligible on either the Lamarckian or the Darwinian hypothesis.

“On the Occurrence of the Genus *Astrocrinites* (Austin) in the Scotch Carboniferous Limestone Series, with the Description of a New Species (*A. ? Benniei*), and Remarks on the Genus.” By R. Etheridge, Esq., jun., F.G.S.

The author, in the introduction to this paper, commenced with a general history of the genus *Astrocrinites* of Austin, commenting upon the change of name it had received from the several authors who had written upon and noticed the species *A. tetragonus* of Austin.

In 1843 Major T. Austin described this aberrant Echinoderm under the name *Astrocrinites*, assigning as its geological horizon the Carboniferous Limestone, and locality Yorkshire.

Dr. H. G. Bronn rejected the name *Astrocrinites* on account of

its resemblance to *Asterocrinites* of Münster, and proposed instead that of *Zygocrinus*. Römer, from the four-rayed structure of our *Asterocrinites*, allied it to the Cystoidea rather than to the Blastoidea. Prof. de Koninck and M. le Hon, however, referred *Zygocrinus* to the Blastoidea, and stated their reasons for so doing. Prof. Morris in 1854 altered Austin's *Asterocrinites* into *Asterocrinus*, and does not notice Bronn's name *Zygocrinus*. Prof. Pictet provisionally referred the latter genus structurally to *Codonaster*, noticing, however, its four instead of five pseudambulacra. The author then notices at some length the species he proposes to call *A. Benniei*, which appears to differ much from Austin's *A. tetragonus*. The body or calyx of *A. Benniei* is quadriradiate, having four convex lobes, three of which are alike, the fourth differing considerably from the others; the deep reentering angles between the lobes are occupied by the pseudambulacra; the dorsal surface is densely covered with closely set tubercles, but shows no point of attachment; the ventral surface is flattened, having a large central aperture, from which radiate the four pseudambulacra; excentric as compared with the ambulacral system is a second and pyriform aperture of complex structure. The component parts are then minutely described, followed by careful descriptions of the pseudambulacra, apertures, and ornamentation, also a discussion as to the presence of a madreporiform tubercle. The second part of the paper treats upon the affinities of *A. Benniei* (Ether.) with *A. tetragonus* (Austin). Part the third enters fully and critically into the systematic position of *Asterocrinites* amongst the Cystoidea and Blastoidea. In the concluding and fourth portion of the paper, the localities and geological horizons are given. Twenty-seven figures, occupying three plates, accompanied the paper.

MISCELLANEOUS.

On the Relations of Artemia salina and Artemia Mühlhausenii, and on the Genus Branchipus. By M. W. J. SCHMANKEWITSCH.

THE author has observed that under the influence of a gradual concentration of the salt water in which *Artemia salina* lives that species is gradually modified, and at last acquires the characters of *A. Mühlhausenii*. In 1871 the salt marshes near Odessa contained *Artemia salina* in great abundance. At this time, in consequence of the rupture of a dyke, the quantity of salt contained in these pools was rather small, their water marking only 8° Baumé. After the dykes were repaired the concentration increased rapidly, so that in the summer of 1872 the water already marked 14°; in 1873 it had risen to 18°; at the beginning of August 1874 to 23°·5, and in September of the same year it had attained 25°. At the same time that the salting became stronger and stronger, the *Artemia salina* was modified from generation to generation to such an extent that, at the end of the summer of 1874, a great portion of the individuals of this species no longer had caudal lobes, and already presented all

the specific characters of *A. Mühlhauseni*. The author minutely describes the gradual changes that he observed. These were manifested especially in the caudal part, and were accompanied by a diminution of size.

These observations, made upon animals living at freedom in salt marshes, are corroborated by experiments made by the author upon *Artemiæ* reared in captivity in water of which the saltness was gradually increased. Under these conditions he observed the same transformations leading to the same forms.

The inverse experiment was tried with *Artemia Mühlhauseni* taken in the salt marshes and reared in water rendered less and less salt. This *Artemia* was then seen to retrograde by degrees towards the form of *Artemia salina*.

In proportion as the saltness increases or diminishes a correlative increase or diminution of the surface of the branchiæ is observed in the *Artemiæ*. The form of these organs also differs in the two species; those of *Artemia salina* are of an elongated form, their two dimensions being in the proportion of one to two, whilst those of *A. Mühlhauseni* are oval, and their two dimensions are in the proportion of two to three.

According to M. Schmankewitsch, the only (?) anatomical character that distinguishes the genus *Branchipus* from *Artemia* is that in the latter we count (including the two segments which bear the external sexual organs) eight apodal terminal segments, the last of which is nearly twice as long as the preceding one; whilst in *Branchipus* there are nine apodal segments, the last two of which differ but little from each other in length. When a series of generations of *Artemia* have been reared in water less and less salt, the last segment (8th) divides into two, when there are nine apodal segments as in *Branchipus*. Moreover it must be noted that in youth, at the moment when they have just quitted the larval state, the *Branchipodes* have only eight apodal abdominal segments, the last of which has the same proportions as in *Artemia*.

It is not only by the number of abdominal segments that the *Artemiæ* approach *Branchipus* under the influence of the surrounding medium; other characters which the former genus borrows from the second also make their appearance; this is the case, for example, with the length of the caudal lobes, the number of setæ they bear, &c.

The results of these observations lead the author to the conclusion that the *Artemiæ* which ordinarily pass their lives in strong salt water are merely degraded forms of *Branchipodes*, produced under the influence of the surrounding medium. Inversely we may suppose that the *Branchipodes* represent a form more advanced in development than the *Artemiæ*.

The facts contained in M. Schmankewitsch's memoir appear to be well observed, and possess great interest from the point of view of the theory of transformism. We cannot, however, abstain here from making one or two critical remarks:—first, that the author makes no allusion to a rather important character which separates

Artemia salina from *A. Mühlhausenii*, namely the different form of the lower antennæ, which in the former species presents an inflation wanting in the second; secondly, M. Schmankevitch seems to assume that *Artemia* is distinguished from *Branchipus* only by the number of abdominal segments, and he does not mention the very marked differences presented by the inferior antennæ in the two genera. Lastly, it is rather difficult to understand whether the modifications which cause *Artemia salina* to pass into *A. Mühlhausenii* make their appearance sooner or later than, or at the same with, the modifications which approximate the genus *Artemia* to the genus *Branchipus*.—*Zeitschr. für wiss. Zool.* xxv. Suppl. i. 1875, p. 103, pl. 6; *Bibl. Univ. Arch. des Sci.* liv. Nov. 15, 1875, p. 284.

The Drosera as an Insect-catcher. By THOMAS MEEHAN.

Mr. Thomas Meehan referred to a discussion before the Academy recently in which the question occurred, whether those plants which had contrivances for catching insects made any nutritive use of the insects so caught. It had been argued from experiments made in England with plants under bell-glasses and free from insects which were quite as healthy as those which had had insects regularly supplied to them, that the plants were not actually insect-eaters.

In a recent botanical trip to New Jersey he had found in Atlantic County, about five miles from Hammonton, three species of *Drosera* (*D. filiformis*, *D. longifolia*, and *D. rotundifolia*), all growing near each other in immense quantity. All of these species had insects of numerous kinds attached to them. Large numbers of plants had no insects. The species with the largest number of plants having insects on them were in the order as above named. The insects are held by the pin-like glandular hairs, which seem to lean in from all sides towards the insect (as if, from its struggles to escape, drawn in) and thus securely hold it. The remains of the insects which have been caught seem to continue attached to the plant for a long time; and thus can be seen which plant has had the benefit of insect-food, if food it be. No difference, however, in health or vigour could be traced between those which had had insects and those which had had none. Mr. Meehan did not, however, think that these observations, or experiments founded on any thing they suggested, would settle the question of nutrition. Among ourselves there were discussions as to whether people were healthier as vegetarians or flesh-eaters, while figures showed little difference, if any, either way. A plant might feed on insects when it could get them, and yet be no healthier than those which had to get along as other plants did. It was necessary, however, to the theory advanced by those who believed the insect-catching were really insect-eating plants, to show that some superior advantages favoured the insect-catchers. It was believed that the power to catch insects was a developed one, a power not possessed by their predecessors, and developed according to the law of natural selection. Unless insect-catching can be shown to be an especial advantage, there was nothing to select. At any rate, his observations on the *Drosera* only showed

that all the plants, whether with insects or with none, were equally healthy.

Some observers have recorded that there is a motion of the leaves as well as of the glandular hairs in the effort to catch insects. Only one fact was noticed bearing on this question: one leaf of a *Drosera filiformis* had coiled over towards its upper surface from the apex, and held an insect in its folds.—*Proc. Acad. Nat. Sci. Philadelphia*, July 20, 1875.

On the Classification and Synonymy of the Stellerida.

By M. E. PERRIER.

In presenting to the Academy the first part of my "Révision de la Collection des Stellérides du Muséum d'Histoire Naturelle de Paris," I request permission to submit the principal results contained in the portion of this work which is still to be published, and which will include the investigation of five of the eight families into which I divide the Stellerida known at the present day. These families are the Goniasteridæ, Asterinidæ, Pterasteridæ, Astropectinidæ, and Brisingidæ. As in the case of the first three families, the Asteriadæ, Echinasteridæ, and Linckiadæ, it is especially from the various arrangement of the skeletal pieces that the primordial characters have been derived. With me the family Goniasteridæ corresponds to the genera *Astrogonium*, *Goniodiscus*, *Stellaster*, *Asteropsis*, *Oreaster*, and *Culcita*, as defined by Müller and Troschel; but I have not been able to adopt the limitation of these genera marked out by those authors. Their genera *Goniodiscus* and *Asteropsis* especially are eminently artificial. The genera created by Gray are, in some respects, better, but too numerous; the truth seems to me to lie between the two. For the new limitation of the genera, I have appealed sometimes to the form of the skeletal pieces, sometimes to the arrangement of the pedicellariæ, which had previously furnished such clear characters in the family Asteriadæ. I cannot, however, accept the great genus *Goniaster* which Von Martens has endeavoured to reestablish. From an examination of Gray's types in the British Museum, his genera *Randasia* and *Hosea*, which belong to this family, must fall; the former contains only young *Culcites*, the latter young *Antheneæ*.

The genera composing my family Asterinidæ are *Patiria*, Gray (restricted), *Nepanthia*, Gray (pars), *Asterina*, Nardo, *Palmipes*, Linck, *Disasterina* (nov. gen.), and *Ganeria*, Gray. This last genus, which is but little known, is a most curious intermediate type between the Asterinidæ and the Astropectinidæ. The *Nepanthiæ* have been wrongly regarded as *Chætasteres*. I have ascertained that Gray united in this genus two very distinct types—one identical with *Chætaster* in the family Astropectinidæ, and another which, by its imbricated skeletal pieces, belongs to the family Asterinidæ. This latter is our *Nepanthia*.

The family Astropectinidæ includes the genera *Chætaster*, *Luidia*, *Astropecten*, *Archaster*, and *Utenodiscus*. Each of the other two families contains only a single genus.

Beyond these modifications introduced into the systematic arrange-

ment of the starfishes, the important question of the synonymy has engaged all my attention; and in this also I have had to make many rectifications. The direct comparison of the types of Lamarek, Müller and Troschel, Duchassaing, and Michelin with Gray's types, which were studied in London, and those which Dr. Lütken was kind enough to send to me, the examination of the specimens recently brought from New Zealand by M. Filhol, and which have been identified with Capt. Hutton's types, and the study of the specimens ticketed by various American Museums which I found in London and Paris, and in the collection of M. Cotteau at Auxerre, have led me to the following conclusions.

Asterias striata, Lam., which every one, on the faith of Müller and Troschel, regarded as an *Asteracanthion*, does not even belong to the family Asteriadae, of which that genus forms part, and must constitute a distinct genus of the Echinasteridae (*Valvaster*, gen. nov.).

Asterias calamaria, Gray, and *Coscinasterias muricata*, Verrill, are identical. *Asterias echinophora*, *A. clavigera*, and *A. exigua* of Lamarek have been described under new names, which must be suppressed. *Ophidiaster Leachii*, Gray, and *Leiaster coriaceus*, Peters, are identical. This is also the case with *O. pyramidatus*, Gray, and *O. porosissimus*, Lütken; *O. cylindricus*, Lam., and *O. asperulus*, Lütk.; *O. pusillus*, Müll. & Tr., and *O. granifer*, Lütk.; *Linckia pacifica*, Gray, and *L. nicobarica*, Lütk.; *Asterina minuta*, Gray, and *A. folium*, Lütk.; *A. pentagonus*, Müll. & Tr., and *A. Krausii*, Gray; and *Astropecten articulatus*, Say, and *A. dubius*, Gray.

Asteropsis pulvillus and *A. ctenacantha* of Müller and Troschel are only the same species in different states of preservation. We must also regard as identical:—1. *Linckia Guildingii*, Gray, *Scytaster stella*, Duch., and *Linckia ornithopus*, Val.; 2. *Gomophia cegyptiaca*, Gray, *Scytaster zodiacalis*, Müll. & Tr., and *Oreaster Desjardinsii*, Mich.; 3. *Astropecten armatus*, Müll. & Tr., *A. polyacanthus*, Müll. & Tr., *A. hystria*, Val., and *A. Wappa*, Val.; 4. *A. armatus*, Gray, *A. erinaceus*, Gray, and *A. Erstedii*, Lütk.; 5. *A. duplicatus*, Gray, *A. Valenciennii*, Müll. & Tr., and *A. variabilis*, Lütk.; 6. *Asteriscus minutus*, Müll. & Tr., *A. marginatus*, Val., and *A. stellifera*, Möbius.

On the other hand, Dr. Lütken believed that *Asterias canariensis*, D'Orb., was identical with *Chætaster longipes*, Retz.; but it is certainly a distinct species, which, indeed, is *Narcissia teneriffæ* of Gray. It is also in error that Von Martens refers *Astropecten mauritanus*, Gray, to *Archaster angulatus*, Müll. & Tr. Gray's species is certainly an *Astropecten* allied to *A. scoparius*, Val. *Nectria ocellifera*, Gray, is not the same as *A. ocellifera*, Lam.; *Astrogonium australe*, Müll. & Tr., is not, as authors have supposed, the *Tosia australis* of Gray, but his *Tosia aurata*; and it is *A. geometricum*, Müll. & Tr., that represents *Tosia australis*. The *Asteriscus* figured by Savigny is not, as stated, *A. verruculatus*, Müll. & Tr., but *A. cepheus*, Val., which itself appears to be the true *A. Burtonii*, Gray. The remarkable animal described by Hutton under the name of *Pteraster inflatus* is not a *Pteraster*, but a *Palmipes*. *A. obtusangula*, Lam., has been wrongly referred by Müller and Troschel to *Oreaster*; I retain for it the name of *Goniaster*. *Gymnasterias inermis*, Gray, is only a

young *G. carinifera*. The species designated by Verrill under the former of these names consequently remains undetermined. Lastly, Gray's *Petalastres* are true *Luidia*.

I may add that I cannot doubt the identity of the *Luidia senegalensis*, Müll. & Tr., and the *Goniaster africanus* of Verrill from the African coast, with *L. Marcgravii*, Steenstr., and *G. americanus*, Verrill, of the American shore. *Asterina stellifera*, Möbius, and *Linckia Guildingii* are likewise common to both shores.

To sum up: with 200 species, represented by about 1200 specimens, the collection of the Museum possesses nearly half the known species of true starfish, the number of which, according to the lists that I have prepared, may be estimated at 420. In the work of revision that I have just terminated, I did not think I ought to confine myself to the species of our Museum. I have included all those that I have had an opportunity of examining, making a total of 300 species, including close upon 2500 specimens, as to which I have brought together precise information, with regard to both their synonymy and their geographical distribution, the origin of each specimen having been carefully ascertained. These species are divided into 46 genera, many of which had to be created or remodelled. A great number of old species which had been very doubtful have been described afresh from the original specimens; and 50 new Stellerida have been added to the list of known species.—*Comptes Rendus*, December 3, 1875, p. 1271.

On an Amphipod (Urothoë marina), a Commensal of Echinocardium cordatum. By M. A. GIARD.

The sandy shore that stretches between Wimereux and Ambleteuse furnishes in abundance *Echinocardium cordatum*, known to the fishermen under the name of *œuf de Grisard*. Dr. Robertson has given us some details as to the mode of life of this *Spatangus**; but his statements are incomplete and even sometimes incorrect. The urchin lives in the sand at a depth of from 15 to 20 centimetres; it communicates with the surface by two canals of the thickness of a quill, one of which terminates at the central point of the ambulacral star, and the other at the anal aperture. This second canal has not been noticed by Dr. Robertson, who thinks that the sand introduced into the digestive cavity of the animal must be disgorged by the mouth after having served for nutrition, thanks to the organic materials that it contains. The aperture of the anal tube is perfectly circular; that of the apical tube is irregularly three-lobed. The water penetrates by this latter tube, which contains the long contractile filaments ("locomotive feet," "ringed, worm-like suckers"), the movement of which conveys the alimentary particles to the mouth by the anterior furrow. A portion of the water enters through the madreporic plate into the general cavity and aquiferous system. The anal canal serves for the escape of the sand that has traversed the digestive tube. This canal is traversed by a stream of water, the existence of which is difficult to explain, since

* Quart. Journ. Mier. Sci. xi. p. 25.

there is not, in the neighbourhood of the anus, any aperture belonging either to the cavity of the body or to the aquiferous system. The water rejected by the anal tube is therefore derived from the digestive apparatus. The intestine, stuffed with sand and of extreme thinness, contains tolerably powerful muscular fibres at its anterior part, but which gradually diminish towards the posterior part: I believe that the expulsion of the sand cannot be ascribed solely to these fibres, and that an important part belongs to the organ discovered by Hoffmann, and called by him the "twisted organ" (*gewundenes Organ*). This organ acts as a canal of derivation: it receives the water contained in the sand of the anterior intestine; then by the play of the buccal membrane, and the contraction of the muscles of the first part of the digestive tube, it carries this water into the terminal portion of the apparatus, where it drives before it and carries out the materials accumulated in the posterior intestine. Thus would be explained the anal current and the slow rejection of the sand absorbed; we also understand why no twisted cast is produced, as in *Arenicola*.

The cavity in which the *Echinocardium* is lodged is lined with a glutinous secretion, which was observed by Dr. Robertson. On carefully removing the urchin we almost constantly find, in the sandy gangue cemented by this mucus, three or four small crustaceans, the external aspect of which at once reminds one of the *Hyperia*, the usual commensals of *Rhizostoma Cuvieri*. A more careful examination soon led me to see that these crustaceans belong to the genus *Urothoë* of Dana, and very probably even to the British species described by Spence Bate under the name of *U. marinus*, the differences relating to perfectly secondary characters, and being attributable to less perfect observations than mine. I must, however, indicate one important peculiarity that has escaped the learned authors of the 'History of British Sessile-eyed Crustacea,' namely that *Urothoë marinus* presents a strongly marked sexual dimorphism. The most striking character of the male sex is the length of the inferior antennæ, which greatly exceed the superior ones. It is well known that it is a character of the same kind that distinguishes the male *Hyperia (Lestrigonus)* from their females. This peculiarity, combined with several other analogies derived from their anatomical investigation, supports the prevision of Westwood, who, from the researches of Spence Bate upon the development of certain Hyperinæ, was inclined to think that a more intimate connexion might perhaps be established between these animals and the subfamily Phoxides, to which *Urothoë* belongs.

Among the species of the genus *Urothoë* figured by Spence Bate some present rather short inferior antennæ; in the others, on the contrary, these same organs are of considerable length. With most of these species the descriptions have been drawn up from a very small number of specimens; we may therefore presume that the differences just mentioned are mere sexual characters, and that one sex only has been described for each of the known types. If we accept this opinion, *Urothoë Bairdii* and *Urothoë elegans* must be regarded as representing male individuals; whilst *Urothoë brevicornis* and *Urothoë marinus* are, on the contrary, figured from the

female sex. It is not without interest to add that among the individuals of *Urothœ marinus* forwarded to the authors of the 'British Sessile-eyed Crustacea,' some were from Cumbræ, where they had been collected by Dr. Robertson, the talented zoologist, who, as we have already stated, has investigated the habits of the *Echinocardium* in that same locality. Others were found at Macduff in the stomach of a haddock. Now Alex. Agassiz tells us that the large fishes of the genus *Gadus* are great eaters of sea-urchins. These old observations thus indirectly aid to verify the commensalism of *Urothœ* as ascertained by us.—*Comptes Rendus*, Jan. 3, 1876, p. 76.

On some new Species of Stomatopod Crustacea. By J. WOOD-MASON

Mr. Wood-Mason exhibited several new species of Stomatopod crustaceans, viz.:—*Clorida decorata*, with eyes as in *C. microphthalma*, M.-Edw., and *C. Latreillei*, Ey. & Soul., the inner margin of the sabre-like appendage of the lateral portions of the caudal swimmeret armed with fine acuminate spines, and the telson vermiculated above and below with granulated ridges, claw of raptorial arm 5-toothed—from the Andamans; *Coronis spinosa*, with three spines projecting from the telson just above the level of the marginal ones, of which there are three pairs, the median pair movable and smaller than the rest and with the interval between them finely serrated (five or six teeth on each side of the middle line), between these and each lateral pair two spinules, between the teeth of each lateral pair one spinule, claw of raptorial arm 10-toothed—from the Andamans and New Zealand; *Gonodactylus glyptocercus*, allied to *G. trispinosus*, with the telson ornamented with two oval tubercles bounded by an impressed invected line and with a median basal cinquefoil-shaped one, and the two preceding somites symmetrically engraved with fine lines—from the Nicobars; and *Squilla supplex*, with three short oblique ridges on each side of the telson, between which and the strong median ridge on each side a row of confluent tubercles in the same straight line with the two median marginal teeth, five teeth to the claw of the raptorial arms, postabdominal somites with nine ridges, arranged three in the middle and three on each side—from Bombay.—*Proc. Asiat. Soc. Bengal*, December 1875.

“*Ornithological Errors in the ‘Reliquiæ Aquitanicæ.’*”

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

GENTLEMEN,—With reference to Professor Alfred Newton's Note in the 'Annals & Mag. of Nat. Hist.' for February, pages 168–170, on some ornithological errors in Professor Alphonse Milne-Edwards's memoir on the Bird-remains from the Caves of Périgord, in the 'Reliquiæ Aquitanicæ,' Part xvi., of which I am Editor, responsible for its Translations, I ask permission to state that twelve of the "errors" are evidently discrepancies of fact and opinion between the Author and Prof. A. Newton; and the correction of these M. A. Milne-Edwards acknowledges, with thanks, in his revised reprint of his memoir from the original MS., in the November number of the 'Matériaux pour l'histoire de l'Homme' &c., 1875, p. 473 &c.

Directly after Prof. Newton had read the translated memoir in question, before it was published, he favoured me with his critical

notes thereon, and expressed his wish and intention to publish his correction of the mistakes. In assenting, I stated that he ought to be clearly convinced what were the Author's and what were the Translator's errors. Some of the latter (from among those pointed out by Prof. Newton) I inserted in the *Corrigenda*, at p. 292 of the 'Reliquiæ Aquitanicæ.' I should like to have seen in Prof. Newton's Critical Remarks in the 'Annals' for February some fair assortment of the burdens for Author and Translator; but, according to his last paragraph, everybody except the latter is held blameless. It may have been left for the reader to assort the "errors"; and the discrepancies and differences of the author and critic may not have been considered blameable errors. At all events, while I thank Prof. Newton for his earnest desire to contribute to the utility of the work, I must express my regret that the wording of his verdict should have fallen exclusively hard on the Translator for his nomenclatorial errors.

Yours obediently,

Yorktown, Feb. 21, 1876.

T. RUPERT JONES.

On the Astacus modestus of Herbst. By J. WOOD-MASON.

Mr. Wood-Mason exhibited a specimen of the beautiful macrurous crustacean long ago described and accurately figured by Herbst ('Krabben und Krebse,' Band ii. Heft 5, 1794, p. 173, t. xliii. f. 2) under the name of *Astacus modestus*. This remarkable crustacean, like the *Astacus zaleucus*, v. W.-S. (for which the new generic title *Thaumastocheles* had recently been proposed, P. A. S. B. 1874, p. 181), was an example of a transitional form connecting the two families Thalassinidæ and Astacidæ. In *Thaumastocheles zaleucus* the facies of the former family was combined with characters that entered into the usual definition of the latter; *Eutrichocheles*, as he proposed generically to designate the species described by Herbst, on the other hand, was indubitably, as the totality of its organism showed, a member of the latter presenting certain structural arrangements which were unmistakable marks of real affinity to the former. The *Calliaxis adriatica* of Heller was just such another transitional form. In fact it was now, in his opinion, impossible to frame such a definition of either family as would exclude all the members of the other, owing to the number of the connecting links. The *Eutrichocheles modestus* was also especially interesting as being the nearest known blood-relation of the remarkable blind crayfish described two or three years ago under the name of *Nephropsis Stewarti*. In conclusion Mr. Mason said that he had long been engaged in the comparative study of these and various other allied forms, and that he hoped shortly to be able to formulate the results at which he had arrived. —*Proc. Asiat. Soc. Bengal*, December 1875.

*The Correct Habitat of Centropagus brevicaudatus**, Brady.

By the Rev. A. E. EATON.

I misinformed Professor Brady as to the locality whence this Entomostracan was obtained. It is not a marine species, but is very abundant in freshwater lakes in Kerguelen's Island.

February 11, 1876.

* Described in 'Ann. & Mag. N. H.' ser. 4, vol. xvi. p. 162 (Sept. 1875).

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XXIV.—*Is there such a thing as Eozoon canadense?*
A Microgeological Investigation. By OTTO HAHN*.

I.

AT the time when the microscope began to find a more extended application in geology, came also the discovery of the "Dawn animal"—*Eozoon canadense*, as it has since been called. How great was the delight excited when it was supposed that at length the beginning of organic creation had been found! The Darwinian theory wanted the corner-stone; and there it was. As by a miracle, the primæval slime (*Ürschleim*) had presented itself in a mass of serpentine limestone, which appeared just as the slime itself must have appeared; the film, microscopic tubes of 0.002 millim. diameter were still there wonderfully beautiful; and, as Carpenter says:—"a precise model of the most ancient animal of which we have any knowledge, notwithstanding the extreme softness and tenuity of its substance, is presented to us with a completeness which is scarcely even approached in any later fossil."

Who could help being pleased at seeing with his own eye this firstling of creation?

In a time of general excitement and enthusiasm it is difficult to preserve mental quietude. I have, however, attempted to

* Translated by W. S. Dallas, F.L.S., from a separate impression of the Memoir in the 'Württembergische naturwissenschaftliche Jahreshefte,' 1876.

do this as I commenced a work which concerned not only naturalists but men in general. Every one must feel that investigations into the history of Creation are family affairs. Hence the existence of some anxiety was not to be wondered at; but it excites more astonishment to see how easily many throw off their clothing and spring into the stream. The nature and method of my work may show that I did not commence with preconceptions.

A very great deal has already been written on the question. The results of my investigation have, I think, finally settled it. By my investigation it is established that there is no gigantic Foraminifer in serpentine limestone.

My investigations have shown that the most essential characters of the Foraminifera, the chambers and the test, are not there, but that we have to do with pure rock-formations, such as occur everywhere in serpentine. But if these two characters are wanting, there remain only the canal-systems; and these I have also recognized in gneiss, and at the same time discovered their real significance.

The zoologists may now furnish their reply. The material that I have made use of I will with pleasure place in their hands.

In order to let the opponents of the opinion maintained by me give full expression to their views, I will allow Dr. William Carpenter himself to speak. In his work 'The Microscope and its Revelations' (London, ed. 4, 1868) he describes and discusses *Eozoon* as follows:—

II.

"§ 396. A most remarkable fossil, referable to the Foraminiferal type, has been recently discovered in strata much older than the very earliest that were previously known to contain organic remains; and the determination of its real character may be regarded as one of the most interesting results of microscopic research. This fossil, which has received the name *Eozoon canadense*, is found in beds of serpentine limestone that occur near the base of the *Laurentian Formation** of Canada, which has its parallel in Europe in the Fundamental Gneiss of Bohemia and Bavaria and in the very earliest stratified rocks of Scandinavia and Scotland. These

* "This *Laurentian Formation* was first identified as a regular series of stratified rocks, underlying the equivalents not merely of the Silurian, but also of the Upper and Lower Cambrian systems of this country, by Sir William Logan, the accomplished Director of the Geological Survey of Canada."

beds are found in many parts to contain masses of considerable size, but usually of indeterminate form, disposed after the manner of an ancient coral-reef, and consisting of alternating layers—frequently numbering more than *fifty*—of carbonate of lime and serpentine (silicate of magnesia). The regularity of this alternation, and the fact that it presents itself also between other calcareous and siliceous minerals, having led to a suspicion that it had its origin in organic structure, thin sections of well-preserved specimens were submitted to microscopic examination by Dr. Dawson of Montreal, who at once recognized its Foraminiferal nature *; the *calcareous* layers presenting the characteristic appearances of true *shell*, so disposed as to form an irregularly chambered structure, and frequently traversed by systems of ramifying canals corresponding to those of *Calcarina*; whilst the *serpentinous* or other siliceous layers were regarded by him as having been formed by the infiltration of *silicates* in solution into the cavities originally occupied by the sarcode-body of the *animal*,—a process of whose occurrence at various geological periods, and also at the present time, abundant evidence has already been adduced. Although this determination has been called in question, on the ground that some resemblance to the supposed organic structure of *Eozoon* is presented by bodies of purely mineral origin †, yet, as it has not only been accepted by all those whose knowledge of Foraminiferal structure gives weight to their judgment, but has been fully confirmed by subsequent discoveries ‡, the author feels justified in here describing *Eozoon* as he believes it to have existed when it originally extended itself as an animal growth over vast areas of the sea-bottom in the Laurentian epoch§.

“§ 397. Whilst essentially belonging to the *Nummuline* group, in virtue of the fine tubulation of the shelly layers forming the ‘proper wall’ of its chambers, *Eozoon* is related to various types of recent Foraminifera in its other characters.

* “This recognition was due, as Dr. Dawson has explicitly stated in his original memoir (‘Quarterly Journal of the Geological Society,’ vol. xxi. p. 54) to his acquaintance not merely with the author’s [Dr. Carpenter’s] previous researches on the Minute Structure of the *Foraminifera*, but with the special characters presented by *Calcarina*, as exhibited in thin sections which had been transmitted to him by the author.”

† “See the Memoir of Profs. King and Rowney, in the Quart. Journ. Geol. Soc. vol. xxii. p. 185.”

• † “See Dr. Dawson’s account of a specimen of *Eozoon* discovered in a homogeneous limestone, in Quart. Journ. Geol. Soc. vol. xxiii. p. 257.”

§ “For a fuller account of the results of the Author’s own study of *Eozoon*, and of the basis on which the above reconstruction is founded, see his Papers in Quart. Journ. Geol. Soc. vol. xxi. p. 59, and vol. xxii. p. 219, and in the ‘Intellectual Observer,’ vol. vii. (1865), p. 278.”

For in its indeterminate zoophytic mode of growth it agrees with *Polytrema*; in the incomplete separation of its chambers it has its parallel in *Carpenteria*; whilst in the high development of its intermediate skeleton and of the canal-system by which this is nourished, it finds its nearest representative in *Calcarina*. Its calcareous layers were so superposed one upon another, as to include between them a succession of 'storeys' of chambers; the chambers of each 'storey' usually opening one into another like apartments *en suite*; but being occasionally divided by complete *septa*. These *septa* are traversed by passages of communication between the chambers which they separate, resembling those which, in existing types, are occupied by *stolons* connecting together the segments of the sarcode-body. Each layer of shell consists of two finely tubulated or 'Nummuline' lamellæ, which form the boundaries of the chambers beneath and above, serving (so to speak) as the *ceiling* of the former, and as the *floor* of the latter; and of an intervening deposit of homogeneous shell-substance, which constitutes the 'intermediate skeleton.' The thickness of this interposed layer varies considerably in different parts of the same mass, being in general greatest near its base, and progressively diminishing towards its upper surface. The 'intermediate skeleton' is occasionally traversed by large passages, which seem to establish a connection between the successive layers of chambers; and it is penetrated by arborescent systems of canals, which are often distributed both so extensively and so minutely through its substance, as to leave very little of it without a branch.

“ § 398. Now in the fossilized condition in which *Eozoon* is most commonly found, not only the cavities of the chambers, but the canal-systems to their smallest ramifications, are filled up by the siliceous infiltration which has taken the place of the original sarcode-body; and thus, when a piece of this fossil is subject to the action of dilute acid, by which its calcareous portion is dissolved away, we obtain an *internal cast* of its chambers and the canal-system, which, though altogether dissimilar in *arrangement*, is essentially analogous in *character* to the 'internal casts' represented in figs. 258, 259. This cast presents us, therefore, with a *model* in hard serpentine of the soft sarcode-body which originally occupied the chambers, and extended itself into the ramifying canals of the calcareous shell; and, like that of *Polystomella*, it affords an even more satisfactory elucidation of the relations of these parts, than we could have gained from the study of the living organism. We see that each of the layers of serpentine forming the lower part of such a specimen is made

up of a number of coherent segments, which have only undergone a partial separation; these appear to have extended themselves horizontally without any definite limit; but have here and there developed new segments in a vertical direction, so as to give origin to new layers. In the spaces between these successive layers, which were originally occupied by calcareous shell, we see the 'internal casts' of the branching canal-system, which give us the exact models of the extensions of the sarcode-body that originally passed into them. But this is not all. In specimens in which the Nummuline layer constituting the 'proper wall' of the chambers was originally well preserved, and in which the decalcifying process has been carefully managed (so as not by too rapid evolution of carbonic-acid gas to disturb the arrangement of the serpentinous residuum), that layer is represented by a thin white film covering the exposed surfaces of the segments, the superficial aspect of which as well as its sectional view are shown in fig. 2. And when this layer is examined with a sufficient magnifying-power, it is found to consist of extremely minute needle-like fibres of serpentine, which sometimes stand upright, parallel, and almost in contact with each other, like the fibres of asbestos (so that the film which they form has been termed the 'asbestiform layer'), but which are frequently grouped in converging brush-like bundles, so as to be very close to each other in certain spots at the surface of the film, whilst widely separated in others. Now these fibres, which are less than 1-10,000th of an inch in diameter, are the 'internal casts' of the tubuli of the *Nummuline* layer (a precise parallel to them being presented in the 'internal cast' of a recent *Amphistegina* in the author's possession); and their arrangement presents all the varieties which have been described (§ 391) as existing in the shells of *Operculina*. Thus these delicate and beautiful siliceous fibres represent those *pseudopodial* threads of sarcode, which originally traversed the minutely tubular walls of the chambers; and a *precise model* of the most ancient animal of which we have any knowledge, notwithstanding the extreme softness and tenuity of its substance, is thus presented to us with a completeness which is scarcely even approached in any later fossil.

"§ 399. In the upper part of the 'decalcified' specimen shown in fig. 2, it is to be observed that the segments are confusedly heaped together, instead of being regularly arranged in layers, the *lamellated* mode of growth having given place to the *acervuline*. This change is by no means uncommon among Foraminifera; an irregular piling-together of the chambers being frequently met with in the later growth of

types whose earlier increase takes place upon some much more definite plan. After what fashion the *earliest* development of *Eozoon* took place we have at present no knowledge whatever; but in a *young* specimen which has been recently discovered, it is obvious that each successive 'storey' of chambers was limited by the closing-in of the shelly layer at its edges, so as to give to the entire fabric a definite form closely resembling that of a straightened *Peneroplis*. Thus it is obvious that the chief peculiarity of *Eozoon* lay in its capacity of *indefinite extension*; so that any single organism might attain a size comparable to that of a massive coral. Now this, it will be observed, is simply due to the fact that its increase by gemmation takes place *continuously*; the new segments successively budded-off remaining in connection with the original stock, instead of detaching themselves from it, as in Foraminifera generally. Thus the little *Globigerina* forms a shell of which the number of chambers never seems to increase beyond *ten*, any additional segments detaching themselves so as to form separate shells; but by the repetition of this multiplication the sea-bottom of large areas of the Atlantic Ocean at the present time has come to be covered with accumulations of *Globigerinæ*, which, if fossilized, would form beds of limestone not less massive than those which have had their origin in the growth of *Eozoon*. The difference between the two modes of increase may be compared to the difference between a plant and a tree. For in the plant the individual organism never attains any considerable size, its extension by gemmation being limited; though the aggregation of individuals produced by the detachment of its buds (as in a potato-field) may give rise to a mass of vegetation as great as that formed in the largest tree by the continuous putting forth of new buds."

III.

I commenced my investigations on three undoubtedly true Canadian Serpentine limestones:—

I. A specimen for which I am indebted to the kindness of Professor Hochstetter of Vienna. It came from Carpenter himself, and still bears his ticket. It is 95 millims. long and 50 millims. broad. It may be divided into three layers:—

1. Dolomite, 1-25 millims.; 2, pure pale-green noble serpentine (ophite), 25-35 millims.; 3, broad bands of limestone alternating with bands of serpentine 1 millim. broad, 35-55 millims.; then follows a granular formation.

From all the parts of the stone thin slices were taken. Carpenter regards layer 1 as the base.

Under the microscope layer 1 presents a whitish transparent amorphous matrix, and in this, traversing the stone in an oblique direction so that but little of the matrix is to be seen, hyaline crystals of dolomite, which, however, have their forms not sharply developed. They have innumerable yellow enclosures (picotite?). Sp. grav. 3.16, or that of dolomite. The crystals lose themselves irregularly in

Layer 2, the pure serpentinous mass. Under the microscope traversed by bands with parallel striation, which (in polarized light) immediately prove to be chrysotile. Sp. grav. 2.55. This layer is sharply discriminated from

Layer 3, the alternating layer. First a limestone band 5 milims. broad, then a serpentine band of equal breadth, and so on. Limestone and serpentine bands, but constantly becoming narrower, now alternate; they are parallel, elongated, and cut off perpendicularly at the lateral ends. The limestone bands effervesce with dilute hydrochloric acid and *dissolve rapidly and completely*. They therefore contain no silica. Sp. grav. 2.60. Distributed in the limestone, and more rarely in the serpentinous mass, there are round and six-sided hyaline crystals. These are arragonite. Here also are the canal- or branching-systems. The latter, however, are not uniformly distributed in the limestone, but only in particular granules (individuals). I have found ten canal-systems to 7 cubic centims. The mass of these systems is white by direct, and light brown by transmitted light. In many places the origin of the canal-systems from the spot where the arragonite crystals are may be distinctly recognized. They are never continued into the chambers, and, indeed, have no relation at all to these. Nay, they even thicken towards them in their stolons. Their form I take to be well-known.

What Carpenter calls the "film," is a chrysotile layer around the serpentine. This layer I have observed in nearly all ophites. The aciculæ are not tubes (even under the highest magnifying-powers they contain no filling mass), but *crystals*.

Layer 4. Now follows granular structure. The serpentinous mass is in part not even yet quite homogeneous. *We distinctly see granules with olivine-polarization and cracks, even traces of a lamination*. The passages cease both towards the sides and upwards. The arragonites are still present; but instead of the canal-systems there are only fissures round about the arragonite granules, filled with the same milk-white mass of which the canal-systems in No. 3 consist.

II. Hand-specimen in the collection of the University of Tübingen. 50 millims. long, 40 millims. broad.

1-10 millims. serpentine alternating with threads of chry-

sotile; 10–25 millims. serpentine as in I.; 25–28 millims. a broad limestone band; 29–40 millims. serpentine alternating with limestone in nearly parallel bands, as in I. Seen from the side, the bands lie in oblique lines; the stone is therefore probably composed of undulated layers.

The limestone varies from hyaline to milk-white; both colours are seen in bands side by side. The cleavages are distinctly visible. The arragonite forms small points. The remaining 10 millims. are of granular structure.

In polarized light the chrysotile at once catches the eye; but it is only necessary to make a rough section, and then the white needles project from the matrix. Under the microscope these chrysotile threads are seen almost everywhere on the edges of the serpentine, but also in the limestone at its point of contact with the serpentine, generally perpendicular to both.

III. Hand-specimen in the collection of the University of Tübingen, presented thereto by Professor von Hochstetter. 100 millims. long, 60 millims. broad. Has a round serpentine spot at one end. This circle is surrounded by alternate layers of serpentine and limestone. At the opposite side there is likewise a similar round spot. Between the two there is a paler band (also limestone), bent so that the white appears like a note of interrogation. At the end dolomite. Sp. grav. probably as in I. 3.

In this specimen there are limestone fragments in the serpentine passages. Several canal-systems may be seen even with a power of 25 diameters; in some it may be distinctly perceived that they start from the disseminated arragonite.

What is particularly remarkable in this specimen is that the limestone forms layers with canal-systems only in small surfaces; by far the greater part is granular with distinct fluidal structure, which can only be the consequence of a strong pressure. In consequence of this the layers also are broken up into spherical masses and mixed up together. In many places there are black points in the limestone; these are very probably graphite.

What follows applies to all the three specimens:—

The serpentine undoubtedly originated from olivine which got into a mass of limestone while the latter was still soft. When the decomposition took place quietly and no pressure intervened, the serpentine would at first retain the form of the olivine, but by further decomposition the soft granule would first of all become squeezed flatter in consequence of the pressure exerted by the overlying mass. If no way of escape presented itself, or if an opposing pressure occurred

from the sides, cylinders with an elliptical section would be formed, and by further pressure finally strata (layers) in the limestone mass. But if, as in specimen III., unequal pressure occurred, the layers must have been broken up and torn to pieces; but the parts would then, where they hardened, show granular structure in their section. It cannot be asserted that the intervening calcareous mass was hardened or even present before the serpentine; otherwise the fluidal structure would no longer be explicable.

The canal-systems are of very different diameter; they also differ with regard to their distribution and form. They consist of carbonate of lime. Nowhere do we see around them an envelope like shell-substance, but they rather vanish into the surrounding material.

I also investigated:—

IV. Serpentine limestone from the Bayerische Wald. The sequence is limestone, limestone with graphite, limestone with serpentine, granular as in III., serpentine, limestone with serpentine, limestone with graphite. Distinct chrysotile layers round the serpentine grains. No trace of canal-systems.

V. Serpentine limestone from Krummaw (Bohemia), from Professor von Hochstetter. 1. A similar specimen treated with acid.

The limestone is coloured grey by black enclosures. A large, much divided serpentine layer. The serpentine is enveloped by a layer of chrysotile, which appears as a fine white line. No canal-systems.

VI. Another serpentine limestone will be mentioned below.

All the serpentine limestones at command, especially from Elba and Lissiz, were examined. Much as the latter resembles II., no trace of the canal-systems could be found, but there were chrysotile shells. With regard to the latter, I refer the reader to Draschke, in Tschermak's 'Mineralogische Mittheilungen,' 1871, Heft i. p. 1.

Further, about thirty serpentines, from the pseudomorphic crystals of the Snarum to the pure sedimentary rock, and, lastly, all the primary limestones at my disposal were examined, and, finally, about twenty gneisses. *In that of Mont Blanc I recognized the canal-systems.*

IV.

I regarded it as the simplest course, with respect to the description of the *Eozoon*-rock, to allow its first investigator, if not its discoverer, to speak. Little has been added to his description of *Eozoon canadense*. Gümbel thought he detected

wart-like superficial processes. Max Schultze states that after the calcination of the rock the canal-systems were coloured black; and from this he concludes that their contents were of organic nature.

I could only repeat what is well-known, if I were to reproduce here the present position of the controversy. Zirkel has given a thorough representation of the contradictory opinions ('Die mikroskopische Beschaffenheit der Mineralien und Gesteine,' Leipzig, 1873, p. 313). As regards Max Schultze, I may refer the reader to the 'Verhandlungen des naturhistorischen Vereins der Preussischen Rheinlande und Westphalens,' Jahrg. xxx. p. 164, unfortunately an incomplete work of the celebrated naturalist.

There are consequently two opinions. One maintains the organic nature of *Eozoon*; the other disputes it. The former supports itself upon analogous facts in the animal kingdom, both extinct and living. The latter holds that it can also cite analogies in favour of the assumption of peculiar rock-formations. Few leave the question open.

I thought it best to adopt the following mode of investigation.

I started from the proposition that for every part of a rock the *presumption* is in favour of mere rock-formation. If the organic nature of a portion of the rock is affirmed, the *onus probandi* lies upon those who make the assertion, and, until full proof to the contrary, the presumption remains in force.

But in the present case we stand immediately in face of a great difficulty. What are the characters of an organic being? The same structure, and especially the same structures *together* (as is admitted by Carpenter and his allies), occur neither in extinct nor in living organic creatures; but it is rather stated that the individual parts of the *Eozoon*-structure are only to be recognized in *different* kinds of Foraminifera.

This circumstance alone makes the proof very doubtful. But to this must be added the further fact that the zoologists, and especially the best of them, are least inclined, and indeed least in a position, to know and test all existing rock-structures. The position of the geologist is therefore all the more unfavourable. His proofs are scarcely considered; and even otherwise it is difficult to get their value as proof duly estimated; whilst the zoologist is in the happy position of being able to throw into the scale the Brennus's sword of authority, especially when the microscope is in question.

The position of the two can only be equalized if it be admitted that mere analogy is incapable of furnishing the proof of the organic origin of *Eozoon*; and that, further, no part of the

supposed organism can be recognized as mere rock-structure. It is only if all the essential characters of the Foraminifer, and indeed each for itself, are no mere rock-structures, that the proof from analogy is carried at least to a high degree of probability. But if the inorganic nature of only one is proved, the chain of evidence is broken.

From all this the course of investigation becomes a matter of necessity. All existing serpentine limestones (ophicalcites), all serpentines and primary limestones by themselves, and, further, also the minerals occurring under certain circumstances in the serpentine limestone, must be investigated with respect to their nature and their relations to the serpentine limestone. But when this is done, a large field opens to the geologist. Now the question is, do the *Eozoon*-structures occur in any other rock or not, whether with all the characters together or at least some of them? Upon this it becomes his duty to examine microscopically as to this point all primary and metamorphic rocks, nay, even the rocks of the whole sedimentary series. I have followed the course indicated, and then, and not before, allowed myself to form a judgment upon the zoological facts which had been advanced. In what follows I shall undertake, first, the criticism of the geological, then of the mineralogical, and, lastly, of the zoological facts.

1. *The Geological Facts.*

The *Eozoon*-structures occur in lenticular or spheroidal nodules of serpentine limestone in the limestone of the Laurentian formation of Canada. The limestones belong to gneiss strata, the earliest sedimentary rocks. They are mere enclosures. Are they merely imbedded in the limestone, and therefore formed before it, or were they produced simultaneously with it? This question can be decided only on the spot. It is most probable that they were imbedded as ready-formed nodules; but this is not necessary. If the serpentine-mass was, as it must have been at the time of the formation of the *Eozoon*, still in a fluid state, it must also have found other cavities in the limestone, and have filled these. But we have no account of any such cavities. Hence the first supposition is the more probable.

Eozoon is said to occur not only in Canada, but also in the most various parts of the earth. Gümbel has found it in the Bayerische Wald, Hochstetter in Bohemia (Krummau), and Pusgrewski in Finland. I have examined some of the hand-specimens of the two first named and found in them no *Eozoon*-structures, or at least not all the described characters together.

In these and a great number of serpentine limestones there were everywhere the alternating layers of serpentine and limestone, but nowhere the so-called canal-systems of the Canadian *Eozoon*.

Upon *this*, however, I lay no great weight after the results subsequently obtained. Where these canal-systems do not occur, there is, as I must mention at once, no trace of probability for an organic structure.

According to a communication from King and Rowney, ophicalcites occur even in the Lias of Scotland.

From the preceding statements it follows that even with respect to the question whether *Eozoon*-structures exist, we must carefully and in the first place ascertain quite clearly what are the essential characters of *Eozoon*. If the investigator lays especial stress upon the chambers or alternating layers of serpentine and limestone, he will find *Eozoon*-structures wherever serpentine occurs. I have such specimens out of mineral deposits. I have a specimen of serpentine limestone in which the two layers appear exactly in the same form as in the Canadian specimens, but are 2 centims. instead of 1.5 millim. in thickness.

I have, in the first place, to refer to the formation of serpentine.

Serpentine is not an original, but a metamorphic rock. As is well known, there is no rock which is so certainly the result of metamorphism and can be derived from so many minerals as serpentine; Gustav Rose has shown that it may originate from augite, hornblende, pyrope, and spinel. It probably originates in the greatest masses from olivine, and, indeed, by the access of water. But everywhere it occurs in association with limestone; and so the alternate layers of the two substances cannot be in the least surprising.

I have investigated an immense number of serpentines, and always found that they are products of metamorphism. Take the Snarum pseudomorphs after olivine, in the interpretation of which Prof. Quenstedt first proved his mastership. In these, olivine grains, still undecomposed, lie in the olivine crystal, which is now serpentine. The crystalline form has persisted; the olivine has been converted by access of water into serpentine.

The basalts of the Swabian Alb (especially those of Eisenrüttel) display in every hand-specimen the distinct picture of the serpentinization of olivine. The Karfenbühl, near Dettingen, consists for the most part of such serpentine. In the Canadian serpentine limestone also olivine grains are to be detected with fragments of limestone in the serpentine. By

this, of course, the filling of the chambers would immediately be got rid of as an impossibility; but it might be objected that here the olivine grains are not quite certain, and the serpentine bands, which are vermiform in their section, cannot be so easily explained away.

But at the conclusion of my investigation I was so fortunate as to obtain two specimens of serpentine limestone which remove all doubts. Their derivation is unknown to me; but this does not affect the matter; at any rate, they are not from Canada.

These specimens show in their interior exactly the same serpentine layers as the Canadian ones, and in section exactly the same chambers; but in the middle of the chambers are the *olivine grains*, which still polarize splendidly (red and green). In the rock, where the decomposition has not advanced so far, there are still round, oval, and angular fragments, and, finally, I found the cleavage-planes with the angle of olivine.

That olivine here also is the parent of serpentine is indubitable; but at the same time it is shown how the decomposition of the olivine took place. The olivine changed from without into a gelatinous mass. This, as is well-known, happens in areas; and hence, as chrysotile-threads form at the limits of the areas, the serpentine has afterwards the appearance of chambers. The decomposition may thus be followed piece by piece, and through all stages up to the structure of the Canadian specimens. The gelatinous mass no longer polarizes; but the newly formed serpentine mass polarizes in the same fashion as all aggregated rocks; a new crystal-formation has commenced.

Thus in these two specimens the serpentine structure may be traced in accordance with the form that it took on in correspondence with the action of the decomposing water, from the imbedded and still perfectly preserved olivine crystal with distinct cleavage-planes to the (formerly fluid) serpentine mass. Conceive the olivine crystals gradually converted into a gelatinous matter. The latter must have deposited itself *uniformly* in the calcareous mass, which was also still soft, and consequently must have become round. Now the slightest vertical pressure sufficed to give the gelatinous spheres a cylindrical or lenticular form; their section will always be a line, like that of the Canadian *Eozoon*-rock. The intermediate passages also occur. Further, everywhere on the serpentine, in places at the points of contact with the limestone, there is the "film" or asbestos-layer, *i. e.* a crystallized layer with needles.

In these specimens, therefore, we have the proof that the

chambers, the passages, and the "film" of the "giant Foraminifer" originated from olivine crystals; therefore they are pure *mineral structures*.

I have observed the same things even in the Canadian rock; only in it the olivines are not so fresh as in the former. But as the serpentine mass occurs in exactly the same form as there on the outer surface of the hand-specimen, the conclusion that both were originally in the same state, is perfectly justifiable.

The calcareous layers occur in serpentine rocks which certainly contain no *Eozoon*-structure. There is nothing in favour of their owing their origin to a Foraminiferous test.

The question will now be raised, Do the *canal-systems* of the Canadian rock also exist in the two hand-specimens? No; with the exception of *one* spot in a green mass which does not polarize. It might, however, possibly be that the mass of limestone was over- or underlying, and that the canal-system occurred in the limestone. But this very spot also exhibits the clear points (disseminated arragonite), with which, according to my observations, the presence of the canal-system is always associated, even in the Canadian rock. In all the rest of the rock, in the thin sections, there is no arragonite and no canal-system.

Let us now draw the direct conclusions:—

During the separation of the arragonite from the limestone, water, or some other fluid containing lime, remained behind. By existing pressure this penetrated into the soft limestone mass in exactly the same way that every fluid penetrates into another, denser one, in ramifications.

This may be regarded as hypothesis, although the explanation is not far-fetched. It may be objected that this process must also occur elsewhere.

But I have further been able to demonstrate these canal-systems in the gneiss of Mont Blanc and the Schwarzwald—nay, even in the syenite of the Plauenscher Grunde (Saxony) and in the syenite of the Schwarzwald. I have observed them in about *thirty thin sections of these under crossed Nicols*. It is only thus that they make their appearance in the transparent felspar and limestone, but then as beautifully as in the Canadian specimens.

Thus from this side also, by the demonstration of a perfectly similar phenomenon in other rock, we obtain an explanation of the canal-systems.

And thus the last character of the "giant Foraminifer" is got rid of—a character, however, which could not alone furnish the proof of the organic nature of the *Eozoon*-structures.

With this I might conclude my work. But as I do not wish to fall short even in the smallest degree with respect to the evidence in contradiction and its foundation, I pass on to

2. *The Mineralogical Facts.*

In the formation of the Canadian *Eozoon*-serpentines only three minerals seem at the first glance to take part—dolomite, serpentine, and limestone.

On closer investigation, however, other minerals occurred:—

No. II. has superiorly a *chrysotile band*, 7 millims. in breadth, which is frequently repeated in the serpentine. Whenever I ground the surface of the plate rather rough, a thread of silvery lustre appeared everywhere around the serpentine bands; and this was not merely asbestos-like, but actually asbestos, *namely chrysotile*.

Besides chrysotile, *arragonite* occurs in disseminated clear grains, and even in six-sided prisms.

The arragonite is surrounded by the same mass that forms the canal-systems; this is white by direct, brown by transmitted light. When treated with acid, *it dissolves at the same time with the limestone*. If the canal-systems were connected with the chambers and, as Carpenter thinks, injected with serpentine-mass from the latter, *they would not dissolve at all in acid*; they must be serpentine and show the colour and polarization of serpentine. Where there are serpentine grains, the same white mass passes into the fissures surrounding the serpentine grain. It is only in the alternating layers that the canal-systems are in the limestone; and frequently their origin on the disseminated arragonite grains may be distinctly detected.

Hence we get the following as to the formation of the stone:—

The serpentine grains were originally olivine. During their decomposition they swelled up, and in consequence burst up the surrounding limestone, when the fluid *white* calcareous mass entered into the fissure. But where the limestone mass was still soft when the serpentine mass swelled up in it, either the extending serpentine mass itself pressed the white calcareous fluid into the limestone, when the canal-systems were formed, or a pressure was produced upon the whole mass, and then the same effect occurred, only the immediate cause was different.

It was undoubtedly either a pressure from within, caused by the decomposing olivine grains, or one from without upon the whole mass, that produced the canal-systems. This is proved even by their form. In the first place, they are quite irregular

in their arrangement. Where they are arranged somewhat in a spiral line, this is to be ascribed to the circumstance that the calcareous layer itself, from which they originated, had already a circular or spiral arrangement produced by pressure, as is shown in specimen III. This, however, is accidental. Usually they are irregular in arrangement, position, and form. I have observed such a canal under a power of 750 diameters. No trace of calcareous envelope, or of tubular form; the picture is rather that of a fissure; the canal is quite irregular, thicker or thinner, and in a zigzag direction.

In conclusion I have a remark to make with regard to the limestone. This consists, like all primary limestones, of separate individuals, distinctly separated from each other by their lamination and a line, and in polarized light fully show themselves to be individuals by their different position. Many individuals have the *twin cleavage-planes produced by pressure*. I have here to refer to the discovery of Prof. von Reusch, who produced the cleavage-planes by concussion. This phenomenon of itself indicates powerful pressure undergone by the mass *after its solidification*. Curiously enough there are no canal-systems in the limestone individuals with twin lamellæ. *Moreover a canal-system generally does not extend beyond one limestone individual*. This is easily explained. The fluid could penetrate only into a still soft individual; it must therefore have found a limit at the next somewhat more hardened one. It must not be overlooked that the canals, when they strike upon the serpentine mass or on neighbouring individuals, become thicker, and terminate with a kind of knob, the most certain evidence of a mass pushing from behind and here coming to a stop.

The canal-systems occur only where the serpentine mass is elongated, transparent, and yellowish; therefore only where the whole mass was visibly completely metamorphosed, softened, in fact, into a pasty fluid, and pressed while still in this state; for only thus could the original olivine-forms be converted into serpentine layers. Thus also are explained the vertical lines in which the serpentine layers laterally strike against a narrow limestone layer.

Thus, then, there does not remain much to be said about

3. *The Zoological Facts.*

If we glance back over the previous results we have, for every part of the *Eozoon* (the chambers, the walls with columns, the film, the intermediate mass with large passages, as well as the canal-systems), not only an adequate geologico-mineralogical explanation, but also the same phenomena in rocks in which no one will speak of *Eozoon*-structure, unless,

indeed, the canal-systems in gneiss must of themselves alone be explained as of organic origin. I admit that I was for a moment doubtful whether analogy for these structures in gneiss might not be found in the sponges. I had, however, to renounce this charming idea when I found that the canal-systems consisted of quartz which traversed the felspar. Here I would recommend the further examination of this hitherto unobserved phenomenon; I believe that it throws a new light upon the formation of gneiss.

It certainly does not conduce to exactness of inference if, for the organic creature that is supposed to have been discovered, we can find no complete analogue, and, for its separate parts, again at least no exactly similar part in another creature. *Polytrema* is regular. With the *Acervulinae*, with which Max Schultze arranges *Eozoon*, it has nothing in common except irregularity—in such matters a resemblance of very doubtful value. The *Calcarinae* have quite regularly arranged canal-systems. The circumstance that our zoologists are accustomed to preparations very different from rocks, and that they have a preconceived notion that any symmetrical structure cannot be inorganic, contributed not a little to the confusion. I need only refer to the microscopic picture of the pitchstone of Arran. But no rock is more deceptive in this respect than serpentine. This greenish yellow transparent mass, with its peculiar trembling lustre (caused by hyaline crystals) looks so deceptively like sarcode, that it must not be taken amiss of a zoologist if he is unable to tear himself free from the ideas that press upon him at the first glance. If now, unfortunately, the worm-like form is superadded, if the sarcode mass is further clothed with an asbestos layer, and, lastly, we see further “dentine-” and canal- or branch-systems, then it is too much. Can it surprise us if another finds verrucose processes? And yet nothing but illusion. Only a small amount of quiet observation would at once have led back to the truth. The observer must in fact have been puzzled at once by the single fact that the canal-systems do not consist of serpentine mass; and this a glance into the microscope with polarized light would immediately have shown. The canal-systems always penetrate the chamber-walls of the *Operculinae*. Here there is no trace of this, but rather a completely different filling mass in the two. Nay a single olivine grain or calcareous fragment in a chamber of *Eozoon* must fairly raise the question, How can an olivine grain get into the chamber of a Foraminifer? On more careful observation, moreover, chambers existing quite alone (*i. e.* grains) would have been found. The chrysotile shell also is not regularly present; where

present it cannot be mistaken by the geologist. But even as to this shell the zoologists underwent a *deceptio visus*.

The serpentine mass is always round. If a chamber be cut in any way except equatorially, the limestone mass of course projects over the serpentine mass, and the one shines through the other; the inner angle of section now projects itself as a line upon the surface of section; and thus is produced the appearance of a shell, especially if asbestos needles are seated upon the margin of the limestone, and partially project beyond it. We may easily convince ourselves of the illusion at situations of the serpentine mass, as also in purely equatorial sections.

Chrysotile layers are to be found in every serpentine. The weathering of serpentine takes place in divisions; and hence the delusive walls.

How, it must further be asked, should a canal-system make a dead stop before a crystalline individual? If the calcareous shell were originally there, the canal-systems must have traversed it in accordance with the law of organic structure. If crystal-formation, or any other condition which destroyed the canal-systems, afterwards occurred, this altered nothing *in the original arrangement of the canal-systems*; they could at the utmost disappear here and there, and, indeed, in separate crystalline individuals, but must have been continued in the next individual. *But there is nothing of this kind.* The separate systems are rather completely limited in crystalline individuals, from which it follows that the crystalline mass, nay, the limestone, was in existence before the canal-system. These crystalline individuals are only commencements of crystal-formation. And finally we must ask why are there never canal-systems in twin crystals? For the simple reason that these had become hard, while the other parts were still soft.

As a last thing I will notice how improbable was the preservation of the structures in the rock which bears in it such distinct traces of having suffered violence.

I fancy from these statements of fact that the *Eozoon*, after a brief but brilliant existence, is buried. It was indeed a "dawn animal."

In conclusion, I offer my honoured teacher Prof. von Quenstedt, of Tübingen, and Dr. von Hochstetter, of Vienna, my best thanks for the liberality with which they have furnished me with material for my investigation. Nor can I omit to commend the admirable thin rock-sections of Mr. R. Fues, of Berlin.

My investigations were made with an excellent new Hartnack's instrument (VII. A), and with an English one by Baker, of London.

XXV.—On some Recent and Fossil Foraminifera dredged up in the English Channel. By Prof. T. RUPERT JONES, F.R.S., F.G.S., &c., and W. K. PARKER, F.R.S., F.L.S.

I. IN 1857, Dr. S. P. Woodward favoured us with a sample of sea-sand dredged by Mr. M'Andrew and himself from 60 fathoms, 40 miles south of the Scilly Islands. He also gave us a sorting of fossil Nummulites taken from that sand. These are mineralized with carbonate of lime, and are small—the largest not three eighths of an inch in diameter. They are dense, and mostly smooth and even polished, in some cases much worn; and one has a small recent *Spirorbis* attached.

These fossils are:—

Nummulina Ramondi, *Defr.*
— Rouaulti, *D'Arch. & Haime.*

The recent Foraminifera from the same sand we found to be:—

Miliola (Quinqueloculina) seminulum (<i>Lin.</i>). Young.	Polymorphina myristiformis, <i>Williamson.</i>
— — Ferussacii, <i>D'Orb.</i>	— costata, <i>Egger.</i>
Young.	Uvigerina angulosa, <i>Will.</i>
— (Spiroloculina) planulata, <i>Lam.</i>	Cassidulina oblonga, <i>Reuss.</i>
Trochammina squamata, <i>P. & J.</i>	Textularia aciculata, <i>D'Orb.</i> Mostly aculeate on the edges.
Lituola globigeriniformis, <i>P. & J.</i>	— sagittula, <i>Defr.</i> Common.
Lagena sulcata, <i>W. & J.</i>	— agglutinans, <i>D'Orb.</i> Large.
— squamosa, <i>Montagu.</i>	Spirillina vivipara (<i>Ehr.</i>).
— marginata, <i>Mont.</i>	Patellina corrugata, <i>Will.</i>
Nodosaria obliquestriata (both Dentaline and Marginuline), <i>Reuss.</i>	Pulvinulina auricula (<i>F. & M.</i>) Large.
Vaginulina legumen (<i>Lin.</i>). Smooth.	— pulchella (<i>D'Orb.</i>).
Dentalina communis, <i>D'Orb.</i>	Discorbina globularis (<i>D'Orb.</i>) Common.
Marginulina raphanus (<i>Lin.</i>) Short.	— rosacea (<i>D'Orb.</i>) Feeble and more conical than usual; together with intermediate forms.
Cristellaria cymba, <i>D'Orb.</i>	Rotalia Beccarii (<i>Lin.</i>).
— rotulata (<i>Lam.</i>).	Nonionina striato-punctata (<i>F. & M.</i>)
Polymorphina lactea (<i>W. & J.</i>).	
— horrida, <i>Reuss.</i>	
— compressa, <i>D'Orb.</i>	

From the stomach of a *Dentalium* dredged up, at the same time, off Vigo:—

Nonionina umbilicatula (*Montagu*), varying towards *N. scapha* (*F. & M.*).
Small Bivalves, whitened in blotches and along sinuous lines.

II. At the same time we received also from Dr. S. P. Woodward a sample of sand dredged by Mr. M'Andrew and

himself at 70 fathoms, 50 miles S.W. of Ushant. It contained the following recent Foraminifera :—

Miliola (*Biloculina*) *bulloides*,
D'Orb.

— (—) *depressa*, *D'Orb.*

— (*Triloculina*) *reticulata*, *D'Orb.*

— (*Quinqueloculina*) *pulchella*,
D'Orb.

— (—) *Ferussacii*, *D'Orb.*

— (*Spiroloculina*) *planulata*,
(*Lam.*).

Lituola canariensis (*D'Orb.*).

Lagena marginata, *Montagu.*

— *squamosa*, *Mont.*

Dentalina communis, *D'Orb.*

Nodosaria obliquistriata (both *Dentalina* and *Marginulina*), *Reuss.*

Vaginulina legumen (*Linn.*).

Smooth.

Cristellaria crepidula (*F. & M.*).

Rather thick.

— *cultrata* (*De Montf.*).

Polymorphina lactea (*W. & J.*).

— *horrida*, *Reuss.*

— *oblonga*, *Williamson.*

Uvigerina angulosa, *Will.*

Cassidulina oblonga, *Reuss.*

— *laevigata*, *D'Orb.*

Textularia aciculata, *D'Orb.* Mostly
aculeate on the edges.

— *agglutinans*, *D'Orb.*

— *sagittula*, *DeFr.* Common.

Orbulina universa, *D'Orb.*

Globigerina bulloides, *D'Orb.*

Spirillina vivipara (*Ehr.*) = *perforata*,
Schultze.

Planorbulina faretta (*F. & M.*)
Young.

— *tuberosa* (*F. & M.*).

— (*Truncatulina*) *lobatula* (*W. & J.*). Large.

Pulvinulina auricula (*F. & M.*).

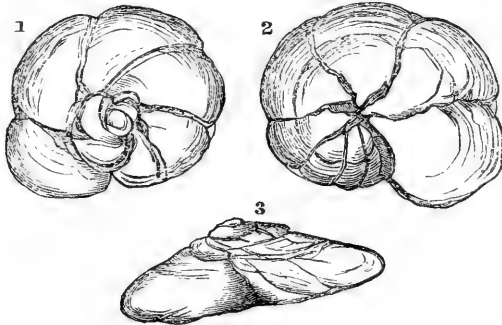
— *repanda* (*F. & M.*).

— *pulchella* (*D'Orb.*).

— *sacculata*, *P. & J.*, nov. spec.

Discorbina globularis (*D'Orb.*)
Common.

The *Pulvinulina sacculata* above named (figs. 1–3) is a well marked form already figured by Soldani, 'Testaceographia' &c. 1789, vol. i. p. 56, pl. 37. fig. B (*Vas 162*). It has a finely tubuliferous and clear shell, subconical, many-chambered, smooth and neatly limbate above on the low spire



Pulvinulina sacculata, *P. & J.*

1. Upper or spiral surface. 2. Lower or umbilical face. 3. Edge.

(fig. 1), and characterized below by about five bladder-like supernumerary umbilical chamberlets, the last showing the relatively large mouth, and all of them defined around by the more solid marginal portion of the shell (fig. 2).

III. In 1859, Prof. D. T. Ansted gave us a sample of the "large deposit, chiefly of Foraminifers in a mud, in deepish water, and rather widely spread," off the coast of Guernsey*, and probably the same as that alluded to by J. Gwyn Jeffreys, Esq., in the 'Report of the British Association for 1865,' Transactions of Sections, p. 183, as a bed with both recent and fossil shells, at from 12 to 20 fathoms, among the Channel Islands. Mr. J. Gwyn Jeffreys also kindly submitted some of this sea-bed to our examination.

Prof. Ansted's sample contained numerous fossilized Nummulites and other Foraminifera. The latter are all dense by mineralization; and most of the Nummulites also are mineralized by carbonate of lime (though not always solid), and are much worn, or, at least, smoothed and even polished. The list is as follows:—

Nummulina Prestwichiana, Jones.		one specimen of a still thicker
— Ramondi, Defr.		Truncatulina.
— Rouaulti, D'Arch. & Haime.		Alveolina Boscii (Defr.). Two
Discorbina trochidiformis, Lam.		specimens.
Planorbulina (Truncatulina) farceta, var. Dutemplei (D'Orb.). And		

In his Notice of the occurrence of certain Fossil Shells in the Sea-bed adjoining the Channel Isles, 1865, it is stated:—"In the course of his dredging-explorations this year among the Channel Isles, Mr. J. Gwyn Jeffreys found shells of species some of which are extinct, and one is not known to inhabit at the present the North Atlantic. They were taken with living Mollusca at depths varying from 12 to 20 fathoms, and in different parts of the sea-bed. The specimens in question had the same appearance as dead shells of recent species; one of them was in a most perfect state of preservation, and evidently had not been rolled or transported to any distance from its original place of habitation. They consisted of *Potamides tricarinatus*, Lam., and *P. cinctus*, Lam. (both Eocene fossils), a species of *Terebratula* (or *Terebratulina*) which Mr. Davidson referred with doubt to *T. squamulosa* of Baudouin (from the Calcaire grossier), and *Discorbina trochidiformis* of Lamarck is also an Eocene fossil, but larger than specimens from the Bracklesham beds. No Tertiary deposit

* In 'The Channel Islands' by D. T. Ansted and R. G. Latham (8vo, London, 1862), at p. 295, it is stated that Dr. Lukis dredged some specimens off the south-eastern extremity of Guernsey, and these are referred to as having been probably drifted from the coast of France. "As there must be a strong and deep current [says Prof. Ansted, in a letter] setting every tide up-Channel and rounding the island of Guernsey, it is not at all unlikely that they may have come from the water off Ushant."

has been noticed in any part of the Channel Isles; but the discovery of the above-mentioned fossils in the adjoining seabed, occupying an intermediate position, would seem to connect this district with Hampshire and Normandy, and to show the great extent of the Eocene basin or area which formerly existed. Another species obtained by the same dredgings, near Jersey, was *Cerithium vulgatum*, Bruguière." As this estuarine species still exists in the Mediterranean region, Mr. Jeffreys thinks that it may have lived in the Jersey area before the coasts were so much submerged as they are now.

IV. It would be of much interest to know the real place of origin of the fossil *Nummulinae* above mentioned. They are of Eocene age; but whether washed about at or near any existing patches of Tertiary beds, or drifted some way from their original place of deposit, is not clear. The *Discorbinae*, *Planorbulinae*, and *Alveolinae* are solid and very much rolled. Some of the more solid *Nummulinae* (chiefly *N. Rouaulti*) are also much worn.

Neither *N. Ramondi* nor *N. Rouaulti* belong to the Tertiaries of N.W. Europe. They occur in the Pyrenean and Gascon region, though *N. Rouaulti* is known to reach as far north as Dax, near Bordeaux, if not, indeed, as far as the Soissonais. The other fossils, however, of the Dredgings under notice, except *Nummulina Prestwichiana*, are found plentifully in the Paris Basin and the Tertiaries of Normandy; and they abound, together with *N. Prestwichiana*, in the "Bracklesham beds" of Hampshire and the Isle of Wight. This last form was described in the 'Quart. Journ. Geol. Soc. Lond.' vol. xviii. pp. 93 & 94, as *N. planulata*, var. *Prestwichiana*, and possibly may be essentially the same as *N. planulata*, var. *a. minor*, D'A. & H., which occurs at Jette, in Belgium.

Since we look upon *N. Ramondi* also as a variety (thick) of *N. planulata*, and as, according to our view of the nature of Nummulites*, *N. Rouaulti* is not far removed from the same subtype, the association of the three *Nummulinae* above mentioned is not strange in a natural-history point of view, although they have not yet been met with elsewhere in company with each other and with the other fossil Foraminifera enumerated above.

Fossil Nummulites (*N. levigata*?) have been dredged up in the English Channel by Mr. Godwin-Austen†, and by M. Ernest Vanden Broeck‡ on the coast of France and Belgium;

* Ann. & Mag. Nat. Hist. ser. 3, vol. v. p. 106 &c., and vol. viii. p. 230 &c.

† *In literis.*

‡ *In literis.*

the latter has also found Nummulites (including probably *N. Ramondi*) in the sea-sand off Gascony. Indeed our friend M. E. Vanden Broeck suggests the question, Can the Gulf-stream have had force enough to drift the fossil Nummulites from the Bay of Gascony to the English Channel?*

So many of the aforesaid fossil Foraminifera, dredged up in the Channel, being near their well-known formations in England and France, and one of the *Nummulinæ* (*N. Prestwichiana*) occurring in Hampshire, if not also in Belgium, we need not look for a distant origin for them; and their strata may be, or may lately have been, in place between France and England. Further, though several of the specimens of *N. Ramondi* and *N. Rouaulti* are greatly worn, many show no sign of having travelled very far, and those that have been worn down have not suffered more than the *Discorbinae* and others.

At all events, the facts are suggestive of further research.

PS. In a letter dated March 7, 1876, Prof. Ansted favours us with his opinion that "it is not impossible or very unlikely that Foraminifera should be drifted from the Bay of Biscay to the Channel Islands. Whatever lives in the southern part of the former sea may be drifted westward by the return storm-waves, reflected from the French coast (and making the notoriously bad and broken seas met with in crossing the Bay) much westward of the line up which comes a drift from the south, caused by the return or back current of the Gulf-stream, when it gets well to the south. Any thing like Foraminifera would then be caught by the tide-wave and carried up-channel."

XXVI.—Notes on some *Heteromerous Coleoptera* belonging to the true *Tenebrionidæ*. By CHARLES O. WATERHOUSE.

HAVING recently had occasion to refer to one of Motschulsky's papers on *Tenebrionidæ* published since his death in the 'Bulletin de Moscou' (1873, p. 23), I have thought that a few remarks on it might be useful. At the same time, I must emphatically protest against the publication of this author's papers, which, it is clear from internal evidence, were written

* M. E. Vanden Broeck remarks that M. A. Lafont, in his paper on the Fauna of the Arcachon Basin, says that *Spirula Peronii* is sometimes found on the coast, evidently brought by the currents from the south ('Actes Soc. Linn. Bordeaux, ser. 3, vol. vi. 1868).

many years ago, are now not a credit to him, and are a great impediment to science.

The first genus referred to in the table of genera is "*Mylaris*, Pallas," "Type *Upis maxima*, Erm." This is evidently intended for *Mylaris* (a genus not characterized by Pallas, and only proposed for *gigas*, Linn.); the species is *maxima*, Germ., a close ally of *gigas*, L., Fabr.

2. *Deriles*, Mots., for *Upis excavatus*, Hbst., Brazil, an undescribed species. With this are associated and imperfectly described, *collaris* (Murray, MS.), *guineensis* (Westermann, MS.), and *hypocrita* (Dej. MS.), which appear to be close allies of *Amenophis*, Thomson, 1858. A species "*hypocrita*, Dej.," was described in 1842 by Prof. Westwood; but I think it is different from the one described by Motschulsky, and is a *Taraxides* (see below).

3. *Mederis*, Mots., for *Upis angulata*, Er., = *Promethis*, Pascoe, 1869, for the same insect.

4. *Asiris*, Mots., *angulicollis*, Mots. This is certainly *Meneristes*, Pascoe, 1869. I cannot say to which species *angulicollis* is to be referred.

5. *Nyctobates*, Guér.-M., for *sinuatus*, Fabr., and allies. Guérin-Ménéville says distinctly that the type of his genus is *gigas*, Fabr. (See above, *Mylaris*.) The name *Nyctobates* cannot, therefore, be applied to *sinuatus*; and I propose the name *Taraxides*.

6. *Alobates*, Mots., for *Nyct. pennsylvanica*, De G.

7. *Tænobates*, Mots., for *N. saperdoides*, Oliv., = *Xylopinus*, Le C. 1866, for the same insect.

8. *Menechides*, Mots., for *N. calcaratus*, F., = *Centronopus*, Sol. 1848, for the same insect.

9. *Lobetas*, Mots., for *Zophobas costatus*, Guérin, = *Hipalmus*, Bates, 1870, for the same insect.

10. *Pediris*, Mots., *longipes*, Mots. This I think must be *Nyctobates sulcigera*, Boisd. The only difficulty in the reconciliation of the two is in the fact that *Pediris* is placed in the section in which the mesosternum is excavated, a character not existing in *sulcigera*; but as *Iphthimus* is placed in the same section, and also wants this excavated mesosternum, perhaps it is altogether a mistake.

11. *Setenis*, Mots., for *N. valgus*, Wiedem. Two of the new species described in this genus are compared to "*Set. unicolor*, Hbst.," which is, I believe, an undescribed species; another, "*impressa*, Mots.," appears to be *impressa*, Fab.

12. *Rhophobas*, Mots., will stand as a good genus.

13. *Notiolesthus*, Mots., type *natalensis*, Mots., but including *Upis rotundicollis* (Esch.), Casteln. 1840 (Philippine Islands).

Notiolesthus morosus, Mots. 1873, is evidently *Nyct. rotundicollis*, Westw. 1842; and *morosus* will have to stand, on account of the earlier *rotundicollis*.

14. *Nuptis* and *Augolesthus* are at present unknown to me.

Above I have proposed the generic name *Taraxides* for *Nyct. sinuatus*, &c. This genus, with *Deriles* and *Amenophis*, is remarkable for the deeply excavated mesosternum, the sides of the excavation being angular in front.

The three may be distinguished as follows:—

- A. Four posterior tibiæ channelled nearly the whole length of their outer edge.
- a. Antennæ with the joints slightly serrate from the fifth joint *Deriles*.
- b. Antennæ with the joints broader and strongly serrate from the fourth joint *Amenophis*.
- B. Four posterior tibiæ cylindrical, not channelled .. *Taraxides*, n. g.

From a note just received from Prof. Westwood respecting some species of *Nyctobates* described by him, it is clear that *N. hypocrita*, *mærens*, and *punctatus* must be placed with *Taraxides*, and *N. lugens*, Mots., will sink as a synonym of *mærens*, W. *N. transversalis*, Westw., will belong to *Deriles*. *N. brevicornis*, W., remains unknown to me: it "has the hind tibiæ cylindrical, except at one third of distal end, which has a slight impression gradually widening to the tip; mesosternum with the hind half convex, but with a groove on each side; metasternum with a central impression, scarcely distinct in front, but deeper in its hind part." It is evidently a *Setenis*.

XXVII.—*Description of a new Species of Chalinolobus from Australia.* By G. E. DOBSON, M.A., M.B., F.L.S., &c.

Chalinolobus signifer, sp. n.

Ears and nostrils as in *Chalinolobus tuberculatus*; but behind the nostrils on the face, between and slightly in front of the eyes, an erect transverse process (like the transverse nose-leaf in *Phyllorhina*, but smaller and not concave in front) is placed. This process commences on each side at a short distance from the eye; and its free upper margin is regularly convex.

Wings from the base of the toes; tail wholly contained within the interfemoral membrane; postcalcaneal lobe well

developed, nearly as large as, and similar to, that in *C. tuberculatus*.

Upper inner incisors long and slender, with a second, very small, external cusp; upper outer incisor, on each side, very small, scarcely as long as the cingulum of the inner incisor. Second upper premolar close to the canine; the first small premolar in the angle between the canine and the second premolar, and visible only with aid of a lens. Lower incisors very small, trifold, not crowded. First lower premolar scarcely equal to half the second premolar in vertical extent.

Length (of an adult male preserved in alcohol), head and body 1.95 inch, tail 1.75, head 0.55, ear 0.4, tragus 0.18, forearm 1.4, thumb 0.25, second finger 2.5, fourth finger 1.9, tibia 0.6, foot and claws 0.3.

Hab. Queensland. Type in the collection of the British Museum.

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

[Continued from p. 128.]

[Plates XII., XIV., XV., XVI., & XVII.]

Genus LITHOSTROTION.

Lithostrotion, Lhwyd, Lithophyl. Britann. Ichnographia, epist. 5, tab. xxiii. 1699.

Gen. char. Corallum compound, fasciculate or astræiform. Corallites surrounded by a complete epitheca; an imperfect or ill-defined accessory wall is usually present. Septa well developed, the primary septa extending from the outer wall nearly to (or sometimes quite to) the columella. A compact, styliform, laterally compressed columella is present. Central area of each corallite formed by irregular, generally somewhat elevated tabulæ. Between the central tabulate area and the wall the interseptal loculi are filled with dissepiments, producing in longitudinal sections a series of small lenticular cells arranged in layers which are directed upwards and outwards.

The corallum in *Lithostrotion* is never simple. Sometimes it is fasciculate, and is composed of more or less cylindrical flexuous corallites; at other times the corallum is astræiform,

and is composed of amalgamated and polygonal corallites ; in some cases (as, for example, in *L. canadense*, Castelnau) the corallum is partly fasciculate and partly astræiform, or different specimens may be wholly the one or the other. In any case, the general form of the corallum does not appear to be a sufficient ground for generic distinction, though the fasciculate forms have repeatedly been placed in one genus and the astræiform in another.

The increase of the corallum is effected in the typical species of *Lithostrotion* by calicular gemmation, involving only a portion of the original calice, and allowing the old corallite to go on growing side by side with the new one. Lateral budding is also not uncommon, the new corallites produced in this way assuming a direction parallel to that of their parents, and growing up side by side with them. The genus *Stylaxis* was founded by Prof. M'Coy for species of *Lithostrotion* which were supposed to increase by fission of the old tubes. The appearance of fissiparous development in these cases seems, however, to be really due to the fact that the young corallites produced by calicular gemmation do not hinder the continued growth of the old corallites, but grow up alongside of them, the two quickly becoming united by their walls ; and even if fission were proved to occur occasionally, it would hardly afford of itself sufficient ground for generic distinction.

The epitheca is well developed and complete, marked with circular striæ and shallow annulations of growth. Sometimes the corallites of the fasciculate species inosculate with one another. If *L. Stokesi*, E. & H., be rightly referred to this genus, the corallites are in this species united by outward expansions of the epitheca ; whilst in *L. harmodites*, E. & H., they are united together by horizontal connecting processes, as in *Syringopora*. There are, however, some doubts as to the true affinities of these forms.

The septa extend from the inner surface of the wall to varying distances from the columella. A few of the primary septa sometimes actually reach the columella ; but most of them, together with all the secondary septa, fall short of it. The sides of the septa are plain and not denticulate ; and in the majority of cases the primary septa extend so far inwards as not to leave any conspicuous space in the centre of the visceral chamber occupied solely by the tabulæ. An inconspicuous septal fossula is sometimes present, as in *L. affine*, Flem. ; and the somewhat aberrant *L. canadense*, Castelnau, is said to possess several small fossettes.

The columella is always present in each corallite, and has the form of a flattened, laterally compressed, compact rod, which

extends without interruption from the bottom of the visceral chamber to the floor of the calice. When cut across in longitudinal sections, the columella presents itself as a thin solid rod occupying the centre of the visceral chamber (Pl. XV. fig. 1 A).

Immediately exterior to the columella is a larger or smaller tabulate area, the tabulæ being often more or less bifurcated and irregular, whilst they are usually directed more or less upwards and inwards (Pl. XV. fig. 1 A). As already stated, the primary septa are continued through this tabulate area nearly to the centre of the corallites, so that the tabulæ are not exposed to view over a central space, as they are in *Diphyphyllum*.

The external area of each corallite is formed by vesicular tissue, constituted by delicate dissepiments, which intersect the interseptal loculi. These dissepiments do not interfere with the continuity of the septa as seen in cross sections (Pl. XIV. fig. 1); but as seen in longitudinal sections they form a series of minute lenticular cells, which are directed upwards and outwards (Pl. XV. fig. 1 A).

In general there does not seem to be any well-defined or perfectly developed accessory wall (in the sense that this structure exists in genera such as *Acervularia*, *Smithia*, *Chonaxis*, *Lonsdaleia*, *Endophyllum*, &c.). There is, however, often the appearance of an inner mural investment, due to the contrasted structure of the outer vesicular zone and the inner tabulate area at their point of junction.

The type species of the genus *Lithostrotion* is *L. basaltiforme*, Fleming (Pl. XIV. fig. 1). Amongst other forms, however, which exhibit all the essential characteristics of the genus, we may mention *L. aranea*, M'Coy, *L. Portlocki*, Bronn, *L. junceum*, Flem.*, *L. fasciculatum*, Flem. (= *L. Martini*, E. & H.), *L. irregulare*, Phill., *L. affine*, Flem., *L. Phillipsi*, E. & H., and *L. arachnoideum*, M'Coy.

The genus *Lithostrotion* is such a comprehensive one, and the vicissitudes which it has undergone are so various, that we have thought it advisable to give here a brief summary of the more important facts in its history, which it may concern the palæontologist to be possessed of. The name of *Lithostrotion* was originally given by Edward Lhwyd to a coral from the Carboniferous Limestone, which appears to be

* We do not feel certain that *Lithostrotion junceum*, Flem., can be retained in the genus *Lithostrotion*. In many respects it presents structural characters very different from those of *Lithostrotion* in its typical form; and it shows curious affinities with the genus *Heterophyllia*. We have this point, however, at present under consideration, and we shall give the results of our investigation at a later period.

the species now known as *L. basaltiforme*, and which must now stand therefore as the type of the genus (*Lithophyl.* *Britann. Ichnograph.*, 1699).

In 1826, Goldfuss described and figured under the name of *Columnaria laevis* a fossil coral which would appear to be a *Lithostrotion* (*Petref. Germ. tab. xxiv. fig. 8*).

In 1828, Fleming employed Lhwyd's name of *Lithostrotion* for four corals—of which one is *L. basaltiforme*, another is a *Lithostrotion* but specifically undeterminable, whilst the remaining two are respectively a *Lonsdaleia* and an *Isastræa* (*Brit. Anim. p. 508*).

In 1832, Lesueur seems to have given the name of *Stylina* to a fossil coral subsequently described by Dale Owen (*Geol. Survey of Wisconsin &c., pl. iv. figs. 5 & 6*), from the Carboniferous Limestone of Iowa, under the name of *Lithostrotion basaltiforme*. The species appears to be *L. canadense*, Castelnau.

In 1836, Prof. Phillips described several species of *Lithostrotion* from the Carboniferous Limestone of Yorkshire (*Geol. Yorkshire, vol. ii. pl. ii.*). *L. basaltiforme* appears under the name of *Cyathophyllum basaltiforme*; but the other species are referred to *Lithodendron*. In this latter reference, however, Prof. Phillips departed entirely from the characters of the genus *Lithodendron* as originally defined by Schweigger (*Beobachtungen, Syst. tab. vi.*); and though subsequently followed by Lonsdale, his course in this respect cannot be sustained.

In 1843, Castelnau gave the name of *Axinura* to the fasciculate corals placed by Phillips in *Lithodendron* (*Terr. Silur. de l'Amér. du Nord*); and in 1845 Mr. Lonsdale expanded and redefined *Lithodendron* to include the same species of *Lithostrotion* (*Murch., Vern. & Keys. 'Russia and Ural,' Appendix A, p. 597*). In the same work Mr. Lonsdale proposed to divert the name of *Lithostrotion* from the fossil originally figured by Lhwyd under this title, and to apply it to the corals now known as *Lonsdaleia*. He also founded the new genus *Stylastræa* for fossils which he believed to be identical with Lhwyd's coral; and he created the genus *Diphyphyllum* for some corals of an internal structure nearly the same as that of *Stylastræa*, but of a fasciculate form.

In 1846, Prof. Dana proposed to apply the name of *Columnaria*, Goldfuss, to the corals now known as *Lithostrotion* (*Expl. Exp., Zooph. p. 363*).

In 1849, Prof. M'Coy published a valuable paper on Carboniferous corals (*Ann. & Mag. Nat. Hist. 2nd series, vol. iii.*), in which he dealt with various corals now usually referred to *Lithostrotion* in the following manner:—(1) He did not accept the genus *Lithostrotion* at all; and he referred the *Lithostro-*

tion of Lonsdale (= *Lonsdaleia*) to the genus *Strombodes*, Schweigger. (2) He accepted the genera *Stylastræa* and *Diphyphyllum* of Lonsdale. (3) He founded the genus *Nematophyllum* (subsequently changing its name to *Nematophyllum*) for a group of corals of which *N. arachnoideum* is the type, and which are clearly astræiform species of *Lithostrotion*. (4) He proposed the name of *Stylaxis* for corals which are stated to differ from the preceding by their supposed fissiparous development, and which are also clearly referable to *Lithostrotion* as now understood. (5) He proposed the name of *Siphonodendron* for the corals referred by Phillips to *Lithodendron*, which are now regarded as fasciculate species of *Lithostrotion*.

In 1850, M. D'Orbigny founded the genera *Acrocyathus* and *Lasmocyathus* for forms subsequently referred by Edwards and Haime to *Lithostrotion*.

In 1850, Milne-Edwards and Haime (Brit. Foss. Cor. Intr. p. lxxi.) accepted the genera *Nematophyllum*, M'Coy, and *Lithodendron*, Phill., separating the two principally by the alleged presence of a well-developed accessory wall in the former, and rejecting *Stylaxis*, M'Coy. They further applied the name of *Lithostrotion* to the corals which we now term *Lonsdaleia*. In 1851 (Pol. Foss. des Terr. Pal.) the same authors accepted the genus *Stylaxis*, M'Coy; they defined the genus *Lonsdaleia* as at present accepted; and they extended to the genus *Lithostrotion* nearly its modern signification, placing under it *Lithodendron*, Phill., *Siphonodendron*, M'Coy, and *Nematophyllum*, M'Coy.

In 1851, Prof. M'Coy published his great work (Brit. Pal. Foss.), in which he adhered to the views which he had previously expressed with regard to the affinities of this group of corals.

In 1852, Milne-Edwards and Haime still further expanded their definition of *Lithostrotion*, to which they now referred the genus *Stylaxis*, M'Coy (Brit. Foss. Cor. p. 191). At the same time, they founded the genus *Petalaxis* for the corals which they had previously described under the names of *Stylaxis M'Coyana* and *S. Portlocki*; and they further rejected the genera *Stylastræa* and *Diphyphyllum* of Lonsdale.

In 1859, Mr. Billings gave reasons for retaining the genus *Diphyphyllum*, Lonsd., showing that it is properly separable from *Lithostrotion*, and that the absence of the columella, which forms one of its distinguishing characters, is not accidental, as believed by Milne-Edwards and Haime (Can. Journ. new ser. vol. iv. p. 133).

In 1861, De Fromental ('Polypiers Fossiles') restricted the

name of *Lithostrotion* to those species of the genus which have an astræiform corallum, whilst he placed the fasciculate forms under the head of *Diphyphyllum*. The same author likewise separated some of the astræiform species of *Lithostrotion*, together with the two species of *Petalaxis*, E. & H., and placed them under the revived genus *Stylaxis*, M'Coy, upon the wrongly alleged ground that the septa are not continued into the external vesicular area. This grouping, however, is in all respects an objectionable one.

In 1872, Prof. de Koninck (*Anim. Foss. Nouv. Recherches*, p. 26) defined the genus *Lithostrotion* in most essential respects as done by Milne-Edwards and Haime. He rightly shows, however, that *Diphyphyllum*, Lonsd., is to be separated from *Lithostrotion*, and he adds the synonym of *Tæniodendrocyclus* (Ludwig, *Palæontographica von H. von Meyer*, p. 220, 1866).

Finally, in 1873, Dybowski (*Mon. der Zoanth. scler. rug. aus der Silurform. Esthlands &c.*) proposed the following grouping of these forms:—(1) the genus *Lithodendron*, Phill., is restored, though upon no sufficient grounds stated. (2) The genus *Lithostrotion* is defined in the same general sense as by Milne-Edwards and Haime, *Diphyphyllum*, Lonsd., being excluded. (3) The genus *Petalaxis*, Edw. & H., is defined as having a quadrate columella, as having the septa confined to the centre of the visceral chamber and separated from the wall by large-sized vesicles, and as having a simple corallum—none of these characters, however, entering into the definition given by Milne-Edwards and Haime, or appearing in the illustrations published by these authors.

As regards the genera allied to *Lithostrotion*, its closest ally (in the matter of external appearance at any rate) is *Diphyphyllum*, Lonsd. In this latter genus, however, there is never any columella, and the septa always leave a conspicuous central tabulate area uncovered and exposed to view. Nor are these structural features accidental or in any way due to peculiarities in the mode of fossilization of particular specimens; but they are of constant occurrence even in the most excellently preserved examples. Indeed the two genera in question attain their maximum in different formations, *Diphyphyllum* being principally Devonian, whilst *Lithostrotion* is essentially and almost exclusively Carboniferous. It need hardly be added that there can be no risk of confounding *Diphyphyllum* with *Lithostrotion*, except as regards the fasciculate species of the latter, since none of the former are known to possess an astræiform corallum.

The genus *Stylastræa* was founded by Lonsdale (*Murch., Vern. & Keys., Russia & Ur., Append. p. 619*) to include

certain Carboniferous corals which agree with *Diphyphyllum* in the absence of a columella, in the comparatively short septa, in the possession of a central exposed area of tabulæ, and in the other details of their internal structure, but which are astræiform in their mode of growth. This genus is rejected by Milne-Edwards and Haime (Brit. Foss. Cor. p. 192) upon the same grounds which induce them to abandon *Diphyphyllum*; and they consider it to have been founded upon astræiform species of *Lithostrotion*. Not having seen Mr. Lonsdale's original specimens, we cannot hazard a positive opinion; but we are inclined to believe that he could hardly have made any mistake about the absence of a columella and the comparatively undeveloped septa of *Stylastræa*; and therefore we do not think that this genus can be regarded as a synonym of *Lithostrotion*. In the meanwhile, however, we leave it an open question whether *Stylastræa*, Lonsd., can be retained, or whether it should not rather be merged with the genus *Diphyphyllum*.

From the fasciculate and astræiform species of *Cyathophyllum* the genus *Lithostrotion* is at once distinguished by the fact that there is no true columella in the former, whilst the septa, typically, meet in the centre and become twisted together.

From *Acervularia*, Schweigger, *Smithia*, E. & H., *Columnaria*, Goldf. (= *Favistella*, Hall), and *Palæophyllum*, Billings, the genus *Lithostrotion* is fundamentally separated, amongst other characters, by its possession of a columella.

Phillipsastræa, D'Orb., is compared by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 447) to the astræiform species of *Lithostrotion*, in which, however, the outer wall is wanting, so that the corallites become confluent by their septa. The true affinities of *Phillipsastræa* appear, on the other hand, to be rather with *Heliophyllum* than with *Lithostrotion*; and it seems very doubtful if a true columella is really present in the genus. What has been taken for the columella seems to be only a pseudo-columella formed by a projection of the tabulæ or by the septa; and even this is often wanting.

From *Lonsdaleia*, M'Coy, and its allies *Chonaxis*, E. & H., and *Axophyllum*, E. & H., the genus *Lithostrotion* is separated by its simple compact columella, and the fact that the septa extend without interruption through the external vesicular zone.

The genus *Koninckophyllum*, Thomson and Nicholson, is distinguished from *Lithostrotion* by its being generally simple, and by the much greater development of the peripheral zone of vesicular tissue, though it approximates to the latter in the structure of the columella. It is also distinguished by the septa not being developed to the same extent.

The genus *Petalaxis*, E. & H., lastly, has been but imperfectly defined (Brit. Foss. Cor., Intr. p. lxxi, under the name of *Nematophyllum*); and it seems difficult to determine precisely what characters its authors wished to assign to it. So far, however, as can be judged from the descriptions and figures of the two species* embraced under this name (viz. *P. M. Coyana*, E. & H., and *P. Portlocki*, E. & H.), the genus would not appear to be separated by sufficient characters from *Lithostrotion* proper.

With the exception of a single species (*L. antiquum*, Bronn), which is believed to be of Devonian age, all the known species of *Lithostrotion* are referable to the Carboniferous period, where they constitute one of the most abundant and characteristic groups of corals.

Genus KONINCKOPHYLLUM, Thomson and Nicholson.

Gen. char. Corallum simple or compound. Septa well developed, but not reaching the centre, united externally by numerous delicate dissepiments, which give rise to an exterior zone of dense vesicular tissue. Tabulæ occupying a central area of considerable size, into which the septa are only very partially, or not at all, continued. A styliform, compact or subcompact columella. Occasionally a septal fossula. In the compound forms increase is by calicular gemmation.

We have believed ourselves justified in founding this genus for the reception of certain corals from the Carboniferous rocks of Scotland, which present a combination of characters peculiarly their own, and which may be regarded as, in some respects, intermediate between *Cyathophyllum* and *Lithostrotion*. We have named the genus in honour of Prof. de Koninck, whose work amongst the Palæozoic corals has so deservedly contributed to the high reputation which he has obtained in various branches of palæontology.

The corallum in *Koninckophyllum* is sometimes simple, and sometimes compound. When simple, it is usually of small size, rarely exceeding two inches in length, and it is conical,

* These species were originally described by Milne-Edwards and Haime (Pol. Foss. p. 453) under the names of *Stylaxis M. Coyana* and *S. Portlocki*, and were transferred subsequently to *Petalaxis* (Brit. Foss. Corals, p. 205). Under any circumstances, these species must not be confounded with the forms known as *Lithostrotion M. Coyanum* and *L. Portlocki*, Bronn. These latter are entirely distinct from the former, and are retained in *Lithostrotion* in the last grouping of the genus proposed by Milne-Edwards and Haime. If *Petalaxis* be abandoned and relegated to *Lithostrotion*, then the specific names of *M. Coyana* and *Portlocki* applied to the two species of the genus will have to be changed.

cylindrical, or cylindro-conical in form. When compound, the corallum is usually fasciculate; and its mode of increase is by calicular gemmation, the young corallites being always produced near the periphery of the old calices (Pl. XII. figs. 1 & 3).

The epitheca is thin and complete, marked with fine encircling striæ and shallow accretion-ridges. The calice is moderately deep, its margin being sometimes thin, at other times thick and everted.

In the centre of the visceral chamber is a small, compressed, compact, or sometimes imperfectly cellular, styloform columella, which forms a small projection in the floor of the calice (Ann. & Mag. Nat. Hist., Feb. 1876, Pl. VIII. fig. 8). As seen in longitudinal sections, the columella (Pl. XII. figs. 2 A, 3 A, & 6 A) forms a distinct thin line, which usually runs from the bottom of the visceral chamber to the floor of the calice as a continuous rod. Sometimes, however, it is absent or interrupted over portions of its course (figs. 3 A & 6 A). It was at first difficult to determine whether this was due to any real want of continuity, or whether it was not caused by flexures of the corallum taking the columella at places out of the line of section; but it seems to be really due to the former cause. As seen in transverse sections (Pl. XII. figs. 1, 2, 4, & 5), the columella is shown to be markedly compressed laterally.

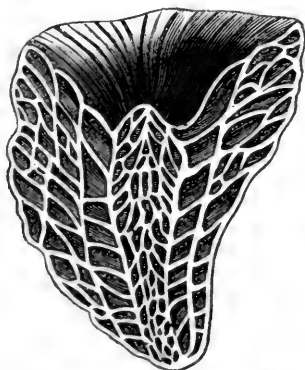
The central area of the corallum is occupied by tabulæ, over the upper surfaces of which the septa do not extend, or only to a very limited extent. The tabulæ are very close-set, often inosculating or almost vesicular, and usually distinctly elevated just before they are pierced by the columella. The result of this last-mentioned peculiarity is that a transverse section cuts through more than one of the tabulæ in the immediate vicinity of the columella. Hence in transverse sections (Pl. XII. figs. 2 & 4) the columella is seen to be surrounded by the divided edges of several of the tabulæ, which might lead to the erroneous impression that the columella is composed of twisted lamellæ, though longitudinal sections clearly prove that this is not the case. In no case do the tabulæ extend to the inner surface of the wall, though the central area which they occupy is one of very considerable dimensions.

The septa (Pl. XII. figs. 1-6) are well developed, but always fall short of the columella by a considerable space. Hence, though they infringe upon the margins of the tabulate area, they are never continued to the centre, and they invariably leave the tabulæ exposed to view over a conspicuous median space. A septal fossula, containing a single short septum, is often present.

Externally, the septa are united by numerous close-set delicate dissepiments, which are sometimes rectangular, sometimes finely anastomosing and reticulate (Pl. XII. figs. 1-6). The dissepiments give rise to an exterior zone of vesicular tissue of an extremely dense and minute character. As seen in longitudinal sections (figs. 2 A, 3 A, 6 A), the vesicles of this zone are exceedingly small lenticular cells, which are arranged in layers directed upwards and outwards from the central tabulate area.

As regards the relationships of the genus, *Koninckophyllum* may be said to be distinguished by characters of an unusually fundamental nature. In some respects it is nearly allied to *Diphyphyllum* and to some of the forms of *Cyathophyllum* (such as *C. paracida*, M'Coy); but it is broadly separated from these genera by the possession of a well-developed, compact and styliform columella. From *Lophophyllum*, E. & H., it is distinguished by the totally different form and connexions of the columella, and the less developed condition of the septa, and, even more strikingly, by its extraordinarily minute and dense zone of vesicular tissue forming the periphery of the corallum. From *Lithostrotion*, again, it is separated by the much more rudimentary state of the septa, the greater development of the vesicular zone, and the fact that the corallum is always compound in the former, whilst it is usually simple in the latter.

There remains, finally, only the genus *Axophyllum*, E. & H., which need be considered here, though its characters are such as really to render its separation from *Koninckophyllum* a matter of no difficulty, as will be at once seen by a reference to the annexed woodcut and the subjoined description. The corallum



Longitudinal section of *Axophyllum Konincki*, E. & H., the type species of the genus *Axophyllum*. After Milne-Edwards and Haime.

in *Axophyllum* is always simple, turbinate in form, with a complete epitheca. The centre of the visceral chamber is occupied by a strong cylindrical columella, of comparatively gigantic size, and formed of numerous vertical, spirally twisted lamellæ. Hence, on longitudinal section, the columella appears as a cylindrical cellular mass of large size. The columella pierces a central area, occupied by strong remote tabulæ and surrounded by an accessory wall. The space between the inner mural investment and the true wall is occupied by dissepiments, giving rise to an exterior zone of large vesicles. The septa are well developed, and extend to the centre of the visceral chamber. It will be seen from the above that the structure of *Koninckophyllum* is entirely different from that of *Axophyllum*, as defined by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 455) and by De Koninck (An. Foss. Nouv. Recherches, partie i. p. 23). Under these circumstances it is unnecessary to add that the compound forms of *Koninckophyllum* cannot be confounded with *Lonsdaleia*, the latter having incomplete septa, which are not connected with the external wall, and having a columella of a different structure.

So far as our present knowledge goes, the species of *Koninckophyllum* appear to be exclusively confined to the Lower Carboniferous rocks. All our specimens are from Scotland (Brockley, near Lesmahagow; Charleston, Fifeshire; and Dunbar, Haddingtonshire). The compound forms are sometimes found in vast numbers, covering very extensive areas. The description of the various species of this genus we reserve for another communication.

Genus LONSDALEIA.

Lonsdaleia, M'Coy, Ann. & Mag. Nat. Hist. ser. 2, vol. iii. p. 11.

Gen. char. Corallum compound, fasciculate or astræiform, increasing by calicular gemmation. Each corallite is provided with a distinct wall; and an inner mural investment is usually developed. The centre of the visceral chamber is occupied by a very large, somewhat cylindrical columella, formed of twisted lamellæ. A well-developed tabulate area of close-set tabulæ, surrounded by an exterior vesicular zone of large-sized vesicles. The septa are present in the central area, most of them falling short of the columella; but they are not continued through the peripheral vesicular zone to the outer wall.

The corallum in *Lonsdaleia* is invariably compound, and is either astræiform or fasciculate. The young corallites are produced by calicular gemmation, the new buds arising in the outer vesicular zone of the parent corallite, and the latter con-

tinuing to grow uninterruptedly onwards. In some forms (as *L. duplicata*, Mart.) the corallites always remain completely free laterally (Pl. XVI. fig. 2); in others (as *L. floriformis*, Flem.) they become united laterally, and assume a polygonal form from mutual pressure (Pl. XVI. fig. 3); whilst in *L. rugosa*, M^cCoy, there is an intermediate state of parts, and the corallites, though usually free laterally, sometimes become more or less amalgamated (Pl. XVII. fig. 1).

The corallites are always enclosed in a complete epitheca of greater or less thickness, which exhibits fine encircling striæ and often well-marked accretion-ridges.

The central area of the corallum is occupied by well-developed tabulæ, which are seen in longitudinal sections (Pl. XVII. fig. 1) to be extremely close-set. They often anastomose with one another, and are very distinctly elevated as they approach the columella. Hence in transverse sections (Pl. XVI. figs. 1 A & 2 A) the divided edges of a greater or less number of the tabulæ may be seen surrounding the columella.

The tabulæ are pierced centrally by the columella, which runs continuously from the bottom of the visceral chamber to the floor of the calice, where it appears as an elevated acutely conical prominence. The columella is of large size, approximately cylindrical in shape, and composed of numerous twisted plates, which appear to become continuous laterally with the tabulæ, as shown by longitudinal sections (Pl. XVII. fig. 1). In transverse sections (Pl. XVI. figs. 1-3) the columella is seen as a conspicuous central cellular mass, the outer portion of which is formed by concentric lines disposed in successive sectors.

The space between the central tabulate area and the inner surface of the wall is occupied by vesicular tissue. The vesicles of this zone are of comparatively very large size; and they are formed by strongly arched plates, the convexities of which are turned upwards, and which are seen in longitudinal sections (Pl. XVII. fig. 1) to have a direction outwards and upwards. In transverse sections (Pl. XVI. figs. 1-3) the divided edges of the vesicles of this zone form an exceedingly conspicuous feature, partly from their large size and partly because they are unencumbered by the septa. A distinct accessory wall is sometimes clearly present, intervening between the central tabulate area and the outer vesicular zone. In other cases the apparent inner mural investment seems to be little more than an appearance produced by the contrast of structure between the central tabulate area and the peripheral zone of vesicular tissue at their line of junction.

The septa are present in a well-developed form in the exterior portion of the tabulate area, but do not exist at all in the outer vesicular zone, or only extend into the latter region in a very rudimentary and imperfect form (Pl. XVI. figs. 1-3). Secondary septa are usually, if not always, present; and the primary septa for the most part stop short at a little distance from the columella. In some cases, however, a few of the primary septa seem to be continued inwards as far as the columella. When viewed in transverse sections (Pl. XVI. figs. 1 A, 2 A, & 3 A), the septa are seen to be united by delicate transverse dissepiments, which, however, are not developed between the septa in their inward extension, and become sparse and irregular as the septa are traced outwards to the outskirts of the vesicular zone.

The genus *Lonsdaleia* was first clearly defined by Prof. M'Coy (*loc. cit.*); but he included only the fasciculate forms under this name, and erroneously referred the astræiform species to *Strombodes*. The essential structural characters of the genus, however, had at an earlier date been fully recognized by Mr. Lonsdale (Murch. Vern. & Keys. Russ. & Ur. p. 602); but he considered that the name of *Lithostrotion* was the one properly applicable to these corals. Milne-Edwards and Haime (Brit. Foss. Cor. p. 190) first showed that the name of *Lithostrotion* should properly be applied to the group of corals of which *L. basaltiforme* is the type; and in this they have been supported by most subsequent writers on the subject. Fromentel, however, took the retrograde step of separating the astræiform species under the name of *Stylidophyllum* (Poly-piers Foss. p. 316); and Dybowski has so far adopted the same course as to restrict the name of *Lonsdaleia* solely to the same species (Mon. der Zoanth. scler. rug. p. 83).

The zoological characters of the genus *Lonsdaleia* are so well marked that there is little chance of its being confounded with any other. From the true *Strombodes*, Schweig., from *Spongophyllum*, E. & H., and from *Endophyllum*, E. & H., it is at once distinguished, amongst other characters, by its possession of a columella. From *Lithostrotion* and *Diphyphyllum* it is separated by the fact that the septa are not in direct connexion with the outer wall; whilst the latter genus has no columella, and this organ in the former genus appears as a compact styliform rod. By far the nearest allies of *Lonsdaleia*, as at present understood, are *Chonaxis*, E. & H., and *Axophyllum*, E. & H. The former of these appears to differ from *Lonsdaleia* solely, or chiefly, in the fact that the external walls are wanting, and the corallites are united together directly by the amalgamation of their vesicular zones. The genus *Axophyllum*,

again, as described and figured by Milne-Edwards and Haime, appears to differ in no essential structural character from *Lonsdaleia*, from which it is separable chiefly by its being simple instead of compound. If this identity of structure should be confirmed by further investigation, it will become very doubtful if the genus *Axophyllum* can be retained; but we have at present no sufficient means of arriving at a final judgment on this point. From the description given by Prof. de Koninck, on the other hand (An. Foss. Nouv. Recherches, p. 23), it would seem that the septa of *Axophyllum* are in connexion with the outer wall, which would constitute a sufficient distinction from *Lonsdaleia*. Another ally of *Lonsdaleia*, in a somewhat unexpected quarter, is found in the genus *Clisiophyllum*, Dana. Both these genera have a distinct columellary line, and possess a few lamellæ, which spring from near the inner margins of the primary septa, and are connected by a system of endothecal dissepiments. On the other hand, *Lonsdaleia* is distinguished from *Clisiophyllum* by being compound, by increasing by calicular gemmation, by the fact that the septa are not connected with the external wall, and by the large size of the vesicles of the exterior vesicular zone. Finally, the genus *Koninckophyllum*, Thoms. & Nich., is distinguished from *Lonsdaleia* by the fact that the septa are directly connected with the outer wall, by the different nature of the columella, and by the minute and dense vesicular tissue of the outer zone, as well as by the generally simple nature of the corallum.

In its range the genus *Lonsdaleia* is restricted, not having been hitherto found to transcend the limits of the Carboniferous rocks.

EXPLANATION OF THE PLATES.

(Unless otherwise stated, the figures are of the natural size.)

PLATE XII.

- Fig. 1.* *Koninckophyllum proliferum*, Thomson and Nicholson, transverse section of a small slab exhibiting the different stages of growth by calicular gemmation. Lower Carboniferous, Bathgate, Linlithgowshire.
- Fig. 2.* *Koninckophyllum magnificum*, Thomson and Nicholson, transverse section of an exceptionally large example; 2 A, longitudinal section of the same, exhibiting the columellary line, the large tabulate area, and the dense outer vesicular zone. Lower Carboniferous, Charleston, Fifeshire.
- Fig. 3.* Transverse section of *Koninckophyllum interruptum*, Thoms. and Nich. The section is cut about a quarter of an inch below the floor of the calice, and does not show any signs of the columella, proving that this organ is really absent occasionally in portions of the corallum: the septa also are seen to be wanting at certain points; and these vacant spaces are the bases of young

corallites budded off from the disk of the calice. 3 A, longitudinal section of the same, showing the absence of the columella in the upper portion of the corallum and its presence in the lower portion. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.

- Fig. 4. Koninckophyllum Lindströmi*, Thomson and Nicholson, transverse section; the external vesicular tissue is extraordinarily dense, and the columella is apparently connected with the septum occupying the septal fossula. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.
- Fig. 5. Koninckophyllum radiatum*, Thomson and Nicholson, transverse section. Lower Carboniferous, Charleston, Fifeshire.
- Fig. 6. Koninckophyllum retiforme*, Thomson and Nicholson, transverse section, showing the rectangular dissepiments and the septal fossula occupied by two short septa; the columella is imperfectly cellular. 6 A, longitudinal section of the same. Lower Carboniferous, Brockley, near Lesmahagow, Lanarkshire.

[*Figs. 8, 8 A, and 8 B* of the preceding portion of this paper, 'Annals,' February 1876, Pl. VIII., are illustrations of *Koninckophyllum magnificum*. *Fig. 8* shows the floor of the calice, with the protuberant columella; *fig. 8 A* is a transverse section of the same; and *fig. 8 B* is a longitudinal section, showing the columellary line, with the elevated tabulæ around it.]

PLATE XIV.

- Fig. 1. Lithostrotion basaltiforme*, Flem., a transverse section, showing a portion of the internal structure and the aspect of the calices. Lower Carboniferous, Arbigland, Dumfriesshire.
- Fig. 2. Lithostrotion Portlocki*, Bronn, transverse section of a small slab; 2 A, longitudinal section of the same; 2 B, a few of the corallites enlarged. Lower Carboniferous, Dunbar.
- Fig. 3. Lithostrotion M^cCoyanum*, E. & H., transverse section of a small slab. Lower Carboniferous, Penrith, Cumberland.
- Fig. 4. Lithostrotion Flemingii*, M^cCoy: the crown of the dome-shaped mass is ground away, exhibiting the arrangement of the septa and, towards the margin, the calices. Lower Carboniferous, Arbigland, Dumfriesshire.

PLATE XV.

- Fig. 1. Lithostrotion Phillipsi*, E. & H., transverse section of a small slab; 1 A, longitudinal section of the same, showing the columellary line. The absence of the columella in parts is due to the flexuous form of the corallites. Lower Carboniferous, Arbigland, Dumfriesshire.
- Fig. 2. Lithostrotion Martini*, E. & H., transverse section of an unusually large variety. Lower Carboniferous, Arbigland, Dumfriesshire.
- Fig. 3. Lithostrotion irregulare*, Phill., transverse section of a small slab. Lower Carboniferous, Boghead, near Lesmahagow.
- Fig. 4. Lithostrotion junceum*, Flem., longitudinal section of a small slab; 4 A, transverse section of a small slab of the same; 4 B, a few of the corallites enlarged, showing the peculiar arrangement of some of the primary septa. Lower Carboniferous, Brockley, Lesmahagow.

PLATE XVI.

- Fig. 1. Lonsdaleia rugosa*, M^cCoy, transverse section of small slab, showing the development, from the young corallite emerging from

the oral disk of the parent to the perfect corallite; 1 A, the central corallite of the preceding, enlarged, with two young corallites. Main Limestone (Lower Carboniferous), Boghead, Lesmahagow.

Fig. 2. *Lonsdaleia duplicata*, Mart., transverse section of a small slab; 2 A, two of the corallites enlarged. Lower Carboniferous, near Muirkirk.

Fig. 3. *Lonsdaleia floriformis*, Flem., transverse section of a small slab; 3 A, two of the corallites enlarged. Lower Carboniferous, Bathgate, Linlithgowshire.

PLATE XVII.

Fig. 1. *Lonsdaleia rugosa*, McCoy, longitudinal section of three corallites, taken from a large slab; 1 A, a corallite, showing the acutely conical boss formed by the columella in the floor of the calice, and the columellary line in the centre; 1 B-1 F, corallites in various stages of growth, arising from the outer vesicular tissue. The different appearance presented by different portions of the section is due to the flexuous form of the corallites. Main Limestone (Lower Carboniferous), Boghead, Lesmahagow.

XXIX.—Description of a new Species of the Genus *Merula* from the Fiji Islands. By E. L. LAYARD, C.M.G., H.B.M. Consul for Fiji and Tonga, F.Z.S., &c. &c.

Merula vitiensis, n. sp.

Some months since my kind friend Mr. A. Tempest, among a collection of birds made by him for me at Bua, on the large island of Vanua Levu, gave me a specimen of a "Blackbird," which at the time I identified, from the short description in the 'Ornithologie der Viti-, Samoa- und Tonga-Inseln' of Drs. Finsch and Hartlaub, as *Merula vanicoroensis*. The acquisition by myself, at Samoa, of specimens of that bird, at once, however, showed me that I had committed an error; and I hasten to rectify it.

The Fiji bird, which I propose to call *Merula vitiensis*, is of a silky smoky brown above, not nearly so dark as *vanicoroensis*; below, it is grey-brown, with the same silky lustre; throat and side of neck grey; the centre of the belly has some feathers tinged with ruddy brown; bill and legs bright pale yellow. Length 7" 6^{'''}, wing 4" 3^{'''}, tail 3" 2^{'''}, tarse 1" 5^{'''}, bill 1" 2^{'''}.

Mr. Tempest describes this bird as being extremely shy and difficult to procure, in notes and habits resembling the European bird, scratching on the ground under bushes. The nest also is said to resemble that of *M. vulgaris*.

XXX.—On the *Myriopoda*, from Siberia and Waigatsch Island, collected during the Expedition of Prof. Nordenskiöld, 1875. By ANTON STUXBERG.

As far as I am aware from studying the literature of the subject, only ten species of Myriopods have hitherto been known from the whole of Siberia, including the island of Sakhalin. These are:—(1) *Lithobius sibiricus*, Gerstf.; (2) *L. rapax*, Mein.; (3) *Scolioptanes sacolinensis*, Mein.; (4) *Geophilus longicornis* (Leach), Gerstf.; (5) *G. pilosus*, Mein.; (6) *Iulus terrestris* (Linn.), Gerstf.; (7) *Iulus amurensis*, Gerstf.; (8) *Iulus armatus*, Gerstf.; (9) *Platydesmus amurensis*, Gerstf.; (10) *Craspedosoma dahuricum*, Gerstf.

Beside other Land-Arthropods, during Prof. Nordenskiöld's last expedition to Novaja Semlja and Siberia, a considerable number of specimens of Myriopods were collected sufficiently perfect for description. This collection includes eighteen species. One of these, *Geophilus pilosus*, Mein., was already known from the north of Asia—not from the mainland of Siberia, but from the neighbouring island of Sakhalin. Two others, *Lithobius crassipes*, L. Koch, and *Polyzonium germanicum*, Brandt, have been long since found in Europe; the remaining fifteen species are new to science.

The following is a list, systematically arranged, of all the Myriopods now known to inhabit Siberia:—

CHILOPODA.

1. *Lithobius ostiacorum*, n. sp.
2. — *sibiricus*, Gerstf.
3. — *rapax*, Mein.
4. — *princeps*, n. sp.
5. — *scrobiculatus*, n. sp.
6. — *sulcipes*, n. sp.
7. — *Nordenskiöldii*, n. sp.
8. — *formicarum*, n. sp.
9. — *crassipes*, L. Koch.
10. — *fugax*, n. sp.
11. — *vagabundus*, n. sp.
12. — *captivus*, n. sp.
13. *Scolioptanes sacolinensis*, Mein.
14. *Geophilus sibiricus*, n. sp.
15. — *longicornis* (Leach), Gerstf.
16. — *pilosus*, Mein.

CHILOGNATHA.

17. *Iulus terrestris* (Lin.), Gerstf.
18. — *profugus*, n. sp.
19. — *amurensis*, Gerstf.
20. — *armatus*, Gerstf.
21. *Polydesmus clavatipes*, n. sp.
22. — *tabescens*, n. sp.
23. *Craspedosoma dahuricum*, Gerstf.
24. — *cylindricum*, n. sp.
25. — *deplanatum*, n. sp.
26. *Platydesmus amurensis*, Gerstf.
27. *Polyzonium germanicum*, Brandt.

Our present knowledge of the structure of the Siberian Myriopods scarcely offers any opportunity for comparison with those of other countries. For, of the twenty-seven species above mentioned, no less than twenty-three consist of forms

that have not as yet been found anywhere but in Siberia; and as regards the other four species, it seems probable that two of them, namely those which have been referred by Gerstfeldt to *Geophilus* (*Arthronomalus*) *longicornis*, Leach, and *Iulus terrestris*, Linné, represent quite distinct though allied forms. Indeed it is scarcely to be supposed that two forms so undoubtedly European would extend so far eastward, beyond Baikal, as where the Songari empties itself into the Amur, where the latter—or the river Schilka, where the former is said to have been found. Statements of this kind must be received with caution and not implicitly relied on. The two others, the *Lithobius crassipes*, L. Koch, and the *Polyzonium germanicum*, Brandt, as we have already said, were long since known as European. The former is a species frequently met with and widely spread in Europe. It is also found on the coast of North Africa, and in the north of Europe extends far beyond the woody region, being found in the island of Waigatsch, the south end of which lies forty-five geographical miles to the north of that region. In Siberia it is found in the neighbourhood of Yenisei between 61° and 64° north latitude, and may probably be met with much further to the north. The *Polyzonium germanicum*, on the other hand, is a more southern form. It is found in the Caucasus, Poland, Germany, in France (near Paris), in Denmark, in the south of Sweden as far as Bohuslän (58° – 59° N. lat.), and is said to occur on the shores of the Gulf of Finland, but not further north*. Such being the case, it appears rather strange to find it in Siberia near the river Yenisei, in the high latitude of $66^{\circ}17'$ north. In Scandinavia it is one of the most southern Chilognatha; near Yenisei, it was the very first of this order that was found by the Swedish expedition when ascending the river on their way back through Siberia. For these reasons it seems probable that the latter species has its original centre not in Europe, nor in the Caucasus, but in Central Asia; and it has perhaps, in spreading, taken the same course as the great number of plants which at the present time belong to the flora of Europe, but originally came from the widely branched Altai range. But this cannot as yet be more than conjecture.

Before entering upon a description of the species brought home, I may be allowed here to make the following brief remarks. The *Platydesmus amurensis*, Gerstf., is the representative of a genus of which before only one species was

* The information that this species is met with in Finland was given me by Dr. Richard Sievers, who is occupied with a monograph of the Myriopoda of Finland.

known, viz. the Mexican one. The *Craspedosoma deplanatum*, n. sp., as bearing the strongest resemblance to a typical *Polydesmus*, is unique, having no known ally in any part of the earth. The *Craspedosoma dahuricum*, Gerstf., and the *C. cylindricum*, n. sp., may be regarded as representatives of the European *C. Rawlinsii*, Leach, their close resemblance in form pointing to a near affinity of origin. The *Polydesmus clavatipes*, n. sp., is a form of the subgenus *Icosidesmus*, Humb. & Saussure (distinguished by the strange conformation of the legs), of which, as far as I know, only one species has been described, viz. from New Zealand. If we except the *Lithobius sibiricus*, Gerstf. (which has been, considering the claims of the present time, very imperfectly described, and probably is a collective species), and the *L. ostiacorum*, n. sp. (a *Lithobius* sensu strictiore*), the remaining *Lithobii* belong to that division of the subgenus *Archilithobius* which is characterized by four (never more) teeth on the coxal part of the second pair of jaw-feet, and by usually 20-jointed antennæ, and of which the centre, to judge from the 119 species hitherto known of the genus *Lithobius* in the wider sense, seems to be in the north-east of Asia, though it has also some representatives in Europe, and at least as many on the Californian coast.

It is obvious from the foregoing remarks that the Siberian Myriopoda have very little in common with those of Europe; and what there is leads us to suppose that Asia has been the centre in which they originated. In order to acquire a true knowledge of the geographical distribution of the species, it makes a great difference whether we say that Asia has received such and such forms from Europe, or that Europe has received them from Asia. The Siberian Myriopod fauna is much too independent, as it were, in its composition, to allow us to speak of genuine European forms. It seems we shall come nearest the truth by saying that Europe has borrowed from Asia the Myriopods it has in common with Siberia.

1. *Lithobius ostiacorum*, n. sp.

Lamina cephalica subcircularis, lateribus valde rotundatis, eadem longitudine ac latitudine, infra marginem posticum impressionibus duabus rotundate triangularibus evanidis, lævis, setis rigidis longis sparse vestita; antennæ articulis 20, cylindræis, longe setosis compositæ, dimidiam corporis longitudinem assequentes; oculi ellipsoidei, ocellis 9-10 in 3 series (1+3, 2, 3 v. 1+3, 3, 3)

* Compare Stuxberg, "Genera et Species Lithobioidarum" (Øfvers. Kgl. Vet. Akad. n. s. Förhandl., årg. 32 (1875), no. 3), where (p. 8) the six subgenera *Eulithobius*, *Neolithobius*, *Lithobius*, *Pseudolithobius*, *Hemilithobius*, and *Archilithobius* are briefly characterized.

rectas longitudinales digestis compositi; coxæ pedum maxillarum secundi paris dentibus 2+2 haud validis armatæ, sinu mediano angulari prope æque profundo ac lato, antice setis longis vestitæ; scuta dorsualia leviter rugosa et sparsissime pilosa, 3., 5., 8., 10., 12., 14. margine postico magis magisque sinuata, 1., 2., 4., 6., 7., 9., 11., 13. rotundata et tribus sulcis parvis prædita, 9., 11., 13. angulis posticis productis; scuta ventralia convexiuscula, postica præsertim sparse pilosa, omnia impressionibus angularibus; pori coxales rotundi in ♂ 3, 3, 4, 3-3, 4, 4, 3-4, 4, 4, 3-4, 4, 4, 4-4, 4, 5, 4-4, 5, 4, 4-4, 5, 6, 4, in ♀ 3, 4, 4, 4-4, 4, 4, 4-5, 5, 5, 5; pedes primi paris calcaribus 0, 0, 1-0, 1, 1: pedes anales mediocres, longitudine tres partes antennarum æquantes, haud incrassati, unguibus 2, calcaribus 1, 3, 2, 0 armati (mas articulo quinto supra profunde sulcato); pedum analium articulus primus inermis: unguis genitalium femineorum integer, acutus; calcarium 2 paria, quorum exterius interiore multo majus. Color dorsi testaceus vel brunneo-testaceus, interdum vitta abrupta obscuriore, ventris pallidior, griseus; caput multo obscurius quam dorsum. Longitudo corporis 12-14 m. m., antennarum 6 m. m., pedum analium 4 m. m.

Hab. circa flumen Jenissej ad Krasnojarsk (56°), Kolmogorova (59° 30'), Verschinskoi (68° 45'), Dudino (69° 15').

2. *Lithobius princeps*, n. sp.

Lamina cephalica subquadrata, lateribus valde rotundatis, latitudine majore quam longitudine, setis longis sparsissimis vestita; antennæ articulis 20, cylindraceis, rigide setosis compositæ, longitudine tertiam partem corporis vix assequentes; oculi ellipsoidei, ocellis 18-19, in 5 series transversas digestis (1+4, 4, 4, 3, 2-1+3, 4, 5, 4, 2), compositi; coxæ pedum maxillarum secundi paris dentibus 2+2 brevibus, validis, nigris armatæ, sinu mediano profundo et lato, fere duplo latiore quam longiore; scuta dorsualia sat rugulosa, sæpissime subglabra, angulis posticis rotundatis; scuta ventralia plana vel subplana; pori coxales magni, rotundi vel medii transversi, ovals, in ♂ 5, 5, 6, 5-6, 6, 6, 6, in ♀ 6, 7, 6, 7-7, 7, 7, 7; pedes primi paris calcaribus 2, 2, 1; pedum analium articulus primus inermis; pedes anales mediocres, inflati, sparse et rigide setosi, unguibus 2, calcaribus 1, 3, 2, 1 armati: unguis genitalium femineorum ad basin inflatus, bilobus, lobo superiore paullo brevior quam inferiore; calcarium 2 paria, crassa, valida, exterius interiore parum majus. Color dorsi et capitis brunneus vel castaneus, ventris et pedum flavus vel griseus. Longitudo corporis (18-) 21 m. m., antennarum 6.5 m. m., pedum analium 6.5 m. m.

Junior. Antennæ articulis 20, subcylindraceis; oculi ocellis 10 in 4 series transversas digestis (1+1, 3, 3, 2); coxæ pedum maxillarum secundi paris dentibus 2+2 armatæ; pedes primi paris calcaribus 0, 0, 1; pedes anales calcaribus 1, 3, 2, 0; pori coxales 4, 4, 4, 4 rotundi. Longitudo corporis 11 m. m.

Juvenis antennæ articulis 17 moniliformibus; oculi ocellis 5 in 2 series digestis (1+2, 2); coxæ pedum maxillarium secundi paris dentibus 2+2 armatæ; pedes primi paris calcaribus 0, 0, 1; pedes anales calcaribus 1, 1, 1, 0; pori coxales 2, 1, 1, 1 magni, rotundi. Longitudo corporis 7 m. m., antennarum 1.7 m. m.

Pullus pedum paribus 10, duo paria gignit; antennæ articulis 17 moniliformibus; oculi ocellis 3 in seriem simplicem curvatam digestis; coxæ pedum maxillarium secundi paris dentibus 2+2 armatæ; pedes primi paris calcaribus 0, 0, 1. Longitudo corporis 3.3 m. m., antennarum 1 m. m.

Hab. circa flumen Jenissej inter 61 et 62 gradus lat. bor.

3. *Lithobius scrobiculatus*, n. sp.

Lamina cephalica subquadrata, latitudine majore quam longitudine, foveis 6 rotundatis plus minus profundis pone et 3 ante suturam frontalem prædita; antennæ articulis 20 cylindræis compositæ, dimidiam corporis longitudinem haud assequentes; oculi ellipsoidei, ocellis 17, in 4-5 series transversas curvatas vel irregulares digestis, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 brevibus validis armatæ, sinu mediano semicirculari, haud profundo; scuta dorsualia rugosa, sparsissime hirsuta, angulis posticis rotundatis; scuta ventralia plana vel subplana; pori coxales 6, 7, 7, 6 (♀) magni, rotundi vel medii ovoides, transversi; pedes primi paris calcaribus 1, 2, 1; pedum analium articulus primus inermis; pedes anales (mutilati): unguis genitalium femineorum bilobus, lobis latis, curtis, nigris, inferiore duplo minore quam superiore; calcarium 2 paria, exteriore interius haud multo superante. Color dorsi testaceus, capitis brunneo-testaceus, ventris et pedum griseus. Longitudo corporis 16 m. m.

Hab. circa flumen Jenissej ad Pupkovskij (64° 42'). Unum tantum specimen (♀) vidimus.

4. *Lithobius sulcipes*, n. sp.

Lamina cephalica subcircularis, margine postico fere recto, setis paucis vestita; antennæ articulis 20 moniliformibus, rigide setosis compositæ, quorum ultimus 2 præcedentibus longitudine æqualis, dimidiam corporis longitudinem prope assequentes; oculi ellipsoidei, ocellis 10-13 in 5 series longitudinales, rectas vel subrectas digestis (1+4, 3, 2-1+5, 4, 3), postico maximo et longo intervallo ab cæteris distante; coxæ pedum maxillarium secundi paris dentibus 2+2 validis, nigrescentibus armatæ, sinu mediano non profundo, ad marginem anticum pilis sparsis magnis vestitæ; scuta dorsualia sublævia, postica præsertim sparse pilosa, omnia angulis posticis rotundatis, 3., 5., 8., 10., 12., 14. margine postico magis magisque sinuata, 1., 2., 4., 6., 7., 9., 11., 13. recta; scuta ventralia posteriora convexiuscula, anteriora medio impressa, 5-13. angulis posticis sulco obliquo profundo præditis; pori coxales

rotundi, in ♂ 2, 3, 3, 3-3, 3, 4, 3-3, 4, 3, 3-3, 5, 4, 4, in ♀ 3, 4, 4, 3-3, 4, 4, 4; pedes primi paris calcaribus 0, 0, 1-0, 1, 1; pedum analium articulus primus inermis; pedes anales mediocres vel breves, vix vel minus inflati, articulis 4°, 5°, 6° supra sulcatis, unguibus 2, calcaribus (1, 2, 0, 0) 1, 3, 1, 0-1, 3, 2, 0-1, 3, 2, 1: unguis genitalium femineorum integer, acutus vel subacutus; calcarium 2 paria, interius exteriore plerumque duplo brevius. Color dorsi testaceus, interdum vitta longitudinali abrupta æque ac capite obscuriore, ventris et pedum dilutior; pedes anales sæpissime fusco-annulati. Longitudo corporis 14 m. m., antenarum 6 m. m., pedum analium 4·7 m. m.

Hab. circa flumen Jenissej ad Krasnojarsk (56°), Vorogova (60° 55'), Podkamemno Tunguskoj (61° 40'), Nischnij Inbatskoj (63° 50'), Baklanovskij (64° 25'), Troitskoj (65° 45'), Goroschinskoj (66° 17').

5. *Lithobius Nordenskiöldii*, n. sp.

Lamina cephalica subcircularis, longitudine paullo majore quam latitudine, lævis, setis sparsis vestita; antennæ articulis 20 (17, 18, 19), brevibus, crassis, dense et rigide setosis compositæ, duplam capitis latitudinem longitudine æquantes; oculi ocellis 4-7 magnis, in duplici serie longitudinali dispositis, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 validis, conicis, haud nigris, æquo intervallo distantibus, margine antico-laterali setis nonnullis armatæ; scuta dorsualia lævia, postica præsertim pilis longis sparse vestita, omnia angulis posticis rotundatis, 1., 3., 5., 8., 10., 12., 14. margine postico sinuata, primo excepto haud elevata, 2., 4., 6., 7., 9., 11., 13. recta; scuta ventralia omnia plana vel convexiuscula, impressionibus angularibus nullis vel brevibus; pori coxales rotundi, in ♂ 1, 2, 2, 2-4, 4, 4, 3, in ♀ 3, 3, 3, 3; pedes primi paris calcaribus 0, 1, 1; pedum analium articulus primus inermis; pedes anales breves, incrassati, unguibus 2, calcaribus 1, 2, 0, 0-1, 2, 1, 0-1, 2, 2, 0 (mas processu magno articuli quinti setigero): unguis genitalium femineorum conicus, integer; calcarium 2 paria, brevia, conica. Color dorsi testaceo-brunneus, capitis cum trophis et antennis æque ac ultimorum segmentorum cum pedibus analibus brunneus. Longitudo corporis (6-)10 m. m., antenarum (1·8-)3·5 m. m., pedum analium (2-)3 m. m.

Hab. circa flumen Jenissej ad Sopotschnaja Korga (71° 40'), Dudino (69° 15'), Selivaninskij (65° 55'), Pupkovskij (64° 42'), Nischnij Inbatskoj (63° 50'), Vorogova (60° 55').

6. *Lithobius formicarum*, n. sp.

Lamina cephalica subcircularis, margine postico subrecto, eadem longitudine ac latitudine, lævis, setis longis sparse vestita; antennæ articulis 20 moniliformibus vel cylindræcis compositæ, longe et

rigide setosæ, breviores, longitudine tertiam partem corporis superantes; oculi ocellis 4-6, in 2-3 series partim longitudinales partim subtransversas digestis, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 longis, acutis, haud validis; scuta dorsualia lævia, setis longis sparsissimis vestita, angulis posticis rotundatis, 8., 10., 12., 14. margine posticosinuata, cetera recta vel subrecta; scuta ventralia convexiuscula; pori coxales rotundi, minimi, magno intervallo distantes, in ♂ 1, 2, 2, 2; pedes primi paris calcaribus 0, 0, 1; pedum analium articulus primus inermis; pedes anales tenues, longitudine quatuor partes antennarum æquantés, setis longis sparsissimis vestiti, unguibus 2, calcaribus 1, 2, 1, 0-1, 3, 2, 0-1, 3, 2, 1 armati. Color dorsi testaceus, capitis obscurior, ventris griseus. Longitudo corporis 6.5 m. m., antennarum 2.5 m. m.

Hab. ad flumen Jenissej circa pagum Podkamenno Tunguskoj (61° 40') in coloniis formicarum. Feminas non vidimus.

7. *Lithobius crassipes*, L. Koch, 1862.

1862. *Lithobius crassipes*, L. Koch, Myriapodengatt. *Lithobius*, p. 71.

1866. — *curtipes*, Palmberg, Bidr. t. känded. om Sveriges Myriapoder Ord. Chilopoda, p. 19.

1866. — *crassipes*, Palmberg, ibidem, p. 21.

1869. — " Meinert, Naturhist. Tidsskrift, 3dje Række, Bind v. p. 263.

1869. — *crassipes*, v. Porath, Cefvers. Kgl. Vet.-Akad. Förhandl., årg. 26, p. 639.

1869. — *curtipes*, v. Porath, ibidem, p. 639.

1871. — " Stuxberg, ibidem, årg. 28, p. 501.

1871. — *crassipes*, Stuxberg, ibidem, p. 500.

1872. — " Meinert, Naturhist. Tidsskrift, 3dje Række, Bind viii. p. 340.

Lamina cephalica subquadrata, eadem fere longitudine ac latitudine, margine postico subrecto, pilis sparsissimis minimis vestita; antennæ articulis 20 moniliformibus, ultimo duplo longiore quam præcedentibus 2 junctis, compositæ, breves, tertiam partem corporis longitudinis vix assequentes; oculi ocellis 6-12, in 2-3 series longitudinales irregulares digestis (1+3, 2-1+3, 3-1+4, 3-1+4, 3, 2-1+4, 4, 3), compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 validis armatæ, setis paucis ad marginem anticum, sinu mediano profundo; scuta dorsualia obsolete rugosa, sparse vel dense pilosa, præsertim postice, angulis posticis rotundatis; pori coxales rotundi in ♂ 2, 3, 3, 2-2, 3, 3, 3-3, 3, 3, 3-4, 4, 4, 3, in ♀ 2, 3, 3, 3-3, 4, 4, 3-4, 4, 4, 3; pedes primi paris calcaribus 0, 2, 1-1, 2, 1; pedum analium articulus primus inermis; pedes anales breves, inflati, articulo quinto in mare processu parvo prædito, ungue singulo, calcaribus 1, 3, 2, 0 armati: unguis genitalium femineorum trilobus; calcarium 2 paria. Color brunneus vel castaneus, capite obscuriore aut pallidiore. Longitudo corporis 8-10 m. m.

Hab. in insula Waigatsch ad promontorium Grebennij sub

lapidibus calcareis frequentissimus, nec non circa flumen Jenissej ad pagos Nischnij Inbatskoj (63° 50') et Vorogova (60° 55').

The specimens from Waigatsch correspond better than those from Yenisei with the Scandinavian ones. Those from Yenisei, namely, differ in appearance by being much darker brown in colour; and their dorsal shields are very densely covered with hairs, which is seldom the case, and then only in a slight degree, with the specimens from Waigatsch, and, as far as I know, never with Scandinavian or South-European specimens.

Meinert (*op. cit.* 1872, pp. 341, 342) has noticed that the *Lithobius curtipes*, adopted by Palmberg in 1866, by v. Porath in 1869, and by me in 1871 as one of the Myriopods of Sweden, is not C. L. Koch's species of the same name, but a form of *L. crassipes*, L. Koch. He also corrects an error in C. L. Koch's, L. Koch's, and my own statements regarding the situation of the process-like appendage which characterizes the fifteenth pair of feet in the male. I avail myself of this opportunity to admit the truth of all this. I also remark that the *L. curtipes*, C. Koch, does not occur, or, at least, has not hitherto been found within the Scandinavian provinces, and as little in Sweden and Norway as in Denmark. Excepting the *L. forficatus* (Linné) from North-east America and the entire west of Europe from Italy and Spain to the north of Sweden, there is no species of the genus *Lithobius*, so rich in forms, that for wide geographical distribution can at present compare with *L. crassipes*, which has already been found at Bona on the coast of North Africa, in Spain, in the south of Tyrol, in Bavaria, in Denmark, in the south and middle of Sweden, in Finmark and the north of Finland, and now in the island of Waigatsch and far into Siberia near the river Yenisei.

8. *Lithobius fugax*, n. sp.

Lamina cephalica subcircularis, margine postico parum rotundato, eadem longitudine ac latitudine, lævis, setis sparsissimis minimis vestita; antennæ articulis 20 cylindræis compositæ, breves, tertiam partem corporis longitudinis superantes; oculi ocellis 9, binis posticis maximis, ab aliis parvo intervallo secretis, ceteris in circulum digestis, singulo centrali, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 validis nigris armatæ, sinu mediano profundo, paullo latiore quam longiore; scuta dorsualia lævia, haud pilosa, angulis posticis rotundatis; pori coxales rotundi in ♂ 3, 4, 4, 4-3, 5, 5, 4, in ♀ 3, 4, 4, 4-4, 4, 4, 4; pedes primi paris calcaribus 1, 2, 1; pedum analium articulus primus inermis; pedes anales mediocres, sat inflati, sparse pilosi, ungue singulo, calcaribus 1, 3, 2, 0; unguis genitalium femineorum bi- vel obsolete trilobus;

calcarium 3 vel 4 paria, longitudine subæqualia. Color dorsi testaceo-brunneus, capite obscuriore, antennis pedibusque ultimis rufo-brunneis. Longitudo corporis 12–13 m. m., antennarum 3–4 m. m., pedum analem 3 m. m.

Hab. ad urbem Krasnojarsk (56°) sat frequens.

9. *Lithobius vagabundus*, n. sp.

Lamina cephalica subquadrata, marginibus lateralibus parum rotundatis, eadem latitudine ac longitudine, lævis, setis sparsissimis vestita; antennæ articulis 20 (19) moniliformibus, ultimo 2 præcedentes longitudine æquante, rigide setosæ, longitudine tertiam partem corporis assequentes; oculi ocellis 5–6, in 2 series longitudinales subrectas digestis, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 armatæ, sinu mediano latiore quam longiore; scuta dorsualia omnia sublævia, pilis evanidis, angulis posticis rotundatis; pori coxales rotundi in ♂ 2, 3, 3, 2–3, 4, 4, 3, in ♀ 4, 4, 4, 4–4, 5, 5, 4; pedes primi paris calcaribus 0, 1, 1; pedum analem articulus primus inermis; pedes anales mediocres, sat inflati, sparse et longe setosi, articulo sexto in mare ad latus exterius sulcato, ungue singulo, calcaribus 1, 3, 2, 0–1, 3, 2, 1: unguis genitalium femineorum ad basin inflatus et crassus, acumine integer, acutus; calcarium 2 paria. Color dorsi brunneus vel testaceo-brunneus, capite segmentisque ultimis cum pedibus rufescentibus. Longitudo corporis 11 m. m., antennarum 3·5 m. m., pedum analem 3 m. m.

Hab. circa flumen Jenissej ad Vorogova (60° 50'), Intsarevo (62°), Surgutskoj (62° 50'), Aninskoj (63° 30'), Goroschinskoj (66° 17').

10. *Lithobius captivus*, n. sp.

Lamina cephalica circularis, eadem longitudine ac latitudine, lævis, setis sparsissimis prædita; antennæ articulis 20 brevibus, cylindraceis, ultimo 3 præcedentes junctos longitudine æquante, compositæ, breviores, tertiam partem corporis longitudinis haud assequentes; oculi ocellis 6 magnis, in 2 series longitudinales rectas digestis, compositi; coxæ pedum maxillarium secundi paris dentibus 2+2 validis armatæ, setis sparsis, longis præsertim ad marginem anticum vestitæ; scuta dorsualia lævia, longe et sparse setosa, 1., 3., 5., 8., 10., 12., 14. margine postico sinuata, 2., 4., 6., 7., 9., 11., 13. recta, omnia angulis posticis rotundatis; scuta ventralia plana; pori coxales in ♂ 4, 4, 4, 3, rotundi; pedes primi paris calcaribus 1, 1, 1; pedum analem articulus primus inermis; pedes anales haud longi, incrassati, setis longis, rigidis vestiti, ungue singulo, calcaribus 1, 2, 1, 0 armati—maris articulus quintus processu haud magno, setis nonnullis (4, 5, 6) rectis prædito, instructus. Color dorsi testaceo-brunneus, capitis obscurior; antennæ versus

apicem dilute brunneæ. Longitudo corporis 7·5 m. m., antennarum 2·5 m. m.

Hab. ad flumen Jenissej circa pagum Podkamenno Tun-guskoy (61° 40') in coloniis formicarum. Unum tantum specimen (♂) vidimus.

11. *Geophilus sibiricus*, n. sp.

Sat gracilis; flavus vel cereus, capite cum trophis dilute brunneo; laminis dorsualibus lævibus, non setigeris; pedes maxillares secundi paris læves, sparsissime punctati, flexi marginem frontalem non assequentes; coxæ coalitæ minus latæ, margine antico dentibus duobus minimis armatæ; unguis inermis; lamina cephalica multo longior quam latior (longitudine ad latitudinem = 5:4), lævis, supra glabra, ad latera pilis nonnullis longis vestita; lamina basalis lata, quintuplo latior quam longior; lamina præbasalis oblecta; lamina frontalis non discreta; antennæ longæ, quadruplo longiores quam caput; laminæ dorsuales læves, glabræ, obsoletius bifoveolatæ; spiracula omnia rotunda, antica magna, media et postica minima; laminæ ventrales pilis brevibus densius vestitæ, bisuleatæ, anticæ medio profunde foveolatæ; pedes sat longi, tenues: pleuræ posticæ læves, haud pilosæ, poris 12-15 magnis, partim ventralibus, partim lateralibus, partim oblectis instructæ; lamina ventralis subquadrata, lateribus subrectis, postice parum convergentibus: pori anales nulli; pedes anales pedibus paris præcedentis multo longiores, ungue longó, curvato, acuto—feminæ tenues, attenuati, parce pilosi. Pedes feminæ p. p. 57, 59. Longitudo 35-37 m. m.

Hab. ad Krasnojarsk.

12. *Geophilus pilosus*, Meinert, 1870.

“Minus robustus, ochraceus, vel præter partem mediam luridam ochraceus, capite cum trophis brunneo, pilis brevioribus densius vestitus: pedes maxillares secundi paris sat grosse, densius punctati, flexi marginem frontalem magno spatio superantes; coxæ coalitæ latæ, margine antico medio angulatim sinuato, lineis duabus chitineis valde abbreviatis, lateralibus fultæ; unguis inermis: lamina cephalica longior quam latior, sat grosse et dense punctata; lamina basalis minus lata; lamina præbasalis oblecta (lamina frontalis discreta): antennæ longæ: laminæ dorsuales densius punctatæ, præsertim posticæ, obsoletius bisuleatæ; spiracula antica, præsertim par primum, magna, rotunda; laminæ ventrales pilis densius vestitæ, anticæ medio profunde, lateribus obsoletius foveolatæ; pedes sat longi, antici paullo crassiores: pleuræ posticæ pilis longis sparse vestitæ, poris magnis profundis, numerosis infra et supra instructæ; lamina ventralis angustissima, lateribus fere parallelis: pedes anales pedibus paris antecedentis paullo longiores, pilis longioribus

sparse vestiti, unguē parvo armati—feminæ tenues attenuati, maris incrassati. Pedes feminæ p. p. 49, maris p. p. 45." (*Meinert.*) Longitudo feminæ 30–35 m. m.

Hab. circa flumen Jenissej ad pagos Nischnij Inbatskoj (63° 50') et Aninskoj (63° 30'), nec non inter urbes Krasnojarsk et Tomsk.

13. *Iulus profugus*, n. sp.

Corpus tenue, postice sensim attenuatum, ante sparse, post densius et longius crinitum; vertex sulco transverso profundiore, foveis setigeris duabus in striam productis; antennæ longitudine altitudinem corporis æquantes; oculi subtriangulares, ocellis 28, in series 7 transversas (4, 5, 5, 5, 4, 3, 2) digestis, compositi; segmentum primum læve, tenuiter aciculatum, lateribus fere semicirculariter rotundatis, supra marginem lateralem sulco singulo; segmentorum pars posterior dense et profunde striata, striis marginem posticum longo intervallo non assequentibus; pars anterior antice levis, postice tenuiter striata: foramina repugnatoria parva, longe pone suturam transversam sita; segmentum ultimum spina prominente, crassa, non acuta nec elongata; valvulæ anales non marginatæ, dense et longe setigeræ. Numerus segmentorum 40. Color fusco-brunneus; oculi nigri. Glandulæ odoriferæ perlucides. Longitudo 15 m. m., altitudo 1·3 m. m.

Hab. in Sibiria occidentali inter urbes Tomsk et Kainsk.

14. *Polydesmus clavatipes*, n. sp.

Corpus parum depressum, convexiusculum, sparse et breviter setosum, nitidum; vertex glaber, pulcherrime reticulatus, sulco longitudinali subprofundo; frons dense et longe crinita; antennæ latitudine corporis paullo longiores; segmentum primum semicirculare, ad marginem anticum 12 tuberculis minimis, lateribus productis, rotundatis; segmentorum pars posterior lateribus rotundatis, non deplanatis nec dentatis, supra tuberculata, tuberculis 36 maximâ parte evanidis, setigeris, in 3 series transversas digestis; foramina repugnatoria parva, in lateribus sita; valvulæ anales manifeste marginatæ, setis nonnullis vestitæ. Color dorsi brunneus, immixtis maculis albidis præsertim in lateribus segmentorum anticorum, linea longitudinali obscura. Longitudo 10–11 m. m., latitudo mediî corporis 1·2–1·3 m. m.

Hab. inter urbes Atschinsk et Marinsk.

15. *Polydesmus tabescens*, n. sp.

Corpus elongatum, tenue, depressum, pilis brevibus clavatis, subnitidum; vertex sulco nullo longitudinali nec transverso, una cum fronte densissime crinitus; antennæ longitudine $\frac{1}{2}$ majore quam latitudo corporis; segmentum primum semicirculare, margine

antico tuberculato, lateribus productis, fere rectangulis, supra tuberculis minimis, evanidis; segmentorum pars posterior lateribus dentatis, post rotundatis, non productis, tuberculis 36 partim evanidis, setigeris, in 3 series transversas digestis; foramina repugnatoria —?; valvulae anales marginatae, setis paucis circa aperturam vestitae. Color albidus. Longitudo 7–7.5 m. m., latitudo medii corporis 0.6–0.7 m. m.

Hab. circa flumen Jenissej ad urbem Jenissejsk et ad pagum Aninskoj (63° 30').

16. *Craspedosoma cylindricum*, n. sp.

Corpus cylindricum, crassum, sparse et rigide setosum; vertex glaber; frons ad marginem labri setis nonnullis vestita; oculi triangulares, ocellis 24, in 5 series transversas digestis (5, 5, 5, 4, 3, 2), compositi; antennae longitudine $\frac{1}{2}$ majore quam latitudo corporis; segmentum primum lateribus valde productis, supra marginem carina elevata obliqua praeditis; segmenta linea dorsuali canaliculata, antica processibus perparvis, media et postica evanidis, setigeris, ad marginem inferiorem sulco longitudinali obliquo supraque eum carina praedita; valvulae anales marginatae, ad aperturam setis paucis vestitae; setae apicales 2, parte basali crassa, triplo longiore quam latiore, pellucida. Numerus segmentorum (26, 27,) 28. Color fusco-brunneus, linea dorsuali vittisque lateralibus pallidioribus. Longitudo 11–12 m. m., latitudo medii corporis 1.6 m. m.

Hab. in Siberia occidentali inter urbes Atschinsk et Marinsk.

17. *Craspedosoma deplanatum*, n. sp.

Corpus deplanatum, dorso prope plano, setigerum; vertex glaber, non tuberculatus, laevis; frons ad marginem labri setis sparsis minimis praedita; oculi triangulares, ocellis 28, in 7 series transversas digestis (7, 6, 5, 4, 3, 2, 1), compositi; antennae longitudine majore quam altitudo medii corporis; segmentum primum lateribus parum productis, prope rectangulis, rotundatis, tuberculis setigeris parum prominentibus, sulco transverso profundiore; segmenta linea dorsuali canaliculata, lateribus valde productis et supra exaratis, margine antico-laterali rotundatis, postico-laterali acutis; valvulae anales marginatae. Numerus segmentorum 32. Color nigro-brunneus, capite segmentisque anticis pallidioribus. Longitudo 12–15 m. m., latitudo medii corporis 2–2.3 m. m.

Hab. in Siberia occidentali inter urbes Atschinsk et Marinsk.

18. *Polyzonium germanicum*, Brandt, 1834.

1834. *Polyzonium germanicum*, Brandt, Isis, p. 704.

1837. *Platyulus Audouiniaus*, Gervais, Ann. Sci. Nat. 2^me sér. t. vii., Zoologie, p. 48.

1837. *Polyzonium germanicum*, Brandt, *ibidem*, t. viii. p. 378.
 1839. *Liosoma roseum*, Motschoulsky, Bull. de Moscou, p. 44, tab. i.
 1840. *Polyzonium germanicum*, Brandt, Bull. Scientif. vii. p. 527.
 1841. — *germanicum*, Brandt, Recueil de Mém. cet. p. 50.
 1844. — „ Gervais, Ann. Sci. Nat. 3^me sér., t. ii. Zoologie,
 p. 72, tab. 5. fig. 12.
 1844. *Platyulus Audouinianus*, C. Koch, Deutschl. Crust., Myriap. &
 Arachn. 40, 17.
 1847. *Polyzonium germanicum*, Gervais, Hist. Nat. des Ins. Aptères, t. iv.
 p. 204.
 1851. — *germanicum*, Menge, Neueste Schriften der Naturforsch.
 Gesellsch. in Danzig, p. 7.
 1863. — *germanicum*, C. Koch, Die Myriapoden, Bd. i. p. 89, fig. 77.
 1866. — „ v. Porath, Sveriges Myriap., Ordn. Diplopoda,
 p. 34.
 1870. — *germanicum*, Meinert, Naturhist. Tidsskrift, 3de Række;
 Bind vi. p. 461.
 1871. — *germanicum*, Stuxberg, Öfvers. K. Vet. Akad. n. s. Förhandl.,
 årg. 27 (1870), p. 914.

Corpus depressum, convexiusculum, glabrum; caput parvum, cordi-
 forme, rostro piloso fere quadruplo brevior quam antennis; oculi
 ocellis 1, 2 vel 3, haud procul pone antennis siti, postice diver-
 gentes; antennæ articulis brevibus compositæ, longitudine dimi-
 diam corporis latitudinem haud assequentes; segmentum primum
 lateribus longe productis; segmenta omnia lævia, glabra, parte
 postica levissime aciculata; foramina repugnatoria, primo pari
 excepto, procul pone suturam transversam sita; valvulæ anales
 convexiusculæ, marginatæ, læves, glabræ. Numerus segmentorum
 43–47 (40–50). Color dorsi flavus vel fulvus, interdum vittis
 transversis obscurioribus, ventris pallidior. Longitudo 12–18 m. m.

Hab. circa flumen Jenissej ad pagos Vorogova (60° 55'),
 Nischnij Inbatskoj (63° 50'), Baklanovskij (64° 25'), Goro-
 schinskij (66° 17').

XXXI.—*Descriptions of some new Species of Annelida from
 Kerguelen's Island.* By W. C. M'INTOSH.

THIS collection was made by the British Transit-of-Venus
 Expedition, and consists of seven species, representing five
 families, one of which, however, is Nemertean. Six appear
 to be new. Like the Polyzoa and Cœlenterata, described by
 Professors Busk and Allman, they were procured by a grapple
 in the Laminarian region, under a depth of 10 fathoms. The
 Rev. A. E. Eaton (Naturalist to the Expedition) states that
 the shore was somewhat unfavourable for collecting between
 tide-marks, as it consisted for the most part of ledges of rock
 without loose boulders, or of a coarse and barren shingle. The
 mean temperature of the water between tide-marks was 36° F.

Mr. Eaton found the same paucity of Annelida in the littoral region at Spitzbergen.

The tubicolar forms and Polynoidæ occurred on the roots of *Macrocystis*, and some of the young Nereids in the usual silken tubes on the fronds of *Delesseria*. None of the Annelids were found under stones.

Family Polynoidæ.

Genus HERMADION, Kinberg.

Hermadion longicirratum, Kbg.*

This form seems to be identical with Kinberg's species from York Bay, Straits of Magellan, though the scales and bristles differ slightly from the published figures—the former being densely covered with minute spinulose papillæ, and the latter showing dorsally a less expanded distal region, with a close series of oblique rows of spines. The tip in some is slightly dilated. The ventral bristles, again, have the curve of the terminal hook pronounced, while the spinous region is rather narrow and short. All the bristles are of a deep brownish yellow hue. The antennæ, tentacular cirri, and dorsal cirri have a filiform tip attached to a bulbous region, the latter and the rest of the cirrus beneath being furnished with small clavate papillæ. Much more minute clavate papillæ occur on the palpi. The brownish scales generally have a few whitish touches: the first is circular, the succeeding reniform, and the posterior elongated from before backward. It is a large and broad form, one specimen being about $2\frac{1}{4}$ inches long.

Hab. Swain's Bay and Royal Sound, Kerguelen's Island (*Eaton*); York Bay, Strait of Magellan (*Kinberg*).

Genus EUPOLYNOË, M'I.

Eupolynoë mollis, n. sp.

This species superficially resembles *Alentia gelatinosa*, Sars, though a close examination shows many points of difference, and leaves a general impression that the form is intermediate in character between the latter and such types as *Harmothoë imbricata*, L.

The head is proportionally larger, and does not exhibit the nuchal process so characteristic of *A. gelatinosa*; and instead of the closely approximated pair of large eyes on each side, the lateral pairs are widely separated, a large one occupying the anterior prominence and a small one being situated at the posterior border. Moreover they nearly constitute a square;

* Fregatten Eugen. Resa &c. p. 22, tav. vi. fig. 33.

whereas in *A. gelatinosa* they lie in the processes of a V. The tentacle is absent; but its basal segment is very large in comparison with the antennæ and tentacular cirri. In *A. gelatinosa* they do not differ much.

The scales appear to be fifteen on each side, and they are nearly as soft as those of *A. gelatinosa*, which they further resemble (though smaller) in shape and smoothness. With regard to the latter, however, a high power shows that there is a limited area, near the outer and anterior border, covered with distinct papillæ. The dorsal cirrus has a very slight enlargement below the tapering tip (as in *A. gelatinosa*); but, in addition, it has a few minute clavate papillæ. The latter also occur on the ventral cirri.

The feet are as distinctly marked as in *Alentia*; but there is a much greater disproportion between the dorsal and ventral bristles, both of which are pale. The dorsal fascicle consists of a short series of somewhat translucent bristles with distinct spinous rows (almost as well marked as in *Evarne*), and gently tapering to a smooth portion at the tip. The long ventral bristles, again, consist of two groups, more evidently separated than in *Alentia* or *Eupolynoë anticostiensis*. The superior tuft arises behind the spine, and is composed dorsally of slender bristles with very elongated and delicately tapered spinous regions, ending in minutely bifid tips like those in *Eupolynoë anticostiensis**. A gradual change ensues toward the lower bristles (of this tuft), which have a stouter shaft, a shorter spinous region, and a strong hook with a secondary process at the tip. The bristles of the next series have still stronger shafts, shorter spinous regions; and the hook at the tip increases in size, while the secondary process diminishes. Inferiorly, again, there is a tendency to repeat the elongated spinous region and slender forked tip of the upper series.

There are nine papillæ on the dorsal border of the extruded proboscis, and the same number on the ventral surface. A filiform cirrus occurs under each inferior maxilla.

Hab. Royal Sound, Kerguelen's Island (*Eaton*).

Family Nereidæ.

Genus NEREIS, L.

Nereis Eatoni, n. sp.

This species somewhat resembles *Nereis Dumerilii*, Aud. & Ed. The head has four large eyes, the anterior pair being somewhat ovoid and by far the larger. When turned back-

* Ann. & Mag. Nat. Hist. ser. 4, vol. xiii. p. 265, pl. x. f. 3.

ward the long tentacular cirri reach to the fourteenth segment. The maxillæ have about eight distinct teeth behind the point. The paragnathi form, near each maxilla, five long rows and four shorter; and there are besides several interrupted transverse rows between the former on the ventral surface. All are composed of denticulate horny processes of microscopic size. The anterior feet have blunt processes; their cirri are shorter; and the bristles have on the whole shorter tips than in *N. Dumerilii*. The articulating end of the shaft in the latter organs has also a somewhat wider pit for the terminal process. At the twenty-fifth foot the superior lingula is rather larger than in *N. Dumerilii*, and the outline of the other processes also differs. Toward the posterior extremity (*e. g.* the sixtieth foot), again, the superior lingula forms a very prominent elongated process, which is much thicker and less pointed than in the British form; and it also differs from *N. polyodonta*, Schmarda, in this respect.

Hab. Royal Sound, Kerguelen's Island (*Eaton*).

Family Terebellidæ.

Genus AMPHITRITE, O. F. Müller.

Amphitrite kerguelenensis, n. sp.

A large form with seventeen setigerous tubercles. The cephalic region shows four lobes, viz. the ventral anterior lobe, a large process in front and beneath the first branchia, a fan-shaped lobe, and finally a large fold running from the root of the last branchia downward. The long branchiæ spring from three short trunks on each side. There is a prominent papilla below each setigerous tubercle in the first six segments, and in addition a similar process below the second branchia. The ventral scutes appear to be twelve. The hooks somewhat resemble those of *A. affinis*, Mgrn., but differ in the anterior curvature. The colour of one specimen was purplish brown.

The species forms a heavy tube of fine mud, lined by a thin chitinous secretion; and, from the flattening of the ventral surface, it would appear to lie on the bottom.

Hab. Royal Sound, Kerguelen's Island (*Eaton*).

Genus NEOTTIS, Malmgren.

Neottis antarctica, n. sp.

A very large member of the family, differing from *Thelepus* in having three groups of branchiæ on each side, and from

Grymæa by the fact that the bristle-tufts commence on the third segment, and also by the structure of the hooks. The cephalic lobe is furnished with numerous ocular specks. The bristles resemble those of *Thelepus*, as also do the hooks, which are borne on a thin lateral lamella marked by a band of dark pigment. A single process only appears in profile above the large tooth of the hook. The brownish body is peculiarly streaked posteriorly by pale transverse lines.

The animal constructs a large chitinous tube of a dark brownish colour, on which Polyzoa, Zoophytes, and Algæ flourish.

Hab. No. 3, Kerguelen's Island (*Eaton*).

Family **Serpulidæ**.

Genus SERPULA, L.

Serpula — ?

The softened specimen resembles *S. vermicularis*, L., in external appearance; but the operculum is undeveloped. The branchiæ appear to be about forty in number on each side. The anterior hooks are larger than in *S. vermicularis*, and form a triangle of quite a different shape. The uncini along the edge of the organ are seven or eight in number, the inferior, as usual, surpassing the rest in size. The posterior hooks present the same structure, and are accompanied by the brush-shaped bristles as in *S. vermicularis*.

The tube resembles that of the latter, even to the double funnels so often seen in front.

The absence of the operculum prevents further definition.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

Order **NEMERTINEA**.

Suborder ANOPLA.

Family **Lineidæ**.

Genus LINEUS, Sowerby.

Lineus corrugatus, n. sp.

Body (in spirit) flattened, rather abruptly pointed anteriorly, and more gradually posteriorly. The œsophageal region is marked externally by a series of prominent and somewhat regular rugæ, which sweep from the mouth dorsally and ventrally; so that the dorsal view recalls that observed in *Arion ater*.

Colour dark olive throughout, with the exception of a white band, which crosses the anterior border of the snout, and passes backward to the posterior third of the lateral fissure, where it bends dorsally and terminates.

The special characters are the very large mouth, with the prominent rugæ, which show that the animal probably possesses unusual powers of œsophageal protrusion—a supposition borne out by the great development of the external circular muscular fibres and the succeeding longitudinal coat of the organ. The internal glandular lining is also very firm. The outer layers of the proboscis correspond with the type in the Lineidæ; but the internal longitudinal layer is largely developed.

Hab. Swain's Bay, Kerguelen's Island (*Eaton*).

XXXII.—*Extinct LEMURINA.*

By WILLIAM HENRY FLOWER, F.R.S.

THE animals commonly known as Lemurs, from the island of Madagascar, and certain nearly related species from the African continent and the southern parts of Asia, constitute a well-defined group of mammals, which were formerly associated with the Monkeys in the Linnæan order *Primates*, and the Cuvierian *Quadrumana*, forming in the latter the third main division *Strepsirrhina* (Geoff. St.-Hilaire). As more complete knowledge of their organization has been gradually attained, the interval which separates them structurally from the Monkeys has become continually more evident; and since they cannot be placed within the limits of any of the previously constituted orders, it has been considered advisable by some naturalists to increase the ordinal divisions in their behalf, and to allow them to take rank as a distinct group, related to the *Primates* on the one hand, and to the *Carnivora* and *Insectivora* on the other*.

The disputed zoological position of the Lemurs, and the great importance which has been attached to them by some zoologists, such as Hæckel, who regard them as the direct transition between the lower and higher mammals, and as survivors of a

* For the arguments in favour of this view see Alphonse Milne-Edwards, "Observations sur quelques points de l'embryologie des Lémuriens et sur les affinités zoologiques de ces animaux," *Ann. des Sciences Nat.* Oct. 1871; and P. Gervais, "Encéphale des Lémures," *Journ. de Zoologie*, t. i. p. 7. For those for retaining them among the *Primates*, see Mivart "On *Lepilemur* and *Chirogaleus*, and on the Zoological Rank of the Lemuroidea," *Proc. Zool. Soc.* 1873, p. 484.

large group, now almost extinct, through which the higher Primates, including man, must have passed in the progress of their development, make the consideration of their ancient history one of great interest.

Until very recently fossil Lemurs were quite unknown; at all events the affinities of certain remains provisionally assigned to the group were much questioned; but within the last few years the existence of Lemuroid animals in Europe during the later Eocene and early Miocene periods has been perfectly established, and remains of a large number of animals attributed, though with less certainty, to the group have been found in beds of corresponding age in North America.

In 1862 Rüttimeyer described the fragment of a right maxilla and three molars from a siderolitic deposit (Bohnerz) at Egerkingen, near Soleure, Switzerland, under the name of *Cænopithecus lemuroides*, supposing them to belong to an animal partaking the characters of the American Monkeys and the Lemurs. These remains have, however, by most other palæontologists, been referred to an Ungulate.

More recently M. Bétille discovered, in deposits which are being worked for phosphate of lime at Sainte Néboule de Bédrier, Department of Lot, France, attributed to early Miocene age, the nearly complete cranium, and subsequently, at the same place, a portion of a ramus of a mandible of apparently the same species of animal. These were described by M. Delfortrie, in the 'Actes de la Société Linnéenne de Bordeaux,' t. xxix. 1^o liv. 1872 *, under the name of "*Palæolemur Bétillei*;" and through the kindness of M. Delfortrie and Professor Gervais, of Paris, excellent casts of both are in the Museum of the Royal College of Surgeons. The cranium is generally well preserved; but unfortunately the anterior part, containing the incisor and canine teeth, has been broken off. The crowns of the premolars also are destroyed; but their number and characters are indicated by their roots, and the molars are complete on both sides. The affinity to the Lemurine animals, and especially to the African forms, the *Nycticebinæ* and *Galaginæ*, is chiefly shown by the general form of the cranium, the large size and anterior direction of the orbits, the small and narrow muzzle, and the position of the lachrymal foramen outside the anterior edge of the orbit. In size the fossil is intermediate between the Potto (*Perodicticus potto*) and *Galago crassicaudatus*. The whole skull, however, is more depressed, the orbits are smaller, the brain-cavity relatively smaller and more constricted behind the orbits, and the

* See also 'Journal de Zoologie,' tome ii. p. 415.

muscular ridges more developed than in any existing member of the group. The occipital ridge is very marked; and the upper borders of the temporal muscles meet in the middle line, forming a well-marked sagittal crest, as is the case with *Loris tardigradus* and the larger Galagos, but not with the Potto.

The ramus of the mandible is considerably deeper and stouter than in any existing form. The number of the molar series appears to be $p. \frac{4}{4}$, $m. \frac{3}{3}$, the typical number in the Eocene mammals, and therefore one more premolar than in the existing *Lemurinae*, and two more than in the *Indrisinae*. The upper molar teeth are of a much more simple and primitive character than in existing Lemurs, being nearly equal in size and having nearly square crowns, with four distinct cusps, one at each angle, rather obliquely placed, the inner ones behind the corresponding outer cusps, and with the transverse or rather oblique connecting ridges but little developed. The third molar has the postero-internal cusp rudimentary.

In the mandible six teeth are preserved, the two in front (pm. 2 and pm. 3) each with one cusp. In the third (pm. 4) the cusp is broad and almost bifid, and the heel is so well developed that it closely approaches a true molar in form. The latter show very much the characters of the lower molars of the smaller Lophiodons, having two pairs of obliquely placed cusps, connected by transverse ridges, anterior and posterior, with an oblique ridge running forwards and inwards from the postero-external cusp. The last has an additional posterior tubercle. This pattern of tooth, which is the foundation of that of all the Perissodactyles, however modified, is also that on which that of the existing Lemurs is based, and is retained most clearly in the Tailless Potto (*Perodicticus calabarensis**).

On the whole, then, it appears that the animal whose skull was discovered at Bédouer was correctly assigned by Delfortrie to the Lemurine group, though it cannot be placed in any of the existing genera, and shows in all its cranial and dental characters such modifications as might be expected in an ancient form, being decidedly more generalized and lower than any of the living Lemurs. Of these, however, it more nearly resembles the Indo-African forms, and not those of the island of Madagascar or of the extreme east, having no near relationship with *Tarsius*, *Chiromys*, or the *Indrisinae*, and not much with the true Lemurs. If the bones of its feet could be found, their structure would afford most valuable evidence of the

* See Huxley, "On the Angwántibo (*Arctocebus calabarensis*)," Proc. Zool. Soc., June 28, 1864.

state of development of the group at the period in which it lived.

A most interesting circumstance was brought to light when M. Delfortrie's specimen came into the hands of M. Gaudry, of Paris. That experienced and accurate palæontologist, with the rich treasures of the Paris Museum at his hand for comparison, recognized that certain more or less fragmentary specimens which had long been in the collection, and had been described from the teeth alone, and generally, though doubtfully, referred to the Ungulata, were really nothing more than animals of the same group, and probably even the same species as *Palæolemur Betaillei*. These are:—*Adapis parisiensis*, Cuvier, from the Paris gypsum, described and figured in the 'Ossemens Fossiles;' *Aphelotherium Duvernoyi*, Gervais, from the same beds; and other specimens from Barthélemy, near Apt. This result is fully acquiesced in by Gervais*, who also adds *Cænopithecus lemuroides*, Rüttimeyer, to the synonyms of the animal, which must henceforth be called *Adapis parisiensis*, as that was the first name assigned to it.

M. Delfortrie's announcement of a fossil lemur from the south of France was soon followed by that of another species by M. H. Filhol, named *Necrolemur antiquus* ('Comptes Rendus,' 1873, tome lxxvii. p. 1111), which was afterwards more fully described and figured in an important memoir †, in which the Lemurian affinities of *Adapis* are criticised, and a second and considerably larger species, *Adapis magnus*, Filhol, found in phosphatic deposits at Raynal, added to the group. The latter, of which the skull was upwards of four inches in length, resembles M. Delfortrie's in its general characters, but modified much in the way that the skulls of larger animals of natural groups differ from the smaller ones. The brain-chamber and orbits are relatively smaller, the face larger, the muscular crests more developed, the constriction between the cerebral and facial portions of the skull more marked. These modifications remove the skull in its general characters still further from the existing Lemurs—so much so that M. Filhol refers it and the other species of *Adapis* to a distinct and hitherto unknown zoological type, intermediate between the Lemurs and the Pachyderms, to which he gives the name of *Pachylemur*. On the other hand, the *Necrolemur antiquus* found at St. Antonin, which is a very small species, scarcely exceeding the smallest living Lemur (*Chirogaleus rufus*) in size,

* Journal de Zoologie, tome ii. p. 421.

† "Nouvelles Observations sur les Mammifères des Gisements de Phosphate de Chaux (Lémuriens et Pachylémuriens)," Annales des Sciences Géologiques, tome v. (no. 4), 1874.

he considers to be a true Lemuroid, more nearly resembling *Galago senegalensis* than any other existing species. Unfortunately, as in both the other examples, the anterior part of the face is so much injured, that the characters and number of the incisor teeth cannot be ascertained. This is a great want in determining the true affinities of these animals, as the condition of the incisors is very characteristic of all modern Lemurs. M. Filhol assumes that there are but three premolars above and below in *Necrolemur*, and that it presents therefore a much closer resemblance to the true Lemurs than to his *Pachylemur*; but I do not see (judging only by the figures which he gives) why the first tooth present should not be a premolar as well as a canine, in which case the dental formula would be the same in both; and otherwise it appears to me that the three heads he figures (*Necrolemur antiquus*, *Palæolemur Billei*, and *Adapis magnus*) form a natural series, the first standing to the second very much in the same relation of proportions &c. as this does to the third. This is particularly well seen in the upper surface, where the temporal crests are separate as far back as the occiput in the little *Necrolemur*, unite about the middle of the parietal region in *Palæolemur*, and in the frontal region in *Adapis magnus*. Similar differences are found among existing members of closely allied forms, in the Carnivora, Insectivora, and even the Lemurs themselves. I therefore do not think that M. Filhol's conclusion that *Necrolemur* is to be regarded as an early Miocene Lemurine, only generically separated from *Galago* or *Hapalemur*, while *Adapis* is a representative of a totally distinct zoological type, is admissible. Such evidence as is before us leads to the supposition that all three are nearly related primitive Lemuroids; but, in the absence of all knowledge of the structure of the limbs, their position cannot be satisfactorily determined.

The recognition of some of the supposed Ungulates of the Paris gypsums as Lemuroids shows how little reliance can be placed upon the characters of the molar teeth alone in judging of the affinities of an animal, and must also lead to the re-examination of some of the smaller mammals of our own Tertiaries, such as *Miolophus*, as it is not improbable that Lemurs may be found among them.

Perhaps the most important of all the numerous recent palæontological discoveries in the Tertiary beds of the Rocky-Mountain district of North America has been that of animals which their describers believe to be low and generalized forms of the order Primates. Their existence was not suspected till

1872, in which year Professor Marsh* and Professor Cope † almost simultaneously announced the fact. Since that time as many as fifteen genera have been assigned to the group, including five previously described by Leidy from teeth alone as being of uncertain position. These are nearly all from Eocene formations, though two have been found in the lower Miocene.

Until we receive fuller information and figures or casts of the remains of these animals, it is premature to speculate upon their real characters or affinities. The difficulty of doing so at present is enhanced by their describers, in the provisional accounts already given, adopting the old assumption that Lemurs and Monkeys are very nearly related, and speaking of them sometimes as one and sometimes as the other. Of course it is possible that these animals or some of them may have been Monkeys, in which case they were not Lemurs; or they may have been Lemurs, in which case they were not Monkeys †. It is possible also that they may form the connecting link between the two, and so justify their old association in one group. Looking at their geographical position, we should be more inclined to regard them rather as the ancestral forms of the present American monkeys, or perhaps of all the *Simiina*, since there seems great reason now to believe that North America was in those days a great region of development, in which arose many of the forms which spread at a later period over the Old World. In this case the Lemurs, which, judging from their present distribution, appear to have spread east and west from Madagascar, or the hypothetical submerged continent "Lemuria," may have had quite a different origin.

The question can only be determined by a rigid and unbiased comparison of the remains, when sufficient materials have accumulated, and is without doubt one well worthy of the devotion of any amount of patience and labour which may be bestowed upon it.

* Am. Journ. Sci. & Arts, vol. v. p. 405, Nov. 1872.

† Proc. Amer. Philos. Soc. 1872, p. 554. See also Cope, "On the Primitive types of the orders of the Mammalia Educabilia," Am. Philos. Soc. April 18, 1873; and Marsh, Am. Journ. Sci. & Arts, vol. ix., March 1875.

‡ Prof. Marsh expressly states, "From numerous specimens the writer has ascertained that the *Limnotheridæ* should be placed in the *Prosimiæ*. The brain was nearly smooth, and the cerebellum large and placed mainly behind the cerebrum. The orbits are open behind, and the lachrymal foramen is outside the orbit." The last-mentioned character is certainly specially Lemurine, though the others are common to the early types of mammals, and widely different from those of modern monkeys.

MISCELLANEOUS.

Note on the Embryogeny of Salmacina Dysteri, Huxley.

By M. A. GIARD.

THE ovarian ovum of *Salmacina Dysteri* presents a transparent vesicle containing, besides the nucleolus, a fine network of protoplasm analogous to that which has been described by O. Herwig in *Toxopneustes lividus*; I have observed the same reticulum in the ovular nucleus of *Lamellaria perspicua*. The egg when deposited remains in incubation under the mantle of the adult and then undergoes the first phases of its evolution. This egg possesses a vitellus of a fine currant-red colour and a very distinct vitelline membrane. After fecundation the germinal vesicle ceases to be visible, and at one point of the surface of the egg we see appear a finely granular circular spot, opposite to which we observe two polar globules. The latter indicate the pole of the egg at which the exodermic elements will subsequently be produced. The spot disappears in its turn, and the egg undergoes a constriction, which is less strongly marked on the side where the spot was than on the other side. Towards the summit of each of the two halves of the egg, on the side where the separation is best marked, stars are seen similar to those described by Flemming in the segmentation of the egg of *Anodonta*, and by other authors in a great number of animals. Soon there are formed, in place of the stars, nuclei situated at the upper part of the globes which have become spherical. Each nucleus is surrounded by a tolerably extensive zone of finely granular formative vitellus. The egg then divides into four equal spheres, two of which touch each other, separating the two others, and thus forming a cross. At the stage of 8 the plastic elements separate from the nutritive elements and give origin to four small spheres situated in a plane superior to the four mixed spheres and alternating with the latter. The four little spheres are the first rudiments of the exoderm; the pole at which they are situated corresponds to the ventral surface of the future embryo.

The difference between the segmentation of the ovum of *Salmacina* and that which has been described in other Annelides by Claparède, Metschnikoff, and Häckel is the same as between the segmentation of the ovum of numerous Eolididæ (*Eolis aurantiaca*, A. & H., for example) and that of *Purpura lapillus* (Selenka) or that of *Brachionus* (Salesky). The multiplication of the exodermic elements is much more rapid than that of the nutritive spheres; nevertheless the latter increase in number, and the plastic part contained in each of them becomes less and less considerable. Soon an invagination is produced on the nutritive side, at the same time that the epibolism of the exodermic elements completes the constitution of the *gastrula*. The *prostoma* (*blastopore* of Ray Lankester) is at first widely open; but it soon becomes contracted. Its contour is not perfectly circular, but there exists at one point an emargination which is continued by a furrow of the exoderm. This furrow by

degrees extends nearly over one third of the surface of the ovum; it closes rapidly, thus englobing the exodermic elements in the ventral part of the embryo. The *prostoma* is still visible, after the disappearance of the furrow, at the inferior extremity of the embryo, in the neighbourhood of the point where the definitive anus will subsequently be formed. From this moment the egg becomes elongated in the direction of an axis passing through the centre and the *prostoma*. The cavity of segmentation is more and more visible between the transparent exoderm and the deep red entoderm.

The embryo then assumes the form *trochosphaera*. On each side of the anterior part two cells of the exoderm give origin to crystallines, which are soon surrounded at their base by a red pigment. Towards the anterior third there is produced round the body an invagination of the cylindrical cells of the exoderm. The invaginated cells become more refringent and contractile; then the invagination returning, they reappear furnished with long flagella. It is at this point that the embryo issues from the egg; but whilst in some Annelides (*Phyllodoce* for example) the *trochosphaera* swims freely in the water, in *Salmacina* the embryo at this stage remains still under the maternal fold; and it is only by breaking the *cormi* that we can follow these first phases of the development. The embryo is slightly bent upon itself; the convex (dorsal) part contains the nutritive elements; the mouth forms on the ventral surface, a little below the vibratile cincture. The part of the embryo above the cincture becomes differentiated into a rounded head no longer containing endodermic elements.

The larva at the moment of its quitting the maternal tube to swim freely possesses the following parts:—1, a rounded head, containing the four eyes, and furnished at the anterior part with three rigid cilia; 2, a cervical part, narrower than the head, having at the cincture long flagella, below which are other, smaller and more numerous cilia, and on the ventral surface the mouth, the circular aperture of which is likewise margined with vibratile cilia; 3, the mantle, formed by a fold of the exoderm, which descends like an apron over the ventral part and rises on the dorsal surface into two epaulet-like organs: the head and neck may conceal themselves in part beneath this exodermic fold; 4, beneath the mantle, and in part concealed by it, at least on the ventral side, there is a portion of the body as wide as the head, which I shall call the *thoracic portion*, because it represents the thorax of the adult animal, or rather the first three segments of the thorax. This part bears three pairs of bundles of setæ. Each bundle contains two setæ; and the setæ of the first bundles are dissimilar. At the base of the second and third pairs of bundles we observe glands (two to each bundle) with granular contents, belonging to the exoderm; below the second pair there are four hooks (unciform plates); below the third pair three hooks. At the extremity of the body of the larva there is also on each side a strong hook, and in the vicinity of the anus two long, rigid cilia. The whole anterior ventral part of the body of the embryo contains large cells with a very distinct and refringent

nucleus and finely granular contents. These cells appear to me to be comparable to those which have been described in the same situation in *Hydatina senta*, and by Ray Lankester in the embryo of *Pisidium pusillum*.—*Comptes Rendus*, January 17, 1876, p. 233.

On the Range of the Striped Opossum.

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

GENTLEMEN,—Permit me, through the medium of your valuable publication, to add a new locality to the already very extensive range of the Striped Opossum, *Dactylopsila trivirgata* (Gray). I have lately received from the Herbert River, near Rockingham Bay, a very fine young specimen of this interesting animal. It differs only from Dr. Gray's description in the great length of the fur on the body and tail, and in the dark parts being of a jet-black colour; the hands and feet are of a pale buff, the terminal third of the tail white, the remaining basal portion black above, mixed with white on the sides and whitish below. For this specimen we are indebted to Mr. J. Montgomery, of the Department of Roads for the District of Cardwell.

Yours truly,

Australian Museum,
Sydney.

E. PIERSON RAMSAY,
Curator.

On the Natural History of the Rockingham-Bay District, Australia.

By E. PIERSON RAMSAY, Curator, Australian Museum, Sydney.

Rockingham-Bay district is a most interesting one for the naturalist. I have myself travelled over the greater portion of the settled districts of the eastern and southern parts of Australia; but in no one place have I met with so large a fauna, the birds alone amounting to about 300 species, including sea-birds. The mammals, including three new species and one of a new genus lately described by me, amount to about 20 species. With insects of all orders the whole district is teeming. The Lepidoptera, of the genera *Papilio*, *Ornithoptera*, &c., are particularly rich and highly coloured; of the Sphingidæ I obtained 8 species, among them three new to science, which I hope shortly to find time to describe.

The only class in which the district appeared to be poor was the land and freshwater shells. Within a radius of about fifty miles, to which my researches were chiefly confined, I only obtained about 15 species, including the genera *Helix*, *Pupina*, *Bulimus*, *Vitrina*, *Geotrochus*, *Physa*, *Lymnea*, *Melania*, *Cyclas*, and *Anodonta*.

The groves of banana (*Musa Banksii*, Müller) and of the noble palm trees were remarkable for their beauty and elegance. I was particularly struck with one, an immense shield-palm, with peltate fronds, and measuring in long diameter 6 feet, short diameter being about 5 feet. This noble species was noticeable at a great distance, its large shield-like leaves presenting broad, well-defined green disks cropping out here and there through the luxuriant vegetation which

so densely clothes the sides of the ranges. My friend the Baron F. von Mueller informs me this plant is quite new to science.

I collected the following species in the Herbert-River district:—

Ptychosperma Alexandræ. This species grows much taller and thinner than the same(?) species further south. The southern limit is, I believe, Rockhampton (although an allied species is found near Toowomba, in the Brisbane district). The seeds also are very much smaller, and of a bright red, oval and pointed.

Kentia Wentlandtiana(?). A species easily distinguished from others in the district by the blunt serrated tips of the pinnae, and broad fan-shaped terminal pinnae of the fronds. It grows within the influence of the tide in almost salt water, on the margins of rivers and creeks near the sea, but is also found in the deep ravines of the mountains.

Kentia Cunninghamsi. I find no difference between this plant and the "bungalow palm" of the Illawarra district.

Livistonia, sp. (*humilis*?). A species resembling our New-South-Wales *Corypha australis*. The fruits are round, plum-coloured when ripe. Grows on the tops of stony ridges, and seldom exceeds 15 feet in height.

Livistonia, sp. A distinct palm from any of the foregoing, found growing within the influence of salt water. Fruit black, round. Species not yet determined.

Calamus of three distinct species abound in the scrubs, some growing to an incredible length, often 400 to 500 yards. One of the largest species, when old and blackened by the effects of decaying vegetation, is much sought after for walking-sticks. The other two species are thin wiry kinds, about half an inch in diameter at most, and not unfrequently used by the natives for ties &c. Both species are distinct from *C. australis* of the New-South-Wales brushes.

Of Cycadaceæ I found 6 species, of which 3 belong to the genus *Cycas*, 1 to *Bowenia*, and 4 to *Macrozamia*. *Macrozamia Denisonii* (*Lepidozamia Peroffskyana*, Regel) grows to a great height in that district, some attaining to 20 feet. I find it mentioned by Mr. W. Hill as *Catakidozamia Hopei*. I am afraid there is very little difference, if any, between these two plants. I have them both growing under glass, and have also examined them in their native habitat.

Of *Pandanus* I noticed three species—two very closely allied, differing slightly in form of growth, but chiefly in the colour of the ripe seed (which is bright yellow in one), and in the shape of the fruits (which, however, vary much in both). The third species is found only in the damp gullies of the ranges; and is distinguished by the great length of its narrow drooping leaves, which are often *ten feet* in length. It is of a trailing habit, the stem about 3 or 4 inches in diameter and frequently 10 or 12 long, recumbent, usually over dead logs, trunks of trees, &c. Seeds small, yellow, and quite distinct in shape, few, scattered, sometimes only one or two on a "cone."

On the Functions of the Glands of the Digestive Apparatus of Insects. By M. JOUSSET.

The physiological functions of the glands of the digestive apparatus of insects have not yet been determined with sufficient certainty; hence the differences of opinion that exist in science as to the part to be attributed to each of these glands in the digestion of food.

The naturalists who have paid attention to this subject have almost always made use in their researches of the liquid contents of the digestive tube; and I have thought that the different results at which they have arrived were to be ascribed to this very defective practice, since these liquids are complex and mixed in always unknown proportions. I have therefore sought amongst the various insects for one in which the arrangement of the glandular organs might enable me to collect these liquids in the gland itself, before their entrance into the digestive tube.

The cockroach (*Blatta orientalis*) is in this case. The three glandular groups of its digestive apparatus are very favourable to experiment and arranged as follows: the upper region, consisting of an œsophagus, a crop, and a tritulatory apparatus, bears œsophageal glands in bunches, called *salivary glands*, nearly 1 centim. in length; the middle region or stomach presents eight glandular cœca, 4 or 5 millims. in length; and, lastly, the lower region, or intestine, bears Malpighian tubes which are easily isolated. These three glandular apparatus occur in all insects; but they vary much in dimensions, and are usually too small to enable us to collect the contents in a state of purity. The cockroach thus forms a fortunate exception.

By experimenting with these liquids collected before their entrance into the digestive tube, I have been able to ascertain that the sole agent in the digestion of amylaceous matters is the secretion-product of the œsophageal or salivary glands. I have convinced myself, by direct experiment, that none of the other glands possesses a marked action upon amylaceous substances, and that the secretion-product of the salivary glands has no action upon the albumenoid and fatty foods. I think that the digestion of feculent substances takes place principally in the crop in those insects which have the œsophageal glands greatly developed, like the cockroach—and that when these glands are small and lodged in the walls of the œsophagus, this digestion, which in this case is of little importance, takes place in the stomach. The glucose produced is absorbed by the stomach and does not pass into the intestine.

The cœca which surround the stomach are endowed with quite different properties. They secrete a yellowish liquid, which is feebly but distinctly acid. After collecting a sufficient quantity, I ascertained that, as already stated, it has no action upon amylaceous matters, but that it dissolves with remarkable energy the albumenoid substances, coagulated albumen, cascine, and in particular fibrine, of which it rapidly liquefies as much as twice its own volume. I

have also ascertained that the albumenoids were not simply dissolved, but transformed into true peptones, no longer coagulable by heat or by acids, but only by bichloride of mercury.

The liquid of the cæca further possesses the property of energetically emulsionizing fats, a property which is not shared either by the salivary glands or by the Malpighian tubes. This emulsion lasts for a very long time and acquires a marked acidity.

We see, therefore, that in a general way the product of the gastric cæca constitutes the most important agent of digestion in insects; and those of them which, like the herbivorous insects, feed upon substances difficult of digestion, possess innumerable gastric cæca and have at their service a great quantity of this liquid. This property of emulsionizing and acidifying fatty matters, which the gastric juice of the Vertebrata does not possess, appears to approximate this product of secretion to the pancreatic juice; and the assimilation would be complete if it applied also to the amylaceous substances; but we have seen that this function belongs exclusively to the œsophageal glands in the digestion of insects. Nevertheless, taking into consideration the weak acidity of the liquid of the cæca and its action upon fats, I incline to regard it as presenting much analogy with the pancreatic juice, the character of the action upon starches not being primordial in the pancreas, as M. Claude Bernard has demonstrated that, in certain fishes, this organ is already destitute of action upon amylaceous matters.

However this may be, I believe that the peptones formed in the stomach and the fatty emulsions are absorbed at once by the walls of the stomach, which is the essential part of the digestive apparatus and plays the double part of the stomach and the small intestines of the Vertebrata. The materials which have resisted these actions, and which are consequently unfit for digestion, alone pass into the intestine, which I regard as playing scarcely any part in digestion properly so called.

The Malpighian tubes in these researches have always offered clearly negative characters. Their product of secretion does not act upon amylaceous substances, or upon albumenoids, or upon fatty matters. This confirms the opinion generally adopted that this group of glands is purely and simply an organ of excretion, a urinary organ probably more complete than that of the Vertebrata, since it is the sole eliminating organ of insects. The presence here of uric acid and of urates has long since been ascertained; but perhaps they furnish other principles analogous to the excremential matters that the liver has to eliminate in the Vertebrata.

These researches confirm the opinion long ago maintained by M. Blanchard as to the very high grade that insects should occupy in the animal series. We see, in fact, that their digestive functions greatly approximate to those of the higher Vertebrata.—*Comptes Rendus*, January 3, 1876, p. 96.

On the Floral Glands of Parnassia palustris; new Physiological Functions. By M. E. HECKEL.

The beautiful floral glands which are admired by all observers in *Parnassia palustris* have long attracted the attention of physiologists from the point of view of their functions. From Conrad Sprengel to the present day most authors have thought that these singular organs play directly or indirectly an important part in the act of fecundation. Having had to observe this flower with reference to the staminal movement, and with the view of establishing, by resuming the study of this phenomenon*, a relation between the foliar and floral cycles, I was led, in order to utilize my many hours of observation, to divide my attention between the male organs and the glands in their neighbourhood. I observed them on the spot and under the most natural condition, during a residence in the environs of Murat (Cantal), at the end of August and the beginning of September.

The most important fact which struck me at the outset, and the observation of which has led me to doubt the reality of the part ascribed to the floral glands when they are regarded as destined to attract the insects which are the agents of fecundation, is the following:—The product of secretion, which is always limpid, and does not contain the pollen fallen from the extrorse anthers, far from being comparable to that of most nectaries, is not saccharine, has no peculiar odour, is sticky, and shows an acid reaction with litmus paper. A very simple experiment showed me that these glands are not indispensable to fecundation, and that, notwithstanding the defective arrangement of the anthers, this act is accomplished normally when the floral glands have been removed from the bud before arriving at their full development; lastly, a capital fact results from prolonged observation:—I have seen no insect penetrate into the perfect flowers except a few little Diptera, which, being perhaps attracted by the product of secretion of the glands forming a barrier round the andrœcium, are immediately stuck fast by this viscous liquid. As in the *Droseræ* I have remarked that, under the influence of the irritation produced by the presence of the insects, the liquid became more abundant; the animal soon died, and was broken up into its constituent parts. In order to appreciate better the action of this liquid, I applied to the largest of these glands very small pieces of raw flesh, which were at last dissolved, and disappeared, in the same way as in the case of the leaves of *Pinguicula vulgaris*. Would the fact which I here indicate, and which would lead me to see in the floral glands of *Parnassia palustris* a carnivorous organ, be an exception in the life of the plant? Must we see in it evidence of ancient habits which at a certain epoch characterized a whole series of plants which are unknown to us, and of which the *Parnassia* would only be an isolated term? It is difficult to reply to such

* It has already been very carefully observed by M. A. Gris (*Comptes Rendus*, tome lxxvii. p. 912, 1868).

questions ; but I would note that the fact which constitutes the subject of this note is not so novel as might be supposed. Jean Bauhin, in his 'Historia Plantarum' (1651), expresses himself as follows with regard to this same plant, which he calls *Gramen Parnassi*:—"Quinque radiatis staminibus, albis apicibus . . . quibus totidem interjecta alternatim staminum flavescens *muscaria*." The double meaning of this last word may perfectly well be interpreted in favour of the fact which I now point out ; and the "flycatcher" would thus have been recognized more than two centuries ago.

M. Duval-Jouve, in connexion with these organs and with my observations, has been kind enough to communicate to me the manner in which he regards their morphological signification. With the learned botanist of Montpellier the *muscaria* would be organs derived from those that we meet with at the base of the petals of the Hellebores. If these glandiferous twists be cleft longitudinally, we get, by spreading out the unrolled twist, the surface of a floral gland. To render the similitude more striking, it is necessary only to suppose the gland which occupies the bottom of the cone divided and transferred to the apex of each of the fibro-vascular axes which, as I have ascertained, exist to the number of from 13 to 15 in the parenchyma of the organ. According to this mode of contemplating the facts, the *Parnassia* would have to be placed close to the Ranunculaceæ, as has already been done ; but in accepting this interpretation it would be necessary to ascribe what seems to me a very wide part, not only to the transformation of the organ, but also to the physiological appropriation of its parts ; therefore, from the narrow point of view with which I have to do, I should be more willing to follow present systematists in approximating the *Parnassia* to the Saxifrageæ and Droseraceæ, which, as we know from Darwin*, include numerous cases of well-ascertained carnivory, whilst nothing of the sort has hitherto been observed among the Ranunculaceæ.—*Comptes Rendus*, January 3, 1876, p. 99.

"Ornithological Errors in the 'Reliquiæ Aquitanicæ.'"

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

GENTLEMEN,—Professor Jones (*Ann. & Mag. Nat. Hist.* ser. 4, xvii. pp. 263, 264) seems to charge me with unfairness in not imputing blame to him as regards the ornithological errors in the 'Reliquiæ Aquitanicæ.' If it will afford him any satisfaction, allow me to withdraw my expression so far as he is concerned, and impute to him the blame of not cancelling the sheet containing those errors, of which he was informed by me before it was issued to the public.

I have the honour to be, Gentlemen,

Magdalene College, Cambridge,
March 3, 1876.

Your obedient Servant,
ALFRED NEWTON.

* Insectivorous Plants, 1875.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 101. MAY 1876.

XXXIII.—*Amphipodous Crustaceans. On the Genera Hyale and Anonyx and a new Species of Probolium.* By the Rev. T. R. R. STEBBING, M.A.

[Plates XVIII. & XIX.]

Hyale Nilsoni and *Hyale Lubbockiana*.

The late Axel Boeck, in his 'Crustacea Amphipoda borealia et arctica,' unites under Rathke's genus *Hyale* the *Allorchestes* of Dana and the *Nicea* of Nicolet. Among the generic characters, he states that the telson is short, thick, and divided. Mr. Spence Bate, on the other hand, in his important and useful British-Museum Catalogue of Amphipodous Crustacea, keeps the three genera distinct—describing *Allorchestes* as having "the telson single," *Nicea* as having the superior and inferior antennæ subequal, "the rest of the animal generally resembling *Allorchestes*, except the telson, which is deeply cleft (or double?)," and finally assigning to *Hyale* a simple telson, though figuring that of *Hyale pontica* as cleft or double. At the same time Mr. Spence Bate expresses his own inclination to classify Rathke's *Hyale* near to *Nicea* of Nicolet, though, as he had not himself seen a specimen of *Hyale*, he felt bound to adopt Dana's arrangement of the genus in the subfamily *Lysianassinæ*. In the 'British Sessile-eyed Crustacea,' by Messrs. Bate and Westwood, the genus *Allorchestes* is stated to have "the telson single;" but there again, by a curious

Ann. & Mag. N. Hist. Ser. 4. Vol. xvii. 23

discrepancy, the figure of *Allorchestes imbricatus* shows the telson divided. Specimens, moreover, from Torbay of a species in other respects agreeing with *Allorchestes Nilssoni* undoubtedly have a divided telson. There is, indeed, a suspicious similarity between the figures in the Museum Catalogue of *Allorchestes Nilssoni* and *Hyale pontica*; but whether these two are identical or not, it is pretty clear that Axel Boeck was right in reducing the three genera *Nicea*, *Allorchestes*, and *Hyale* to one, the name *Hyale* being retained in right of priority.

But if Axel Boeck is right in uniting the genera, he is undoubtedly wrong in confounding the two species *Allorchestes Nilssoni* and *Nicea Lubbockiana*. The two are well discriminated in Mr. Spence Bate's Catalogue, to which Boeck himself refers. The Catalogue, however, describes only the male of *Allorchestes Nilssoni*, and only the female or young of *Nicea Lubbockiana*; this is the case also with the subsequent work entitled 'British Sessile-eyed Crustacea.'

Both of the species, which should now be called respectively *Hyale Nilssoni* and *Hyale Lubbockiana*, seem to have an affection for tufts of *Polysiphonia* and other finely branched weeds; the young forms especially may be taken from these tufts in great numbers. Both old and young of *H. Nilssoni* are very agile, and have the faculty, not apparently shared by their neighbours, of rising on their feet and springing away in a very abrupt manner. Well-grown specimens may be taken in a state of suspended animation, rolled up in the green weeds (*Enteromorpha*) which coat the rocks at high-water mark. The adult male in both species is distinguished chiefly by his superior size generally, and by the largeness of the second gnathopods in particular. In the young the two pairs of gnathopods are closely alike and nearly of the same size, the second pair having in this respect a little the advantage. This observation applies to the females up to an age when they are already prolific, at any rate in the case of *H. Nilssoni*, though subsequently the females of that species have gnathopods agreeing in shape with those of the full-grown male. The second gnathopods are then much larger than the first, with hands about two fifths of the size of the bulky rounded claspers carried by the male.

The two species are so similar in general appearance, that it may be convenient to notice those points in which they more or less decidedly differ. In *Hyale Nilssoni*, by the extent of the flagellum, the lower antennæ are considerably longer than the upper. The lower antennæ often have the last joint of the peduncle ornamented beneath by three rows of cilia, which are not to be found in the corresponding portion

of *H. Lubbockiana*. This latter species has the two pairs of antennæ very nearly equal, although in the full-grown male the lower antennæ are noticeably longer than the upper. Here the first gnathopods have only two or three hairs on the hinder margins of the wrist and hand, whereas in *H. Nilssoni* these margins are prettily fringed with hairs springing from bead-like points of insertion, with the wrist-margin fuller and more rounded. It must, however, be observed that in the largest specimens of both sexes these limbs agree closely with the figure given by Messrs. Bate and Westwood: the fringes have almost disappeared; the hand is widened near the palm; and a re-entering angle breaks the roundness of the hinder margin of the wrist. The second gnathopods have the following minute marks of difference:—In *H. Nilssoni* the apex of the finger closes down into the extremity of the palm, which is well defined by the angle (less and less obtuse with advancing age) which it forms with the margin of the hand, this margin bearing two or three hairs very near to the angle just mentioned; in the allied species the palm is defined by two spines, and the hairs on the margin of the hand occupy a small indentation about the centre of it, while the wrist is a little more produced backwards. It is worthy of notice that in the adults of both species the metacarpus of the second gnathopods meets the hinder margin of the hand, thus occupying the space which in the young belongs to the hinder margin of the wrist. In the case of *H. Lubbockiana*, if there could be any doubt that these two forms of the second gnathopod belong to the same species, it would be set at rest by a specimen in my collection, which obligingly exhibits both forms on the same animal—the result, it may be presumed, of arrested development in the smaller limb of the pair.

In *H. Lubbockiana* the coxæ of all the legs and the thighs of the last three pairs are crenate, with minute hairs in the angles; in the other species, though the hairs are present, the crenature is wanting or inconspicuous.

The foregoing differences have been, we must admit, sufficiently minute, and requiring tolerably careful observation with a good light; but a very transient glance at the pereopoda of the two species will suffice to remove all hesitation as to their perfect specific distinctness. It will not be necessary to do more than describe the last in each series, as all the five pairs in each species have the same general character. In *H. Nilssoni*, then, the metacarpus, wrist, and hand of the last pereopod are comparatively slender. The metacarpus is armed behind with four spines, and two in front, its distal extremity being conspicuously fringed with a set before and behind. The

wrist has the hinder margin smooth, and is shorter than the metacarpus, but is otherwise like it. The hand has spines along the front margin, and a little tuft of hairs in the centre of the margin behind, with some long ones projecting from its point of junction with the finger.

In *H. Lubbockiana* all these joints are stout. The metacarpus has two short spines standing stiffly out from its hinder margin, and an inconspicuous one at the distal end, with two very small pairs on the front margin. The wrist has two pairs of short spines in front. The hand behind is continuously curved and free from hairs or spines; its anterior margin presents three sections—the first armed at the end furthest from the wrist with a stout spine, this spine terminating in a very minute hook; the next section, besides two or three small setæ, carries that which is the most striking feature of this species, a spine twice as long and twice as thick as the one just mentioned, conspicuously hooked at the end, and serrated along the lower margin; it is movable, and can be brought into contact with the large scimitar-like serrated finger; near to the junction of the hand and finger there is another spine, a copy of the preceding one on a far smaller scale.

It was noticed above that *Hyale Nilssoni* has and exercises great powers of leaping; and we might wonder that *Hyale Lubbockiana*, so similar in size and general structure, living apparently in precisely the same environment, should neglect or not possess so effective a resource for escaping from enemies. But a consideration of the spines just described seems to indicate that its safety is consulted by holding fast, while its neighbours have recourse to the opposite expedient of suddenly skipping away. Of the three spines in question, the central and largest would seem a development very difficult to explain, if its two companions did not show us actual gradations leading up to it from the ordinary simple spine—those at the extremity of the wrist supplying yet another intermediate step, and making it clear by one more example how small the changes may be by which very considerable and striking revolutions may be produced in the forms and habits of living creatures. With *Hyale Nilssoni* one might easily be tempted to make separate species for the elder and younger forms, did not a well-graduated intermediate series give very fair evidence of the family tie between them.

Anonyx serratus, Boeck.

Among the species of *Anonyx* described by Messrs. Bate and Westwood, two will be found closely resembling one

another, viz. *Anonyx Edwardsi* and *Anonyx minutus*. The former appears, however, to be identical, not with the original *Anonyx Edwardsi* of Kröyer, but with the *Anonyx serratus* of Boeck; and Boeck, in his subdivision of the genus, uniting this species with *Anonyx pinguis* and *Anonyx minutus*, has given them the generic name of *Orchomene*. A rearrangement of the specific names was doubtless needed; but the use of splitting up a genus, itself so closely allied to its neighbours *Lysianassa*, *Callisoma*, and others, is less obvious. It will, indeed, be a hard necessity for the study of sessile-eyed Crustaceans, if it is forced to accept the principles of classification worked out with so much industry by Axel Boeck, largely based as they are upon differences in the organs of the mouth. How prone authors are to register unimportant differences as characters that make for generic or specific distinction is rather amusingly illustrated in this very genus *Orchomene* of Boeck. In describing the genus he says, "epimerum quintum altius quam latius:" yet of *O. pinguis* he says, "epimerum quintum eadem altitudine ac latitudine," of *O. serrata*, "epimerum quintum latius quam altum," of *O. umbo*, "epimerum quintum in medio gibberum magnum eminens;" so that only the two remaining species, *O. minuta* and *O. Goëssii*, have the generic "epimerum quintum altius quam latius." When, moreover, the three descriptions of the species of *Orchomene* or *Anonyx* named respectively *pinguis*, *serratus*, and *minutus* are compared throughout, it will be found that they consist entirely of characters which are exceedingly liable to vary with age and sex. The same remark will apply to the *Anonyx Edwardsi* and *Anonyx minutus* described in the 'British Sessile-eyed Crustacea.' Of these two, the former is the female, the latter almost certainly the young of *Anonyx serratus*—the adult male now to be described having apparently hitherto escaped observation, unless, which is highly probable, it be the *Anonyx (Orchomene) pinguis* above mentioned.

The following are its characters. The eyes are large, reniform, and red. The upper antennæ have the first joint thick, the two following much shorter, and sloping downwards at the top. The first articulation of the flagellum is nearly as long as all the rest of it. It has two rows of hairs on the inner side, and, also on the inner side, the secondary appendage with its first articulation long, but not so long as that of the flagellum. The lower antennæ have a peduncle of short articulations, followed by a flagellum considerably longer than the whole animal, consisting of about seventy articulations gradually increasing in length and tenuity towards the end, and each surmounted by the *calcola* which has been described

(Brit. Sess. Crust. vol. i. p. 86) as found on the antennæ of *Lysianassa longicornis*, and (Ann. & Mag. Nat. Hist. ser. 4, vol. xv. Jan. 1875) also on those of *Bathyporeia pilosa* (see also Brit. Sess. Crust. vol. i. p. 92). The anterior lateral angle of the head is much produced and rounded. The first gnathopods are short and stout. The hand, which is widest at the base, is longer than the wrist; the triangular wrist is slightly produced behind at the base of the hand. The second gnathopods are long and very slender, the thighs being equal in length to hand, metacarpus, and wrist put together. For the rest, these limbs and the last three pairs of walking-legs are so fully described in the 'British Sessile-eyed Crustacea,' under the two species already cited, that nothing need be added. Of the two intermediate pairs, it is said under *Anonyx Edwardsi* that they are small, under *Anonyx minutus* that they are tolerably robust. Both statements may be accepted together, especially as from the figure of *A. Edwardsi* it would seem that the metacarpus, which is the robust part of the limb, had not been observed in the specimens described under that name. It is the custom of these animals to keep both gnathopods and the first two pairs of walking-legs, together with the long lower antennæ, closely hidden between the deep coxæ, so that in general their true characters can only be observed by dissection. The third segment of the pleon has the hinder margin very slightly serrated; the hinder margins of the two following segments are partially serrated. The first of these has a depression in the upper margin near the base, which passes beneath the preceding segment; its hinder margin is gibbous. The fifth segment has the upper margin curved and passing under that of the fourth; its hinder margin likewise presents a gibbosity. The sixth segment is squared above like the corresponding portion of *Lysianassa longicornis*, the whole tail-piece of which bears a marked resemblance to that of the animal now under discussion. The telson appears to be more or less cleft. The last pair of caudal appendages have the peduncle short and stout, the branches subequal, the lower being rather the longer, both adorned on the upper serrated margins with long cilia and armed below with short spines.

The same dredging which supplied the specimen now described yielded numerous specimens in which no differences from it could be detected, except that they were in various degrees smaller, that the last caudal appendages were not plumose, and that they did not possess the long calceolar-bearing flagella of the lower antennæ. On the other hand, they *did* exhibit the same shape and ornamentation of both pairs of gnathopods; the upper antennæ, with their inner

brushes, were the same; the walking-legs were the same; the pleon, with the exception already mentioned, was the same.

Of Boeck's three species, only *Anonyx* (*Orchomene*) *pinguis* is said to have setose branches to the last pair of caudal appendages. This species, together with that called *minutus*, is said to have red eyes, while to *serratus* black ones are assigned. Messrs. Bate and Westwood, however, say of their *Anonyx Edwardsi*, which is the *Orchomene serrata* of Boeck, that the eyes are red in the young, but become black in the adult animal. No doubt the colour is variable. Certainly in *Amphithoë littorina* the eyes, which these authors state to be black, are not unfrequently red.

As to the upper antennæ, Boeck says of the first joint of the peduncle that it is in *O. pinguis* very thick, in *O. serrata* pretty long, in *O. minuta* short and thick; while he compares the length of the first joint of the flagellum respectively to that of five or six, of two or three, and of three of the following articulations united. The other distinctions are of a similar character, relating almost exclusively to differences of dimensions. These cannot be relied on in comparing animals in other respects nearly alike, for the simple reason that in the growth of all living creatures the proportions of various parts are liable to change, and are besides very frequently different in the two sexes. Thus the head of a tall man may be one eighth of his whole height, but the head of a child will be a much larger fraction of its complete stature.

The contention here advanced, that the long lower antennæ and setose final pleopoda are in some cases characters of the male sex, is supported by the opinion which Messrs. Bate and Westwood express to the same effect in regard to a specimen of *Phoxus plumosus* (Brit. Sess. Crust. vol. ii. p. 527). It may also be considered certain that where animals are only to be distinguished by the length of the lower antennæ, those with the shorter antennæ are the females or juniors, antennæ of an intermediate length, without calceolæ, indicating a male not full-grown. Such a specimen has presented itself among others of *Anonyx serratus*.

If this rule be accepted, and the uncertainty of specific distinctions grounded on proportion of parts or setose adornment be recognized, the opinion here advocated (that the *Anonyx* or *Orchomene* variously called *pinguis*, *serratus*, or *minutus* is the one species *Anonyx serratus*) will have a good chance of prevailing. But the same data seem capable of further extension. Already Lilljeborg has shown that the *Anonyx ampulla* and *A. longipes* of the 'British Sessile-eyed Crustacea' are both of them *A. longipes*, the so-called *A. ampulla* (which has

comparatively long antennæ) being the male. It may be open to question whether *Lysianassa atlantica* may not be the young of *Lysianassa longicornis*; but any one who will read attentively the accounts given by Messrs. Bate and Westwood of *Urothoë marinus*, *U. brevicornis*, and *U. elegans* in the light of what has been said of the species of *Anonyx* and (in a former paper) of the species of *Bathyporeia*, will scarcely escape the conviction that these three descriptions belong to one species. The variation of colour exhibited by *Urothoë elegans* is not uncommon, as in *Iphimedia obesa*, *Calliope læviuscula*, and, to a striking extent, in *Cyrtophium Darwini* *.

It should be added that the white integument of the various specimens of *Anonyx* discussed in this paper displayed similar markings—markings very indefinite in shape, but many of them angular and looking like short disconnected scratches. The abrupt junction of the long narrow flagellum to the broad end of the peduncle in the lower antennæ of the full-grown male is also worthy of notice. In the other specimens, the peduncle being itself comparatively narrow, there was no special abruptness in its junction with the flagellum.

Probolium Spence-Batei, n. sp.

This pretty little species was taken in December of last year from a tidal pool at Goodrington, in Torbay. The solitary specimen obtained was a female with eggs. It measured about one tenth of an inch in length. It has all the characters of the genus *Probolium* of Costa, which answers to the genus *Montagua* of Spence Bate. The specific name is given in honour of this latter author, who has done so much to make known the curious varieties and varied beauty of Sessile-eyed,

* An extract from the 'Comptes Rendus' for Jan. 3, 1876, p. 76, in the last number of the 'Annals' (March 1876), shows me that the sexual character of the long antennæ in *Urothoë* has been already observed by M. A. Giard. In an interesting notice of the commensalism of this crustacean with a sea-urchin, M. Giard draws the inference, in regard to the species named in the 'British Sessile-eyed Crustacea,' that one sex only has been described for each of the known types, that *Urothoë Bairdi* and *Urothoë elegans* must be regarded as representing male individuals, whilst *Urothoë brevicornis* and *Urothoë marinus* are, on the contrary, figured from the female sex.

From the plumosity of the terminal caudal appendages, I had myself been inclined to class *Urothoë marinus* as a young male. But possibly this plumosity may depend on the time of life, and not on the sex. The relative sizes of the specimens, as given in the text of the British-Museum Catalogue, would then suggest that *U. marinus* is an adult female, *U. brevicornis* the undifferentiated young. In a solitary specimen obtained from Goodrington sands, Torbay, the eyes approach the reniform shape assigned to those of *U. elegans*, while the antennæ agree with those of *U. marinus*.

and specially of Amphipodous, Crustaceans. It is much to be wished that his Museum Catalogue of Amphipodous Crustaceans were supplemented by a similar volume on the Isopods of the world at large.

In *Probolium Spence-Batei* the upper antennæ are very slightly the shorter, the middle articulation being the longest of the three that form the peduncle, the last articulation of the peduncle being rather shorter than the first of the flagellum. In the lower antennæ the last articulation of the peduncle is the longest, narrowing rather sharply towards the distal end; its predecessor is somewhat shorter and thicker. The flagella of these, as of the upper antennæ, are slight, with about five articulations. The eyes are black, of moderate size. With some difficulty the incised edges of the first coxæ may be seen through the partially transparent second coxæ that overlie them. The first and second gnathopods are alike, except that the second pair have the advantage in point of size. Of these limbs, the hands are, roughly speaking, oblong, with a tendency towards an ovate shape at the base; the front margin is gently curved, the hinder margin very slightly sinuous. The palm is at right angles to these margins, having a very slight curve, but with the angle well rounded off where it meets the hinder margin, and surmounted by two short spines; along a line which runs quite straight from these spines to the insertion of the finger are set at intervals some four or five very delicate spines; the exceedingly delicate arc, of which this line forms the chord, is finely serrated or pectinate, the appearance presented being that of finely engraved lines parallel to one another, of which four or five occupy each of the spaces between the spines just mentioned at the edge of the circumference, but do not reach to the chord. The wrist is produced along the lower margins, and surmounted at the blunt apex by two or three cilia.

The telson is boat-shaped, the margin rising highest near the middle of each side. The rami of the last pleopoda were missing; their peduncles seemed rather peculiar in not being completely tubular, but open above at the distal end. The penultimate pleopoda have the branches slight, the inner being the longer of the two. In the antepenultimate pleopoda the peduncles are very long; the rami long and slender, equal to one another, not so long as the peduncle, the inner branch bearing three very small spines.

In colour there is nothing to notice but some orange-red dots scantily sprinkled on the third coxæ, and rather thickly on the fourth and broadest; a few small and faint ones could also be discerned on the thighs of the third pair of pereopoda.

EXPLANATION OF THE PLATES.

PLATE XVIII.

- Fig. 1. Hyale Nilssoni*, young male. 1 *a.* Lower antennæ. 1 *b.* Gnathopods. 1 *d.* Last pereiopod. 1 *f.* Portion of pleon. 1 *c.* Gnathopods of younger forms, retained in the female even when spawning. 1 *e.* Pleon of ditto. 1 *g.* Gnathopods of fully developed female. 1 *h.* First gnathopod of fully developed male.
- Fig. 2. Hyale Lubbockiana*, male. 2 *a.* Gnathopods of male. 2 *c.* Last pereiopod. 2 *d.* Pleon. 2 *b.* Gnathopods of young.

PLATE XIX.

- Fig. 3. Anonyx serratus*, male. 3 *a.* Antennæ. 3 *b.* First gnathopod. 3 *c.* Second gnathopod. 3 *d.* First pereiopod. 3 *e.* Pleon.
- Fig. 4. Probolium Spence-Batei*. 4 *a.* Antennæ. 4 *b.* Gnathopods. 4 *c.* Pleon.

XXXIV.—*Notes on Chrysochloris Trevelyani*. By Dr. ALBERT GÜNTHER, F.R.S., Keeper of the Zoological Department, British Museum.

[Plate XX. figs. A & B.]

In the 'Proceedings of the Zoological Society' for 1875, p. 311, I described and figured a large species of Golden Mole from British Caffraria (*Chrysochloris Trevelyani*) from a single flat skin. As the discoverer, Mr. Herbert Trevelyan, shortly afterwards returned to South Africa, I begged him to obtain more and better-preserved examples, entire if possible, or to procure at least the skull. In this he was so far successful as to send home flat skins of two adult and one younger specimen, and three skulls, one of which is in a fragmentary condition. The skins of these examples differ from the typical specimen in the fur being of a greyish brown colour, with scarcely any gloss on it, the under-fur being grey. This difference in the colour is probably due to the season of the year at which the specimens were obtained, those sent last having been killed in the course of the summer.

The skull represents one of the most singular forms in the division of Insectivorous mammals; and although its most prominent and characteristic features are indicated in the other species of *Chrysochloris*, it differs widely from their skulls as regards general form*. From the occipital crest forwards the skull is nearly equally narrow and elongate, the occipital region behind that crest being abruptly truncated, vertical—yet

* For comparison of the descriptive detail I refer to Prof. Mivart's excellent account of the skull of *Chrysochloris*, in 'Journal of Anatomy and Physiology,' ii. pp. 130 *et seqq.*

more so in perfectly adult animals than in younger ones, in which this region is rather more convex. The occipital crest is high, broad, presenting a rough surface behind; each of its halves is curved forward, and, detaching itself from the cranium, it forms, together with the posterior part of the malar bone, a broad, high, vertical shield, protecting the temporal fossa in its entire depth. The remainder of the zygomatic arch is not broader than in the much smaller *C. capensis*. The suture between the squamosal and malar bones is persistent, vertical, terminating below opposite to the glenoid fossa; and it is at this place that the greatest breadth of the skull is situated. The orbits are, as generally in *Chrysochloris*, incomplete; and there is no trace of a postorbital process; neither is the skull constricted laterally behind the orbits. As in *C. capensis* the premaxillary is produced on each side in a short process, which, however, is not so much twisted or flattened as in that species; on the other hand, the nasal aperture is more open, the nasal bones advancing less forwards, so that the terminal portions of the simple naso-turbinal and the more complex maxillo-turbinal can be clearly seen. A well-developed sagittal crest extends from the occipital crest to the nasal bone. The bony vesicle in the temporal fossa, which is so prominent in the other *Chrysochloris*, is much less developed and lower down in the fossa. The palate is of moderate width, widest between the true molars, rather concave antero-posteriorly. It is perforated by numerous minute foramina, but otherwise perfectly ossified, with a prominent tubercle on each side in front of, and close to, the posterior margin, which itself is not thickened but provided with a pointed median projection. This posterior margin is at some distance behind the level of the last molar. The hamular processes of the pterygoids are very long, slender, and pointed; the interpterygoid fossa is deep, narrowing backwards and ending in an excavation.

The auditory bulla is well developed, of a transverse oval shape, at its lower convex surface traversed by a curved ridge, the convexity of which is directed backwards. At its interno-anterior base, behind the hamular process of the pterygoid, there is a vacuity in the bulla, the orifice of the Eustachian canal, which is covered by a separate lunate ossicle (fig. B, *a*), leaning against the lateral wing of the basisphenoid. This singular ossicle, which does not exist in *C. capensis*, is but loosely attached to the surrounding bones and easily detached with the soft parts.

There are no paroccipital or mastoid projections, or the former is but slightly indicated. The glenoid cavity is small, flat, convex behind, transverse, bounded by the cranial wall

internally and behind. The mandible is narrow, narrower below the true molars than below the premolars; symphysis rather long. The coronoid process rises as a triangular plate high above the condyloid, which is directed backwards in a nearly horizontal direction; condyle obliquely transverse. The angle is much produced, expanded into a trihedral bone and somewhat bent inwards.

In regard to the various foramina of the skull and the dentition this species does not differ from *C. capensis*; they have been fully described by Mivart (*l. c.*).

EXPLANATION OF PLATE XX.

- A. Three views of the skull of *Chrysochloris Trevelyani*: the lateral and upper views, of the natural size; the lower, of twice the natural size.
- B. Lower view of the posterior part of the skull, of twice the natural size, turned so as to show the ossicle (*a*) covering the Eustachian orifice. On the left side of the skull the ossicle is removed.

XXXV.—*Description of a new Species of the Genus Nyctinomus from South Africa.* By G. E. DOBSON, M.A., M.B., F.L.S., &c.

Nyctinomus africanus, n. sp.

Upper lip smooth, without vertical wrinkles. Ears from perfectly distinct points of origin though close together, their inner margins arising from the upper surface of the muzzle, though not so near the extremity of the muzzle as in *N. Cestonii*; tragus somewhat similar to that of *N. Cestonii*, but longer, and the upper margin quite evenly rounded off; antitragus quadrilateral, the shortest side in front, the upper margin slightly concave.

Fur bright orange-chestnut above and beneath.

Incisors $\frac{2}{4}$; the lower incisors not crowded: premolars $\frac{2.2}{2.2}$; the first upper premolar very short and blunt, its base occupying the whole space between the canine and second premolar.

Length (of an adult male) 3.6 inches; tail 2.2; ear 1; tragus 0.3; forearm 2.5; thumb 0.4; second finger—metacarpal bone 2.4, first phalanx 1.1, second phalanx 1.3; fourth finger 2.4; tibia 0.75; foot and claws 0.45.

This species resembles *N. midas*, from North Africa, in size and in general appearance. The large tragus, however, at once distinguishes it from that species.

Hab. South Africa (Transvaal Republic). Type in the collection of the British Museum, presented by R. B. Sharpe, Esq.

XXXVI.—*On Fatty and Amyloid Hysterophymata.*

By H. KARSTEN.

DURING the last decennia the form of those small organized corpuscles which occur in the diseased, dying, and dead tissues of organisms, and in fermenting and putrefying fluids, &c., cellular vegetations which I have named *Hysterophymata* (see 'Faulniss und Ansteckung'), as they only originate from already existing specific organisms as morbid formations, has been frequently the subject of observation; but their chemical constitution has hitherto scarcely been referred to.

That these ferment-corpuscles are pathological cells, but not specific organisms, that their form is dependent on the prevalent conditions of nutrition, and that therefore their different developmental forms, produced by these conditions, do not make their appearance in a regular cycle as in the development of organic species, has been already proved by me partly in this *Journal* (1874, vol. xiii. p. 161 *et seqq.*), and partly in other places there referred to.

In like manner, the sequence of chemical actions during the process of the development of these cell-vegetations is not definitely limited and regular in its course like that which constantly repeats itself in endless cycles and with but slight deviations during the development of the seed or the egg, but is dependent upon the passing chemical constitution of the nutritive fluid and the physical conditions.

That these pathological cells, which accompany the morbid processes of organic creatures, which often produce these, and may even, under certain circumstances, cause the death of organisms, produce from themselves by their assimilation-processes many different products, colouring and odoriferous matters, organic acids, &c., which are usually regarded as products of organic decomposition, has been explained by me in my '*Chemismus der Pflanzenzelle*' and elsewhere. On account of the extreme smallness of these bodies, however, it has hitherto been very difficult to convince one's self of the production of these matters by their assimilating membrane. The physical and chemical properties of fat and amyloid, which matters, as I have ascertained by experiment and observation, are also produced by the assimilating activity of these *hysterophymata*, considerably facilitate our acquisition of this conviction; for just as the fats which are developed by the normal process of life of plants and animals owe their origin, according to my investigations*, to the assimilating membrane of the oil-, fat-, and

* H. Karsten, '*Gesammelte Beiträge*' &c. pp. 107, 278, 313, &c.; C. Harz, "*Olivenöl*," *Bericht der Wiener Akad.* 1870.

wax-cells, erroneously in part regarded as drops, so is the necrobiotic product adipocire the production of the metamorphosis of assimilating membranes of the hysterothymata which generate this matter.

I have observed the production of a kind of adipocire in intercostal and lumbar muscles from the pig and rabbit, which were in an atmosphere rich in carbonate of ammonia.

The production of the fat in the temperature of a room was a very tedious affair; it scarcely commenced, in the experiments made by me, under a year. The pieces of meat were hung freely in well-stopped vessels containing a little carbonate of ammonia, which was renewed from time to time. The fat thus produced was white, soft, and greasy, and chiefly soluble in ether. Perhaps an air richer in carbonic acid, or a lower temperature, would give rise to the formation of a harder fat more like adipocire.

During the slow alteration of the tissues composing the muscles there were first of all developed (in four weeks) from the *Micrococci*, which soon made their appearance, cylindrical, many-jointed *Vibriones* (*Bacteria*) in tissue (cells and fibres) of the flesh; afterwards the terminal joint-cell of these became spherically inflated ('*Chemismus der Pflanzenzelle*,' p. 25, fig. v. 4 *d*), and, indeed, first in those contained in the vessels, subsequently in those in the muscle*; then it became separated from the other joint-cells, and developed into filiform and chain-like structures (*Leptothrix*, *Mycothrix*, *Coccus*-chains); finally these also broke up into thin somewhat enlarged joint-cells, which I saw dissolve away when brought into contact with ether upon the object-bearer. In about two years the pieces of muscle were converted into a uniform fatty mass, which, when pressed under the glass cover, emitted oleaginous drops which enveloped numerous vesicles.

The process is different in the development of the amyloid, inasmuch as this does not originate from the membrane of the mother cell, *i. e.* the membrane of the *Coccus* (= *Vibrio*) itself, but from that of its daughter cells. The youngest developmental stage of the hysterothyma-germs from the normal cell-embryos of the fluid cell-contents of plants and animals contains albumen like the cell-embryos. In different *Vibriones* &c. formed during the butyric fermentation from fleshy fruits, roots, &c. (cucumbers, potatoes, beetroot, turnip, carrots, Jerusalem artichokes, dahlias), their contents-cells at about 25°-35° C. (= 77°-95° F.), and with suitable nutritive materials (I found a solution of one half per cent. of phosphate of

* I have seen a state in which the muscular fibres were completely filled with cylindrical, and the vessels with nail-like *Vibriones*.

soda and ammonia particularly favourable), acquired first of all the chemical constitution of the amyloid found in the animal body, and soon after that of lichen-starch, when the development had proceeded further. Contact with solution of iodine produces first a yellow, then a yellowish brown, afterwards a reddish violet, and then a blue coloration. Simultaneous treatment with Millon's nitrate-of-mercury solution shows likewise that the amount of albumen continually decreases. If the fluid in which the organisms rendered blue by iodine are suspended be allowed to evaporate, or warmed for some time until the iodine is evaporated, the amyloid loses its blue colour, which reappears not on cooling, but by fresh contact with solution of iodine. When boiled the amyloid hysterophymata furnish neither jelly nor paste, by which they are distinguished from vegetable amyloid and starch; chloride of calcium does not cause them to swell; alcohol leaves them unaltered.

The form of these sometimes comparatively large amyloid-forming cell-vegetations shows almost all the variations which the hysterophymata in general put on (except *Sarcina* and *Spirillum*). We find simple cells (*Cocci*) and chains of such cells, as well as *Vibriones* (called *Bacteria* in the resting state) and their chain-like series, which frequently seem to pass into *Leptothrix*-filaments, and, when they are somewhat twisted and acquire a screw-like movement, have some resemblance to *Spirillia*. Very frequently in this stage of development the *Vibriones*, by one or both the terminal cells being spherically inflated, become nail-like (*claviformis*) or handle-like (*ansæformis*); moreover the originally cylindrical *Vibriones* become club-shaped (*clavatus*) by the joint-cells towards one end being gradually inflated; or while one terminal cell swells into an oval form, the other joint-cells remain without solid contents and coalesce, and the *Vibrio* becomes tadpole-like (*gyriniformis*). All these last-mentioned forms also form chains*.

The complete development from the first excessively minute germ-cells produced during the dying-off of the mother cell, to the perfect amyloid hysterophymata (some of which grow almost to the size of milk-yeast, see 'Chemismus der Pflanzenzelle,' 1869, p. 13, fig. II. 6, and III. 2), takes place under the most favourable conditions, as above indicated, in from

* That all these form-variations of necrobiotic cells have been regarded by systematists and doctors, to whom their true nature was unknown, as new genera of peculiar organisms, is a striking proof of the necessity of a knowledge of developmental history in the investigation of organic nature (see Nüesch, 'Necrobiose,' 1875, Schaffhausen).

twenty to twenty-four hours. By observations repeated every two hours during this time we may very easily follow the whole course of development step by step, and ascertain by effecting a contraction of the secondary cells by the employment of diosmotic agents, or by sudden considerable alteration of temperature, &c., that in fact the production and development of these hystero-phymata takes place within these cells. In from eighteen to twenty hours the first indications of bluing by iodine usually occur; we find individual joints of the *Vibriones* somewhat inflated, the terminal joints most frequently, and these also separated and coloured blue by iodine in the midst of the great mass of yellow *Dicocci*, *Vibriones*, &c. which were developed somewhat later and more slowly.

The development of the hystero-phymata takes place free in the nutritive fluid, which always contains the contents which have flowed out of the torn or cut cells, and also in the cut cells themselves, much more rapidly than within the closed cells; and we may see several or all the joints of a *Vibrío* simultaneously develop daughter cells, inflated in various forms, and become coloured blue by iodine, while the germs enclosed in the cells have scarcely commenced their evolution. But all the cells of the tissue of a beetroot &c. do not behave in the same manner; nor do all simultaneously develop the same forms in their interior, but earlier or later according to the more or less albuminous nature of the contents. Hence the elongated cambium-cells in the neighbourhood of the vascular bundles are earlier than the cells of the parenchyma; whilst of the latter again some are earlier than the others, according to the constitution of their continually changing contents, which is dependent upon their age and their chemical stage of development.

The cells nearest the surface are also naturally much earlier and more intensely penetrated by the nutritive fluid and excited to the new formation above described than those situated more in the centre of the organ, which frequently develop none of the large vibrioniform cell-structures, becoming blue with iodine when some time has elapsed since the commencement of the process. In these cells *Vibriones* certainly are developed, but only albuminous ones, which are coloured yellow by iodine and reddish by Millon's salt.

It would appear that for the evolution of the amyloid hystero-phymata an organic compound soluble in water is necessary, which diffuses itself outwards from the cells situated in the interior of the tissue, where the latter is permeated by an insufficiently concentrated solution of nutritive material,—and that, on the other hand, the salts of the nutritive material are

held back by the superficial layers of cells in the same way that the humus covering prevents the nutritive salts of plants from sinking into deeper layers of the soil.

For all these reasons, there is in the portions of tissue serving for experiment, and in the nutritive fluid with which these are surrounded, a great multiplicity of developmental stages and forms of the cells originating and developing during the close of the normal process of vegetation and the commencement of the morbid processes of nutrition and growth.

Moreover the above-described variations of amyloid hysterophymata under certain circumstances furnish the most beautiful proof that they are all only developmental forms of Müller's "*Vibrio*," as I have already shown in my memoirs on the "*Chemismus der Pflanzenzelle*," 1869, and on "*Fäulniss und Ansteckung*," 1872. These comparatively large bodies, which show nothing of vibratile cilia or other organs of motion (unless we are to reckon as such the still uninflated joint-cells), are seen sometimes moving so briskly in the most different directions in a confused throng, sometimes with the thicker, sometimes with the thinner end forward, the *Vibriotwins* and chains like automatic snakes, the *Leptothrix*-filaments sometimes, when they are curved, passing one another in the form of a screw like *Spirillia*, swimming with and against the current, and apparently performing voluntary movements, that no one not familiar with the objects can be blamed for regarding these organisms as animals. And yet they are only pathological cell-forms! as their developmental history teaches us. By the addition of a trace of solution of iodine the movement is immediately stopped; the bodies, which are then coloured blue, lie motionless before the observer.

The cause of this movement, which, under favourable conditions, is extraordinarily brisk, appears to be the evolution of the gases produced from the cell-membrane during the butyric fermentation (about $\frac{2}{3}$ carbonic acid and $\frac{1}{3}$ hydrogen and carburetted hydrogen gases). As long ago as 1869 I called attention to this circumstance (*Chemismus &c.* p. 32), and said that many *Vibriones* do not lose their mobility even at the boiling-point of their nutritive fluid, as I observed at that time after the conclusion of the distillation of a fluid of this kind containing *Vibriones*, the fermentation of which continued uninterruptedly after the distillation, although care was taken that no air could penetrate into the vessel which contained the fermenting fluid.

These mobile amyloid hysterophymata, which are produced even when pure water is employed, are obtained in greatest number when a piece of beetroot is digested in a closed vessel

for twenty-four hours at a temperature of 35°–40° C. (=95°–104° F.) in a solution of one half per cent. of phosphate of soda and ammonia. At a lower temperature it takes longer under otherwise similar conditions before this phenomenon is manifested. Thus it requires four days at about 15° C. (=59° F.) and three weeks at 6° C. (=42°·8 F.). At 0°–5° C. (=32°–41° F.) we see the *Vibriones* &c., which then move less briskly and not so generally, grow in from four to six weeks from the albuminous simple germ-cells into the cylindrico-filiform and the various other above-mentioned forms of amyloid hystero-phymata.

As has already been stated, the germs diffused and freely floating in the nutritive fluid are always developed earlier than those enclosed in the cells, as also usually are those contained in the intercellular spaces (see 'Chemismus' &c. p. 35), just as in general the development of the germs between the superimposed membranes of a tissue-cell system advances from without inwards, and this not only in vegetable but also in animal cells, *e. g.* in those of cartilage.

During this development of amyloid hystero-phymata the nutritive fluid very soon becomes acid by the formation of lactic and butyric acids.

Under these conditions, at the above temperature there commences a retrogression of the amyloid bodies; the younger cell-vegetations originating in their joint-cells absorb the amyloid without forming fresh, and become developed into small *Dicocci* and *Bacteria*, which are rendered yellow by iodine.

The production of the organic acids promotes the development of the *Vibrio* joint-cells into yeast; an addition of sugar to the fluid containing amyloid hystero-phymata, even when it is boiled for hours and with the greatest care, hastens this development of yeast; so also an addition of dilute phosphoric acid, in which even fresh vegetable tissue develops yeast instead of *Vibriones*.

Schaffhausen, February 1876.

XXXVII.—*On the Actinozoan Nature of Millepora alicornis, Dana and Linn. (pars)*. By R. G. NELSON, Major-General R.E., and P. MARTIN DUNCAN, F.R.S. &c.

EVERY one who has examined the hard parts of a Millepore critically is impressed with the existence of calices, limited beneath by tabulæ, and separated by more or less spongy-looking cœnenchyma consisting of reticulate and excessively

irregular-shaped processes of carbonate of lime. The absence of septa and of a columella, and the difference in the size of the calicular openings, caused the mass to be placed with much doubt amongst the Tabulata by those who are familiar with the other genera of that heterogeneous group. And the results of the examination of the soft parts, made under many difficulties by the late Prof. L. Agassiz, removed the Millepores from the Actinozoa altogether. He wrote as follows in the 'American Journal of Science and Arts,' 2nd series, vol. xxvi. p. 140 (1858):—"The animals of *Millepora* are Hydroid acalephs and not polyps." . . . "I have seen in the Tortugas something very unexpected. *Millepora* is not an Actinoid polyp, but a genuine Hydroid, closely allied to *Hydractinia*." Dana added a note to this statement, "The drawings of Prof. Agassiz which have been sent us for examination are so obviously Hydractinian in most of their characters that no one can question the relation." Alexander Agassiz, in his charming 'Sea-side Studies' (2nd edit. 1871) and in correspondence with one of us, is satisfied with his father's correctness, and gives a drawing of the *Hydractinia*-looking polyp on the surface of *Millepora*.

The importance of these statements need not be explained; and they led L. Agassiz to examine the hard parts of the Tabulata; and he decided that much of them was sclerobasic instead of sclerodermic. It resulted from the general bearing of his researches that the Tabulata and Rugosa were shifted about by succeeding authors according to their belief in them and in the value of the Tabulata as a natural group. The Hydroid nature of *Millepora* was asserted by the majority of naturalists.

There was some dissent, however, from this generalization. Milne-Edwards, in his 'Hist. Nat. des Corall.' vol. iii. p. 224, did not consider the facts elucidated by L. Agassiz to be "assez bien connus," and he did not remove the Millepores from his Tabulata. In the third Report on the British Fossil Corals (Brit. Assoc. for Adv. of Science, 1871), one of us wrote as follows in allusion to L. Agassiz's opinions:—"Now the distinction between the Actinozoa and the Hydrozoa is well marked: in the first the generative apparatus is included in the gastric and perigastric cavities, and in the last the generative and digestive organs are perfectly apart. Every variety of tentacular and disk apparatus may exist in either; but the external development of the gemmules, ova, and embryonic forms must be recognized before any Cœlenterate animal can be associated with the Hydrozoa. Here is the point where Agassiz fails. His researches are only suggestive until the

generative organs are recognized on the protruded polyps of *Millepora*, and until the mesenterico-ovarian layers are proved not to exist within the calices. The external resemblance of the Millepore-polyps to the sterile *Hydractiniæ* is evident." In the same report it is noticed that "*Millepora* is a most aberrant genus if it be one of the Madreporarian Tabulata. I have not yet satisfied myself about the Hydroidean characteristics of its soft parts; but an examination of the cœnenchyma of a series of species throws great doubt upon the Madreporarian affinities." The intimate nature of the hard parts was thus noticed in the same Report, p. 126:—"A careful examination of the calices of good specimens determines that the trabeculæ of which the cœnenchyma is composed often projects into them in the position of septa; but there is nothing like the regular arrangement as seen in *Heliopora* or in the Poritidæ of the Perforata. The cells of the cœnenchyma may occasionally be seen to open into the space above the last tabula. The absence of septa and this relation of the cœnenchyma to the gastric spaces are most important. The tubular nature of much of the cœnenchyma is evident; and longitudinal sections prove that the spongy nature is by no means constant or uniform." In the 'Trans. Connecticut Acad. of Arts and Sciences,' vol. i. 1868-1870, Prof. E. A. Verrill demolished the theory that because *Millepora* is a Hydroid all the other Tabulata belong to the same order. He admits the Hydroid nature of the polyp of *Millepora*, and shows that Bradley has proved that *Pocillopora* has animals identical in structure with most typical genera of true polyps. He notices the twelve septa of the species of this last genus, and that the genus is a true Madreporarian allied to *Oculina* and *Stylophora*. (See also the same author, "On the Affinities of the Tabulate Corals," Proc. Essex Instit. iv. p. 90, 1869.) Bradley described the polyps of *Pocillopora lacera*, Verrill, as having twelve equal cylindrical tentacles, which are swollen at the tips (six are horizontal, and six upright: Verrill, Notes &c. p. 523).

A paper was read at the Royal Society (received Sept. 28, 1875) by H. N. Moseley, M.A., Naturalist to the 'Challenger' Expedition, "On the Structure and Relations of the Alcyonarian *Heliopora cœrulea*, with some Account of the Anatomy of a Species of *Sarcophyton*; Notes on the Structure of Species of the Genera *Millepora*, *Pocillopora*, and *Stylaster*; and Remarks on the Affinities of certain Palæozoic Corals." The author examined *Millepora alcicornis* at Bermuda and other species elsewhere, and remarks that "the examination of these Millepores was found to be beset with great difficulties," but

trusts to obtain results at the Sandwich Islands*. This difficulty is again referred to (p. 63); but some information is given regarding the question:—"The calcareous cœnenchymal tissue of *Millepora* differs extremely from that of *Heliopora* in being reticulate, not tubular: in histological structure it is similar to *Heliopora*. The coral has only a thin superficial layer of soft living tissue, composed of a network of canals filled with cells resembling those of the canals of Alcyonarians, and covered externally with nematocysts." . . . "Two kinds of polyps are present, large and small. Tentacles are present in both kinds; they appear to be four in number and compound. They are simply retracted by means of muscular fibres, which are arranged round the base of the cylindrical stomach radially, but, as far as has yet been seen, without any disposition in definite groups. No mesenteries have been seen."

Further on the author notices that "*Heliopora* is most undoubtedly an Alcyonarian. The number of its mesenteries, the distribution with regard to them of the retractor muscles, and the form and number of its tentacles are decisive evidence in the matter." Yet in a few lines, in spite of what the author had written regarding the similarity of their histological characters, we are told that with the Milleporidæ and with the Pocilloporidæ and Seriatoporidæ, *Heliopora* is allied solely on account of its possession of tabulæ. Mr. Moseley had Prof. Verrill's book to refer to, and yet appears to have forgotten Mr. Bradley's work, which his own researches prove to be correct.

Evidently in extreme perplexity, like most of us who have ventured to touch the subject of the Millepores, Mr. Moseley determines that "no certain conclusion can be arrived at from the few facts yet ascertained." In other words, the question of the structure and affinities is perfectly open.

Many years ago one of us, then Lieut. Nelson, R.E., was quartered at Bermuda; and the geological description of the Islands in the 'Transactions of the Geological Society' † was one of the results of some study there. The structure of *Millepora alcicornis* was also made a study, and drawings were

* Proc. Royal Soc. vol. xxiv. no. 164, p. 60. The author remarks:—"Few original works relating to the subjects treated of in this paper were available for reference on board the 'Challenger.'" We suppose that the whole of the writings of one of us regarding the Rugosa, in the 'Phil. Trans.,' the Palæontographical Society's publications (Secondary Corals), the papers on Australian corals, and the reports on the Tabulata and Rugosa were not there. In explaining his views regarding the Rugosa the author simply mistakes our meaning in relation to the origin of that group.

† "On the Geology of the Bermudas," Trans. Geol. Soc. 1834, 2nd ser. vol. v. p. 103.

taken of it under advantageous circumstances. For many years these drawings have been on the point of being published, and now, owing to their manifest importance, they are brought forward. In the mean time, and especially of late years, since the Tabulata were considered in the Report to the British Association already noticed, the other contributor to this paper has microscopically examined many specimens, and has worked up to the point where Lieut. (now Major-General) Nelson's long-completed work began.

There is little to add to the description of the hard parts, except to notice that all are agreed in their construction, and that the tubular nature of the coenenchyma relates to old polyp-calices in long series, the tabulæ having been absorbed or broken down. The reticulate appearance on the surface is produced by well-marked ridges and depressions; and cavities exist below the surface in this reticulate mass, which are connected with the calicular spaces. The tissue soon becomes hard and more solid with depth; and infiltration of carbonate of lime appears to have united the reticulate sclerenchymatous processes. But in the midst of branches the reticulate and apparently cellular arrangement persists. The sclerenchyma consists of fibrous-looking plain spicula, arranged side by side and above each other; there are also homogeneous carbonate of lime and granules. The soft tissues (or rather the organic basis which permeates the coral, and in and about which the calcareous element is deposited) are much more plentiful than might be expected; they can be got out by weak hydrochloric acid (dilute), and evidently line the calicular fossæ, the top of the tabulæ, and enter into the cavities in the reticulate superficial structure. The shape of the solid parts of the reticulation is retained by this means, sometimes very perfectly. Once only was a glimpse obtained of any thing like a polyp; and it foreshadowed the truth long before obtained at the Bermudas.

The polyp of *Millepora alcicornis*, as seen by one of us at Bermuda in full expansion, is a very remarkable one; and it is a great satisfaction to be able to state that L. Agassiz saw only a part of the whole, and came to his conclusions too rapidly. The polyps are of different lengths according to their growth, are slender, and stand erect in crowds around the branches (fig. 2). Each arises from a cylindrical stem, which is rendered slightly square close to four tentacles which project upwards and outwards. Their tips are swollen and rounded; and their bases are continuous by means of straight disk tissue which overlaps slightly the analogue of the oral opening. Out of this opening comes a second cylinder, to terminate in four other tentacles in the same way; and in some polyps there is a further growth; so that there are two or more rows of tentacles separated

by the tubular cylindrical tissue (fig. 1). It is evident that Agassiz saw young, ill-developed, and probably injured polyps which had not attained their second row of tentacles.

The number of tentacles may be therefore 4, 8, 12, &c. The tentacles were not noticed to be pinnate*.

In looking at this description there is a probability that *Millepora* is an Alcyonarian; and there is no proof that it is a Hydroid. The arrangement of the sclerenchyma will prevent the species being classified as Madreporarian.

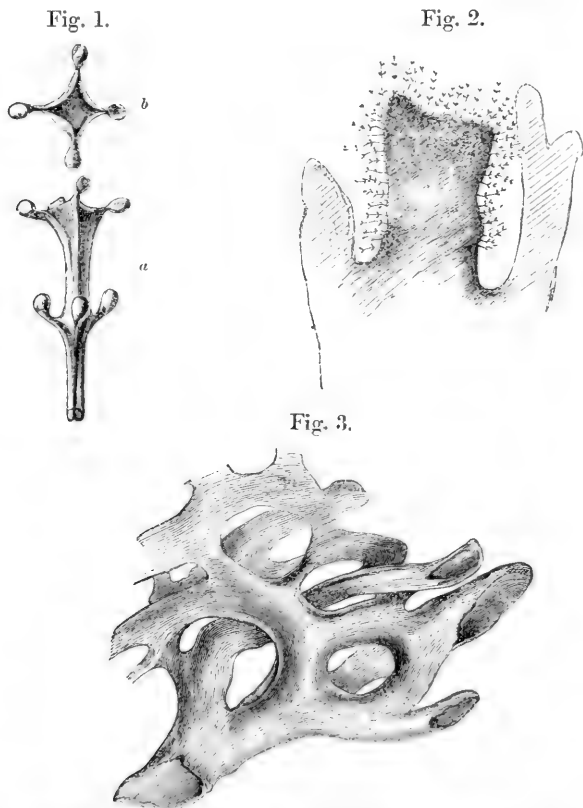


Fig. 1. Expanded polyp of *Millepora alcicornis*: *a*, side view (in some instances there are five or six whorls of tentacles); *b*, view of top.

Fig. 2. Corallum with expanded polyps.

Fig. 3. The tubular cavities of the corallum.

From drawings by Lieut. (now Major-General) Nelson, R.E.

* Pinnate tentacles are not peculiar to Alcyonarians. *Oculina diffusa* of Bermuda has them.

XXXVIII.—*Remarks on 'The Dawn of Life,' by Dr. Dawson; to which is added a Supplementary Note.* By Professors W. KING, Sc.D. &c., and T. H. ROWNEY, Ph.D. &c.

WHEN reading Dr. Carpenter's "final" manifesto* announcing that he withdrew from the Eozoic contest—obviously in consequence of his having at last become conscious of the fact that he and ourselves were working from a different base of operations, naïvely imagining all along that, as in a sporting contest, there must be some "common basis of agreement" between us—we felt it would be unnecessary for us to do any thing more in defence of our position. But as Dr. Dawson has amassed together all his old materials, with some additions, forming them into one imposing stockade, 'The Dawn of Life,' from which he has made an earnest appeal to the *vox populi* for support, we consider ourselves under the necessity of again taking up arms against a "state of things that has long ceased to be desirable in the interests of science, since the settlement of the questions raised is in the highest degree important to the history of life."

Passing over by far the largest portions of 'The Dawn of Life,' as they, and our disproofs of them, have already appeared in different scientific journals, we shall at once enter into the "fire of discussion" by noticing whatever requires our particular attention.

After carefully going over the work, we find that it will be most conducive to a correct judgment to arrange the subjects to be noticed under the following heads:—

1. Restoration of *Eozoon*.
2. "Differences between the cell-wall of *Eozoon* and a vein of chrysotile."
3. "Proper wall shifted by a fault, and more recent chrysotile vein not faulted."
4. "*Archæosphærinæ*" and other "minute foraminiferal forms."
5. New figures of "proper wall."
6. "Stromatoporoid successors of *Eozoon*."
7. "Canals filled with dolomite."
8. "Short answers" to our summarized "objections" against Eozoonism.
9. "Systematic position of *Eozoon*."
10. Natural Theology of the Eozoic Doctrine.

* 'Annals and Magazine of Natural History,' November 1874.

1. "Restoration of Eozoon."

"The place of *Eozoon* will be in the family *Nummulinidæ*, or between this and *Globigerinidæ*" (Dawson). Looking at the "Magnified and Restored Section of a portion of *Eozoon canadense*" in pl. iv. of 'The Dawn of Life'—if the author when he constructed it was unaware that no Nummulid has a canal-system passing off from the nummuline cell-wall, such as is given in the restoration (which is correct as far as the mineral configurations, aciculæ, and arborescences in ophite warrant their being thus represented), we would refer him to Mr. H. J. Carter's paper in the 'Annals' of December last, where it will be learnt, from the highest authority on the matter, that "such a relation of the 'canal-system' to 'nummuline tubulation' could not exist in a foraminiferal test either in theory or fact!" (p. 423) *.

But active believers in Eozoonism have a profound contempt for all laws of organic construction. On a former occasion we had to call attention to another restoration of the "creature of the dawn," in which its "nummuline cell-wall" was represented with an unbroken continuous line. We showed that this was based on a partial consideration of facts. Dr. Dawson has in no way profited by this correction, having represented the "wall" bounded on both sides by two continuous lines (fig. 49 *a'*, p. 176), which, though it may be a fact in the specimen, is a fallacy from a foraminiferal standpoint. The "restored section" represents "*Eozoon*" with its "first gelatinous coat of animal matter which grew upon the bottom, and which must have resembled in appearance at least the shapeless coat of living slime found in some portions of the bed of the deep sea, which has received from Huxley the name *Bathybius*." It is a sad reflection that this "protozoon of indefinite expansion," thus made the basement layer of "*Eozoon*," though examined and believed in by the highest authorities, should have turned out to be no more than a mineral substance. Is it not significant that those who accepted *Bathybius* are for the most part no-surrender champions of Eozoonism?

* The statement in 'The Dawn of Life' respecting the trumpet-mouthed "termination of one of the canals against the proper wall, its end expanding into a wide disk of sarcode on the surface of the wall, as may be seen in similar structures in modern Foraminifera" (p. 182), besides asserting a foraminiferal impossibility, shows the highly imaginative style in which things are represented by scientific Eozoonites. "Thus" how could it be otherwise than that "few even of geological and biological students have clear ideas of the real nature and mode of occurrence of *Eozoon* and its relation to better-known forms of life," or that "the crudest and most inaccurate ideas have been current in lectures and popular books, and even in text-books"?

2. "*Differences between the cell-wall of Eozoon and a vein of chrysotile.*"

It would have much surprised us if "all who have had an opportunity of examining" Dr. Dawson's "specimens" of the "proper wall of *Eozoon*" and his veins of chrysotile had not "expressed astonishment that appearances so dissimilar should have been confounded with each other" (p. 181). But to whom does the charge involved in this statement apply? Not to us; for we have from the first been careful in asserting that the typical "proper wall" is an *acicular modification* of chrysotile—that its aciculæ are cylindrical and separated by interspaces of calcite. Dr. Dawson, who has formed his own ideas respecting chrysotile, describes it as fibrous serpentine, or consisting of "closely packed angular prisms"—"angular crystals,"—and represents it with a *definite* rhombo-prismatic structure (fig. 27, p. 106). Evidently, then, as such description does not apply to the "proper wall" as we conceive it to be, our opponent has at the very outset destroyed the validity of his own argument. But more of this hereafter.

3. "*Proper wall shifted by a fault, and more recent chrysotile vein not faulted.*"

This point is evidently considered by Dr. Dawson as a *crux*. Still, notwithstanding the popular notion that what is written in a book must be true, it is really not worth the paper on which it is written. Any one acquainted with our theory of the origin of the "proper wall" will understand that it does not preclude the formation of this part at different times, and even in the same portions of a rock. Hence the unfaulted vein of chrysotile (*s'* in fig. 3, pl. viii.) represents no more than a divisional structure developed subsequently to the faulting of the adjacent "proper wall." We have no doubt that originally this "wall" was also chrysotile; but whether it became changed into its present acicular condition before or after the faulting took place is immaterial to the question.

Of similar import Dr. Dawson would have us to believe is the fact that "chrysotile veins often penetrate diagonally or transversely across both chambers and walls" (p. 107). Such "veins," it is argued, "have been filled subsequently to the existence of *Eozoon* in its present state." He therefore concludes "that there is no connexion between them and the nummuline wall" (p. 189). This argument may be correct, limited to the cases referred to; but as it is based on partial facts, it in no way invalidates our theory, inasmuch as the vein

noticed in our paper in the 'Annals & Mag. Nat. Hist.' Oct. 1874, vol. xiv. pl. 19. fig. 3 (and equally testified by other veins made known by us²), has originated out of amorphous serpentine, and is formed of (1) incipient chrysotile, (2) true chrysotile, (3) compact aciculæ, (4) separated aciculæ with calcitic interspaces. In the last condition this vein agrees in every respect with the "cell-wall" in its typical form: it is also in a normal position of parallelism relatively to the adjacent "chamber and walls," and does not "penetrate diagonally or transversely across" them.

With regard to the asserted discordancy of direction between the "cell-wall" and chrysotile veins, we may refer to Dawson's figures 1 and 3, pl. viii., which do not seem to be on his side; and what is equally remarkable is the appearance of there being a strict parallelism between the aciculæ of the one and the fibres of the other. But whether these cases are or are not what they appear to be, we cannot but express our belief that Dr. Dawson is acquainted with others in which there are layers of chrysotile strictly parallel with the "cell-wall;" otherwise it will be a remarkable circumstance that several cases of the kind have occurred to us.

Dr. Carpenter some years since kindly presented to one of us a thickish slab, 6 inches long and $4\frac{3}{4}$ inches wide, of "Eozoon," beautifully developed both in its laminated and acervuline form. Beneath the laminated portion there is a mass of serpentine which, at the distance of $\frac{3}{4}$ inch from the cozoonal layers, and *parallel* thereto, is traversed by a vein, $\frac{3}{8}$ inch thick, of chrysotile in a more or less developed condition. There is no necessity for our dwelling on the parallelism alluded to; for we have other cases, against whose significance there cannot be raised any doubt. These consist of thin layers of chrysotile, *agreeing in thickness* with the adjacent layers of "cell-wall," and which are not only parallel to, but have their fibres in strict parallelism with, the aciculæ of the latter. Furthermore, certain of the layers of chrysotile graduate insensibly into "cell-wall" by the conversion of their fibres into separated aciculæ, similarly to the cases that have already been published by us. We are prepared, if necessary, to give a representation of this fact also.

Dr. Dawson avers that our theory of accounting for the cozoonal structures "is chemically extravagant, and that it does not explain the nummuline wall." Passing over the first of these assertions, because it is no more than an echo of the *dictum* of another authority, with whom only, for obvious reasons,

* Quart. Journ. Geol. Soc. vol. xxii. pl. xiv. fig. 2; Proc. Roy. Irish Acad. vol. x. pl. xli. figs. 1, 2, pl. xlii. fig. 6.

the subject involved can be discussed, we have to remark on the second that it betrays such an amount of inappreciativeness of the facts represented in the figures previously referred to, that we have no fear as to the conclusion of any impartial reader who makes himself acquainted with all the evidences adduced for and against our theory.

4. "*Archæosphærinæ*" and other "minute foraminiferal forms."

After the reader has compared the "spheroidal bodies or granules (chamber-casts of '*Eozoon*') of translucent serpentine imbedded in saccharoidal calcite ('skeleton')" from the ophite of Lisoughter, Connemara, represented in figures 13, 14, and 15, pl. xv. vol. xxii., 'Quarterly Journal of the Geological Society,' of our first paper, read January 10, 1866, with the "*Archæosphærinæ*" from St. Pierre, Burgess, and Wentworth, represented in pages 137 and 138, also the similarly named bodies "from Pargas in Finland (after Gumbel)," in page 148 of 'The Dawn of Life,' we may be allowed to ask, What is the difference between the one and the other? Moreover, whether or not we were the first to discover or describe them (for Gumbel's account of them appeared in the same year that ours was published), it does seem unfair that our names have been totally ignored in connexion with these "ancient spherical animals." It is to be hoped that we shall be more fortunate with the *Orbulinas*, *Globigerinas*, &c. recently made known as occurring in the Lizard serpentine*. The "*Archæosphærinæ*" must pale before the latter; but, most unfortunate, the Lizard things must also go into the limbo of mineral mimics! As to the "minute foraminiferal forms," "worm-burrows," &c., nothing more need be said of them in presence of the oviform and annelid-like bodies characterizing the Cornish rock just referred to.

5. "*New figures of the proper wall*" †.

"With respect to the proper wall and its minute tubulation, the essential error of the authors" (ourselves) "consists in confounding it with fibrous and acicular *crystals*. With regard to this position, I may repeat what I have stated in former papers—that the true cell-wall presents minute cylindrical processes traversing carbonate of lime, and usually nearly

* 'Philosophical Magazine,' 1876, i. pl. 2. figs. 19 & 20.

† For obvious reasons we cannot notice figures 11 and 24, copied from another author, especially as they have already been criticised in one of our papers. We cannot but remark, however, respecting figure 11, although held up by Carpenter as representing a portion of the "cell-wall" containing "*empty tubuli*," that this important feature is altogether ignored in 'The Dawn of Life,'—shall we say significantly?

parallel to each other, and often slightly bulbous at the extremity. Fibrous serpentine, on the other hand, appears as angular crystals, closely packed together, while the numerous spicular crystals of siliceous minerals which often appear in metamorphic limestones, and may be developed by decalcification, appear as sharp angular needles usually radiating from centres or irregularly disposed. Their own plate (Ophite from Skye *) is an eminent example of this; and whatever the nature of the crystals represented, they have no appearance of being true tubuli of *Eozoon* †.

After our descriptions, to which Dr. Dawson refers in the extracts just given, were published ‡, one of us went to the Isle of Skye, where materials were collected for the paper which subsequently appeared §; while shortly afterwards Dr. Dawson, unacquainted with the latter communication, forwarded to the Royal Irish Academy a paper || (partially reprinted in 'The Dawn of Life') containing, in addition to several criticisms, the foregoing extract. We were thus led to draw up an answer, which is not even alluded to by our opponent.

Confining ourselves to the point in question, the following is our reply to it:—"We have always admitted that the true cell-wall presents minute cylindrical processes traversing carbonate of lime, and usually nearly parallel to each other, even before Dr. Dawson had published any description of them; and we have throughout persistently used the term aciculi for the 'casts of the tubuli,' by which we wished them to be understood as having a cylindrical form. What is there to justify Dr. Dawson in again repeating that we 'confound the nummuline layer with fibrous and acicular crystals'? In our last paper we accepted Dr. Dawson's first description of the 'true cell-wall' as consisting of 'slender undulating threads

* 'Proceedings of the Royal Irish Academy,' vol. x. pl. xlv. fig. 10. Our description of this figure states that it represents "grains ('chambercasts') of pale green serpentine in a decalcified specimen of Liassic ophite from the Isle of Skye, presented to us by Professor Harkness. The grains are for the most part invested with 'true nummuline layer,' which in some places is asbestiform." One of the grains "has its surface quite hispid with separated aciculi." Any one by referring to our figures and description of the Lisoughter "spheroidal bodies" already alluded to, and published in 1866, will observe that they are described as having attached to them "tufts of crystals," the "crystals" being "divergent, also sub-parallel." This shows that, had the Isle-of-Skye aciculæ been "sharp angular needles" or "crystals," they would have been described as such. We never likened these to the "cell-wall."

† 'The Dawn of Life,' p. 196.

‡ 'Quarterly Journal of the Geological Society,' vol. xxii. p. 218; and 'Proceedings of the Royal Irish Academy,' vol. x. pl. xlv. fig. 10, p. 541.

§ Proc. Roy. Irish Acad. vol. i. ser. 2, pp. 132-139.

|| Ibid. vol. i. ser. 2, pp. 117-123.

of serpentine penetrating a matrix of carbonate of lime;’ and we are now quite ready to accept his latest and additional statement—that it presents the serpentinous threads ‘often slightly bulbous at their extremity,’ as in our paper on the Skye ophite an additional figure is given representing a few ‘nearly parallel cylindrical processes’ attached to the curving edge or surface of a piece of serpentine (‘chamber-cast’), and which before decalcification ‘traversed the carbonate of lime,’ forming the ‘true cell-wall.’ Two of the processes stand out conspicuously; three of the smaller ones are also conspicuous; but the remainder are obscurely defined. It is remarkable that one of the largest is ‘slightly bulbous at the extremity’! As the example shows no appearance of sharp angular needles radiating from a centre or irregularly disposed, it must be taken to represent the true cell-wall. If our position is denied, Dr. Dawson will have to support himself by something more than gratuitous statements, or by weightier arguments than such as he is in the habit of adducing.”

The describers of “*Eozoon*,” though continually writing about the “cell-wall,” are exceedingly chary in giving any definite or intelligible illustrations of it—nothing more in general than figures exhibiting no proper distinction between its so-called “tubuli” and the substance they penetrate. ‘The Dawn of Life’ afforded an opportunity for making ample amends for this neglect, especially as we have before brought it under the notice of its author. It is an easy matter to give a figure of the “casts of the tubuli” as exhibited in decalcified specimens; and they would certainly have been more instructive than the *diagram* in page 106, or any of the representations under figures 30 *a*, 31 *b*, also 2, 3 *a* in pl. viii., all of which would equally stand for chrysotile! But evidently it is preferred publishing “extremely thin slices,” as transparent objects, in which “the best results can be obtained,” to giving representations of the “cell-wall” from decalcified specimens, particularly such as show the casts of tubuli “glued together by concretions of mineral matter,” or those “specimens which manifestly show the transition from the ordinary condition of filling with serpentine to one in which the cell-walls are represented obscurely by one shade of this mineral and the cavities by another” (p. 114). The latter may not give the “best results” in the estimation of *Eozoonites*; but Dr. Dawson must understand that the “scepticism of objectors” is not “met” by such illustrations. Considering that they represent structures consisting of one of the most protean minerals known to mineralogists, obviously whatever form serpentine may occur under, that form ought to be most carefully examined in all its relations.

In one case Dr. Dawson has departed from his usual plan: he has represented in figure 18 *d*, page 67, a "serpentine cast of a chamber, decalcified, and showing casts of tubuli"—in other words, having "a tubulated cell-wall preserved with structure similar to that of *Eozoon canadense*" (p. 91). Now with reference to this case we would simply ask Dr. Dawson why, while accepting its processes as "casts of tubuli," he rejects the *Isle-of-Skye* "grain A x" of serpentine, which "has its surface quite hispid with separated aciculi" *, and pronounces the latter processes to be eminently "crystals"? In our example the aciculæ are so plainly represented and designated that it is unaccountable how the author of 'The Dawn of Life' could allow himself to apply a misleading epithet to them, and to speak otherwise of those belonging to his so-called "curious organisms."

The next new figure to be referred to (fig. 31, *b*), although it does not represent a decalcified specimen, affords any thing but a proof in favour of Eozoonism, inasmuch as it represents a foraminiferal impossibility—"tubuli" passing off obliquely and tangentially from the chamber-casts, to the exclusion of the "canal-system" and the "intermediate skeleton." Dr. Dawson himself seems to have little faith in this "anomaly," as it has been called by Dr. Carpenter, since it is not introduced into his "restoration of *Eozoon*."

The last figure requiring notice (top one in fig. 49, *b*, p. 176) represents another kind of "anomaly," and equally a foraminiferal impossibility—the *under* side as well as the *upper* side of the "intermediate skeleton" furnished each with a "proper wall" (*a* and *a'*), thereby making the pseudopods of the wall *a'* to project into the *skeleton* instead of the surrounding water!

6. "*Stromatoporoid* successors of *Eozoon*" †.

Dr. Dawson frequently introduces these fossils in a way to produce the impression that they form important evidences in his favour: this will be observed in the "short answer" he has offered to one of our "objections" (the 21st, p. 191).

In order to justify himself Dr. Dawson nowhere countenances the idea that the Stromatoporids are either sponges, as entertained by some, or corals, as believed by others; but he regards them as Rhizopods, "nearly akin to Foraminifers." Our respected opponent even goes so far as to declare in regard to two species (or their "canals") that he has "no doubt they

* Proc. Roy. Irish Acad. vol. x. pl. xlv. fig. 10.

† The Stromatoporas, represented by the common *S. concentrica*, form a family, appropriately termed *Stromatoporidæ*.

are really foraminiferal organisms" (p. 159). His position, however, has yet to be proved: nay, we shall at once meet it by the statement that the Stromatoporids do not even belong to the class Rhizopoda—that they are demonstrably sponges*. Therefore, though no objections can be made to the so-called "Stromatoporoid successors of *Eozoon*" being adduced by way of illustrating the presumed mode of growth of the latter, we decidedly refuse to allow them to be introduced in the manner stated above—that is, as essentials in the controversy.

Dr. Dawson affirms that the "radiating canals" of *Caunopora planulata* and *Cænostrema* (two undoubted Stromatoporids), represented in figures 44 and 45 of 'The Dawn of Life,' are exactly those (forming the canal-system) "of *Eozoon*." The fact, however, of their "being more regularly arranged" strongly militates against this idea; and we may add that it is totally destroyed by there being no more than an analogy between them. The canals characteristic of recent Foraminifera are assumed by our opponents to be exactly of the nature of those forming the canal-system of "*Eozoon*." "There is good reason to believe," according to Dr. Carpenter, "that these canals are occupied in the living state by prolongations of the sarcode-body which pass from the chambers into the portions of the system in nearest relation to them, and proceed to its peripheral expansions"†. On the contrary, the canals of the Stromatoporids referred to, and of the type species *Stromatopora concentrica*, served the purpose of *water-passages*, as in sponges. They are consequently functionally different from the "canal-system" of *Eozoon*, and ought to be rejected as direct evidences bearing on the latter structure.

7. "Canals filled with dolomite."

In addition to the alleged cases of this kind that have been made known, other two have appeared in 'The Dawn of Life,' but described as imperfectly as the former. Therefore, if any doubts attach to the new cases, Dr. Dawson must consider himself to blame for them.

We have never disputed that "canals filled with dolomite" or calcite may exist; for our investigations with reference to the chemical changes in minerals and rocks have revealed sufficient evidences to induce us to believe in their probable occurrence. The "canal-system" in its typical form we maintain has originated through the external erosion or decretion of portions

* One of us is preparing for publication a paper "On the Systematic Position of the *Stromatoporide*."

† 'Introduction to the Study of the Foraminifera,' p. 51.

of serpentine, and crystalline aggregations of other mineral silicates, the removed substance being replaced by calcite or some other mineral carbonate. In short, it is our firm conviction that the calcite or dolomite in which the "canal-system" is imbedded, and which forms "the intermediate skeleton," is the product of a process similar to that of pseudomorphism among minerals. In the case of rocks, however no *false form* is assumed by the replacing mineral, as in pseudomorphic crystals. It is for this reason that one of us has termed the process methylosis by which substances constituting rocks are changed into, or replaced by, others*.

But although by our theory portions and aggregations of mineral silicates have been *externally* removed, thereby producing every variety of configuration known as the "canal-system of *Eozoon canadense*," there is no reason why, under certain conditions, the configurations themselves may not have been totally or partially removed from their calcareous matrix, and a cast of them left formed of a mineral carbonate. This replacement would be strictly parallel to pseudomorphism in its typical character: garnets converted into calcite are characteristic examples †.

Reverting to the two new Eozoonal cases lately brought forward, it must be admitted that they are illustrated in the 'Dawn of Life' more definitely than those previously made known; still the description of them (pp. 92, 182) is extremely meagre. It would be advantageous in this discussion to know, not only more about "the structures in very great perfection" seen "in slices," but to have some account of the same "structures" observed "in decalcified specimens." Besides, the fact of their occurring under abnormal circumstances (which by-the-by is what usually happens in "canals filled with dolomite"), as admitted by Dawson, tends materially to strengthen our suspicion as to their nature.

Now, the six "large tubes in dolomite" remind us strongly of the four rods, once serpentine, but now composed of calcite, represented in our recent paper "On the Serpentinite of the Lizard" ‡; therefore, in the absence of precise information, it may be suggested that as the latter are still in the shape of

* 'Geological Magazine,' January 1872.

† We have made known in Skye ophite examples of isolated grains, some once malacolite, others loganite, imbedded in calcite, having their crust remaining, but their interior filled with calcite. In many instances the crust is more or less removed; in some it is singularly pitted, reminding one of the siliceous case of certain Polycystines. See Proc. Roy. Irish Acad. vol. i. ser. 2, p. 138.

‡ 'Philosophical Magazine,' 1876, vol. i. pl. 2. fig. 11.

rods though their substance is changed, and hence are true pseudomorphs, the former not improbably belong to the same category—that is, of chemical changes without alteration of original shape. Again, the statement that “the structure of the dolomite in this specimen,” presumably either figure 4 or 5 in plate viii., “indicates that it first lined the canals, and afterwards filled them,” is strongly in favour of our suggestion. Dr. Dawson has added to his notice of the structure of the dolomite that he has observed the same “appearance in larger canals filled with serpentine.” Ought not this fact to have suggested the pseudomorphic or methyloitic origin of the substance composing the “canals in dolomite”?

In addition to the evidences above adduced, we may refer to some others occurring in a specimen of ophite, collected by Mr. W. King, jun., in the Madras Presidency, in which the serpentine (green, amorphous, and translucent) is broken up, through disintegrating or chemical action, into a variety of forms—lamellar, lenticular, spheroidal, and cylindrical, all more or less lobulated. Confining ourselves to the cylindrical forms (some of which are long, while most of them are short), they are surrounded either with calcite, or white flocculent serpentine—that is, in the disintegrated condition. A transverse section shows some to be composed of ordinary serpentine; most of them, however, are more or less changed, the change (manifested by disintegration) commencing in their axis or at a point in their centre. This point, which is white and flocculent, generally goes on enlarging until there is a large core enclosed within a thin sheet of green serpentine; and the sheath in many instances gradually decreases until it disappears altogether. The core also undergoes a change, calcite taking the place of the flocculent serpentine; and the change goes on, as exemplified in a number of instances, until the entire cylinder is converted into calcite. This is demonstrated by decalcifying the specimens, in which case such cylinders, when surrounded by serpentine, whether compact or flocculent, are represented by cylindrical cavities!

We have in these examples a repetition of the process which developed the rods in the Lizard serpentine, with this difference—that in the latter saponite is one of the products of the process, while in the former we have clear, and it may be positively asserted the clearest, evidence of a process which we fully believe will thoroughly explain the origin of the so-called “canals filled with dolomite,” whenever the existence of any thing of the kind can be demonstrated.

8. "Short Answers" to each of our summarized "Objections" against Eozoonism.

After a lapse of more than four years, and after having been repeatedly reminded of the necessity, Dr. Dawson has at last ventured on noticing, but in the briefest possible way, the twenty-one points which we drew up for the Royal Irish Academy in 1871*. These points, which merely form a summary of the evidences and arguments that have at different times been brought forward in our papers, have been treated as if they were the evidences and arguments themselves; and by so doing they are made to appear to "general" and "unscientific readers" as if nothing more than the "short answers" given by Dr. Dawson were necessary to defend "Eozoon" and its "contemporaries" against all "opponents and objections;" notwithstanding, as it would seem, that answers more "in detail" were required, considering that "few even of geological and biological students have clear ideas of the real nature and mode of occurrence of these ancient organisms, and of their relation to the better-known forms of life" (Foraminifera); and that "very few geologists or naturalists have much knowledge of the structure of foraminiferal shells, or would be able under the microscope to recognize them with certainty. Nor have they any distinct ideas of the appearances of such structures under different kinds of preservation and mineralization"!

Dr. Dawson's "short answers" resolve themselves into three groups:—

1st. Misconceptions.

2nd. Evasions, which we are disposed to believe are unintentional.

3rd. Reliance on the already exploded arguments adduced by other writers.

Presuming that there is no necessity for us to weary the reader with any remarks on the third group, we shall confine our remarks to the other two, restricting ourselves to the most important of the "short answers" they contain, particularly as many of them have already been discussed.

Misconceptions. "Short answers" 4, 5, 6, 7, 10, 11, 13, 14, 15, and 20 belong to this group.

4th. Dr. Dawson seems not to be aware that malacolite, which is mentioned in our "objection," is a white variety of

* *Vide* 'Proceedings of the Royal Irish Academy,' vol. i. ser. 2, pp. 148-152. They were republished, with some slight alterations, in the 'Annals and Magazine of Natural History,' May 1874.

pyroxene. As only "chamber-casts" in a mineral silicate were essential in our argument, we necessarily overlooked those alleged to consist of "dolomite or limestone"—though we could have shown that the existence of "chamber-casts" in either of these substances is one of the resultants of pseudomorphism, as was noticed in our description of some spheroids with a siliceous coat, whose interior had been replaced by calcite*.

13th. We assert that "the configurations presumed to represent the 'canal-system' are *totally without* any regularity in their form, relative size, or arrangement." Dr. Dawson replies:—"The configuration of the canal-system is quite definite, though varying in coarseness and fineness." This answer makes it appear as if we referred to its want of definiteness, which is not the case; for our point is based on the fact (plainly set forth in figures 28, p. 107, 49 *b*, p. 176, and other two in plate vi. of the 'Dawn of Life') that the "canal-system," though definite, is "totally without any regularity of form." The second part of the answer is remarkable for containing a gratuitous denial to a statement supported by cases that we particularized.

It was these cases, occurring at Baden, Amity, and other places, that led us on a former occasion to remark:—"Even the zoologist must believe to be a nummuline foraminifer what is structurally an *impossibilitas Naturæ* in having a 'canal-system' and 'skeleton' that often 'ran wild,' without either 'chambers' or a 'cell-wall.'" Other cases have since come to our knowledge testifying to the surprising vagaries of the "creature of the dawn." One is the presence of typical eozoonal structures, beautifully developed, in bands and slabs of ophite occurring in gneiss, transverse to the bedding, at South Mirzapûr, India†.

We have also to mention that Mr. Burbank, of Lowell, Massachusetts, has found specimens of "Eozoon" in dolomitic accumulations of very small extent (the largest appears to be not more than 250 feet in length by 40 or 50 feet wide) enclosed in gneiss, which is for the most part highly crystalline, and in some places hardly to be distinguished from a true granite. The dolomites are not true stratified deposits, laid down with the gneiss, but have a vein-like character; and they occur filling cavities along the line of

* Proc. Royal Irish Acad. vol. i. ser. 2, p. 138.

† Mr. F. R. Mallet, of the Indian Geological Survey, has kindly furnished us with specimens, in which we find both "nummuline layer" and "canal-system," and which we hope some day to have an opportunity of describing. Mr. Mallet has published a mineralogical description of this case in the 'Records of the Geological Survey of India,' No. 1, 1872.

an *anticlinal* fold in the gneiss. The dolomite is coarsely crystalline, and quite free from admixtures with foreign minerals, except near its junction with the gneiss. The dolomite at the junction becomes charged with a great variety of siliceous, aluminous, and magnesian minerals (quartz, pyroxene, hornblende, tremolite, calcite, serpentine, chrysotile, &c.), all forming a mass with a banded structure following the irregular cavities and pockets in the enclosing gneiss. It is only where the banded portion of a vein joins the gneiss that "*Eozoon*" is found, *specimens occurring attached to the walls of the cavities*. Mr. Burbank's description, which appears in the 'Proceedings of the Boston Society of Natural History,' is minutely and carefully given; yet Dr. Dawson, we are sorry to find, has ventured on derogating from its value with the brief remark that "Mr. Burbank" [who, be it understood, was at first a believer in "*Eozoon*"] "has since maintained that the limestones are not true beds; but his own descriptions and figures lead to the belief that this is an error of observation on his part"*! Has not this "state of things ceased to be desirable in the interests of science"?

15th. Noticing our statement that the laminated character of *Eozoon* is a mineralogical phenomenon, of which we cited instances, Dr. Dawson in his "short answer" asserts that "the lamination is not like that of any rock, but a strictly limited and definite form, comparable with that of *Stromatopora*" (p. 190). We shall simply meet this gratuitous denial with three facts not mentioned in our citation.

If Dr. Dawson had before him, as we have, a Siberian specimen (which no doubt is represented in many museums and collections), consisting of alternating laminae of quartz and brownish felspar, he would find that the lamination is "strictly limited" and of "definite form," and even *far more Eozoon-like* in this respect than *Stromatopora concentrica*. Again, Prof. R. Harkness has presented us with a similar specimen of granite from the isle of Harris, Hebrides, differing simply in the two minerals being white and the laminae slightly thicker. Our kind friend has also given us a specimen, from Fetlar, in the Shetlands, consisting of alternating laminae of serpentine and chrysotile, which in their "definite and strictly limited form" deserve to be thus designated more appropriately than the "*Eozoon*" represented in a "Nature-print" in plate v. of 'The Dawn of Life.'

But what is to be said of the Liassic ophite of the Isle of

* 'The Dawn of Life,' footnote, p. 46. Mr. John B. Perry's minute investigations completely establish Mr. Burbank's conclusions (see Proc. Bost. Soc. Nat. Hist., April 1872).

Skye? If even the "canal-system" and "nummuline layer" were not present in the latter, Dr. Dawson's description of the lamination of "*Eozoon*" would be sufficient to establish its eozoonal character—as not only do its laminae consist of serpentine and loganite, but they are separated by laminae of calcite. As shown in one of our figures*, we have a specimen which might be said, without departing much from the literal truth, to be the counterpart of the "*Eozoon* mineralized by loganite and dolomite," in fig. 7, page 36 of 'The Dawn of Life.'

Evasions, which we are disposed to believe are unintentional.
20th. "The occurrence of the best-preserved specimens of *Eozoon canadense* in rocks that are 'in a highly crystalline condition' (Dawson) must be accepted as a fact utterly fatal to its organic origin." This "objection" is answered thus:—"That the occurrence of *Eozoon* in crystalline limestones is 'utterly fatal' to its claims to organic origin can be held only by those who are utterly ignorant of the frequency with which organic remains are preserved in highly crystalline limestones of all ages." (The remainder of the answer is foreign to the subject). Observe how much our point is incorrectly stated. Nevertheless, as we "feel disposed to treat very tenderly the position" of Dr. Dawson, we shall say nothing more than express a hope that, before indulging in detractions of his opponents, he would endeavour to comprehend the gist of their arguments.

21st. "The occurrence of 'eozoonal features' solely in crystalline or metamorphosed rocks belonging to the Laurentian, the Lower Silurian, and the Liassic systems—never in ordinary unaltered deposits of these and the intermediate systems—must be assumed as completely demonstrating their purely mineral origin." Answer—"This limited occurrence is an assumption contrary to facts. It leaves out of account the Tudor specimens, and also the abundant occurrence of the Stromatoporoïd successors of *Eozoon* in the Silurian and Devonian. Further, even if the *Eozoon* were limited to the Laurentian, this would not be remarkable; and since all the Laurentian rocks known to us are more or less altered, it could not in that case occur in unaltered rocks."

The original Tudor specimen, as we have shown (and *no attempts have yet been made in print to invalidate our position*), may be any thing but eozoonal †; besides it occurs not "in an ordinary unaltered deposit," but in a "micaceous limestone

* Proc. Royal Irish Acad. ser. 2, vol. i. pl. 14. fig. 4.

† See Proc. Royal Irish Acad. vol. x. pp. 511, 512.

or calc-schist," which, in reference to the associated metamorphic rocks, is "comparatively unaltered" (Logan). "Eozoonal features" are required from the "ordinary unaltered deposits" belonging to systems *intermediate* to the Laurentian and the Liassic; but *sponges* have been produced! Why have the "eozoonal features" found in the Lower Silurian (Connemara) *metamorphic* rocks been ignored? The concluding part of the answer is catchy logic, irrelevant to the point which developed it, and, besides being paralleled in some other "short answers," forms an appropriate *finale* to the entire series.

9. "Systematic Position of Eozoon."

Our last paper—" 'Eozoon' examined chiefly from a Foraminiferal Stand-point," compelled Dr. Carpenter, unable to show that our evidences did not prove the "Dawn animal" to be a foraminiferal impossibility, to take refuge under the phrase (the parentage of which, by-the-by, is erroneously given)—"there is no end to the possibilities of Nature." Any naturalist knows what this phrase refers to; but it *does not admit of impossibilities*—as, for example, a "canal-system" abutting directly against the under and affixed side of the "nummuline layer," instead of passing direct out to the surface of the organism; a pseudopodial "cell-wall" situated on the *underside* of a chamber, and directly implanted on the "intermediate skeleton," thereby rendering the protrusion of the pseudopods into the surrounding water, or into any vacancy, an impossibility. It is a folly attempting to get over these things by calling them "anomalies;" they are foraminiferal impossibilities; and we cannot but commend Dr. Carpenter's judgment in relinquishing all attempt to make them otherwise in his "Final Note."

But is not this inability to make its features otherwise than *impossibilities* a severe satire on the "systematic position of Eozoon" as set forth by Dr. Dawson,—that its "place will be in the family *Nummulinidæ* or between this and *Globigerinidæ*, and thus belonging to the highest family in the highest sub-order of the lowest class of animals"?

10. *Natural Theology of the Eozoic doctrine.*

This is the most daring bid which Eozoonism in its latest fancies has made for "unscientific" favour. It is now declared that "the dawn animal is the earliest known representative on our planet of those wondrous powers of animal life which culminate and unite themselves with the spirit world in man himself;" and that "if we believe in a Creator, we shall feel

it to be a solemn thing to have access to the first creature into which He breathed the breath of Life"!

We have long looked upon the logic of Eozoonism as unsound in the extreme; of late we have had strong grounds for entertaining no very exalted opinion of its ethics; and now, since its Natural Theology has been unnecessarily and prominently paraded before the "general reader," we feel ourselves constrained to declare that this is essentially sensational—suggesting Olympian Thaumaturgy rather than Teleogony, and irreverently familiar in its utterances with a subject which Science and Religion alike relegate to the mysterious, incomprehensible, and unresolvable "ways" and "thoughts" of Providence.

SUPPLEMENTARY NOTE.

Dr. Dawson's paper, read before the Geological Society of London on March 3, 1875, has appeared in No. 125, February 1876, of the Society's 'Quarterly Journal.' The paper was too late for notice in the body of the present communication; we shall therefore put together a few remarks on it in the form of an appendix.

What we have already stated in connexion with the veins of chrysotile crossing "chamber-casts," &c., renders it unnecessary for any thing to be added on the subject. The same remark applies to the "*Archæospherina*."

"Canals filled with dolomite" or "calcite." As we now learn that parts of certain "canals" containing calcite had this mineral "*dissolved entirely away in a dilute acid*," we shall, accepting this as reliable evidence, reduce the number of our summarized "objections" to twenty by eliminating the nineteenth, but adding the cases of such "canals" to the eleventh. It must be understood that we hold all the cases which have been brought forward to belong to the same category as the rods in the Cornish serpentine and the Madras ophite—that is, as examples of pseudomorphism.

"The complicated theory of pseudomorphism and replacement advocated by Messrs. Rowney and King" (*sic*) has been much contemned by Drs. Dawson and Sterry Hunt; so we are greatly surprised to find that the author of 'The Dawn of Life' has at last adopted it. "In one specimen," he remarks, "I observed a portion of the fossil *entirely replaced by serpentine, the walls of the skeleton being represented by a lighter-coloured serpentine than that filling the chambers, and still retaining traces of the canals. The walls thus replaced by serpentine could be clearly traced into connexion with the portions of those still existing as calcite*" (p. 70).

The writer of the above has seemingly forgotten the piquant

sally which Sterry Hunt made some time ago in the 'American Journal of Science' on those holding "extravagant views" of pseudomorphism—"In this way we are led from gneiss or granite to limestone, from limestone to dolomite, and from dolomite to serpentine"*², and so on.

We are glad, however, to welcome our opponent as a member of the pseudomorphic corps, which we cannot but think will be all the stronger for his membership.

Still, in the face of a fact of common occurrence to us, Dr. Dawson states that "in no instance" had he observed the "nummuline layer to pass into chrysotile," as it has been represented by us; but it is remarkable that in the specimen above noticed a *portion* of the same layer ("walls of the skeleton") is "represented" by "serpentine" (incipient chrysotile we have no doubt) with "traces" of the tubuli ("canals"), and that it becomes completely changed into true nummuline tubulation ("is clearly traced into connexion with" other portions "still existing as calcite")!

Dr. Dawson, after stating that he has not seen "the chevron arrangement" represented in "fig. 7" of our plate in the 'Annals' for October 1874, mentions that "Mr. Weston was struck with the inaccuracy of the representations in this plate." We could excuse either party for expressing his doubts; but the charge of "inaccuracy" is so plainly made that it must not be passed over. We cannot accept statements unless they are made *in propria personâ*. This has not been done by Mr. Weston; therefore, although we should be glad to have the reasons of one "who has prepared and examined microscopically hundreds of specimens of *Eozoon*," we must call upon Dr. Dawson to publish *his* reasons as to wherein lies "the inaccuracy of the representations in this plate." Meanwhile, we may declare in the most emphatic manner that in *every essential point our "representations" are accurate.*

XXXIX.—Notes on the Mode of Propagation of some Ceylonese Tree-Frogs, with Description of two new Species. By Dr. ALBERT GÜNTHER, F.R.S., Keeper of the Zoological Department, British Museum.

[Plate XX. fig. C.]

OUR knowledge of the mode of propagation of extra-European Batrachians is restricted to a very small number of species; and from the few singular facts with which we have become acquainted, we may expect that most interesting dis-

* 'Chemical and Geological Essays,' p. 287.

coveries will be made by naturalists who have the opportunity of observing these animals in their native countries. The statement of Bello y Espinosa *, that the young of some frog in Porto Rico, called "co-qui" by the inhabitants, do not pass through a metamorphosis, but are provided with four legs and are air-breathers when hatched, is deserving of accurate inquiry, as it seems that in this frog, which is, perhaps, a species of *Hylodes*, the embryo passes through that part of the metamorphosis that is generally undergone by the tadpole in water, in the ovum itself. The observation of A. W. Aitken †, that in tropical parts of Australia certain frogs form a hollow ball of clay, containing about half a pint of clear cold water, in which they sojourn during the drought, is probably also indicative of a provision to secure the safety of the spawn and young. In other tropical countries frogs have been observed to deposit their spawn in small accumulations of water formed in the hollows of trees or branches. Some years ago Mr. E. W. H. Holdsworth, F.L.S., brought me from Ceylon, preserved in spirit, a rounded, flattened, spongy-looking soft object, of the size of a crow's egg, which he believed to be the spawn of some tree-frog. He informs me that he "found this specimen hanging from the side of a stone cistern in the garden at the Governor's house at Kandy; it was about 8 inches from the surface of the water, which was at its usual height in the cistern." The lump is of an indistinct greenish colour, elastic, and offering the same resistance to the touch as the lung of a reptile, which it resembles in the reticulated, vesicular appearance of its surface. On making an incision we find it to consist of an interlaced tissue enclosing larger and smaller vacuities which may have been filled with air or water. A few lines below the surface the ova are found, some lodged in meshes of the tissue, others accumulated towards the centre of the lump. The ova appear now as brown globules of the size of a large pin's-head. A second lump of spawn, of precisely the same shape and size as the first, was more recently sent by Mr. Bligh to Mr. Holdsworth, who kindly gave it to me. This specimen was accompanied by a great number of minute greenish tadpoles and two fully adult specimens of *Polypedates maculatus*. Although I have no doubt that the tadpoles are of the same origin as the spawn described, I do not believe that either is the product of that species, the ova of which, when mature, are at least twice the size of those deposited in the spawn-lump. I am rather in-

* Zoolog. Gart. Frankf. 1871, p. 351.

† Trans. New-Zeal. Inst. ii. 1870, p. 87.

clined to suppose that a species of *Ixalus* will be found to be the progenitor.

So much is evident, that the mass enveloping the ova of this frog offers a much greater protection against mechanical agencies than the gelatinous substance of the common frog-spawn; but whether the cells below its surface contain air, to keep the whole body floating on the water, or whether they contain water, to supply the embryos with the necessary moisture if the spawn remain normally out of the water, is uncertain at present.

Quite recently an instance of a tree-frog carrying its spawn about with it has come under my observation (see Pl. XX. fig. C). In a small collection of Ceylonese frogs submitted to my examination by Mr. W. Ferguson, F.L.S., there was a frog which I consider to be *Polypedates reticulatus*, and which had the ova attached to the abdomen when that gentleman obtained it. The ova are now detached, but still firmly adhere to one another, forming a flat disk. They have left shallow impressions in the skin of the abdomen of the adult frog, corresponding to the arrangement of the ova in the disk, but not deep enough to efface the granulations of the skin. The ova are only twenty in number, of large size, viz. of the size of a hempseed. The adult frog is a female, with a body scarcely 2 inches long, and with the internal signs that the ova have been but recently excluded. Unfortunately we do not know whether the specimen was caught in or out of the water.

None of the other Batrachians which are known to take care of their progeny resemble *Polypedates reticulatus* in this respect. *Pipa*, *Nototrema*, and *Opisthodelphys* carry their ova on the back; and in *Alytes* it is the male which takes care of the spawn. In our Ceylonese frog the mode of attachment is perfectly identical with that which I described in the Siluroid genus *Aspredo* (Fish. v. p. 268).

I trust that these notes, fragmentary as they are, yet contain matter of sufficient interest to induce naturalists resident in Ceylon to continue and complete these observations.

I take this opportunity of adding the descriptions of two new species of *Ixalus* from Ceylon.

Ixalus Fergusonii.

Similar in habit to *I. variabilis*. Snout rather flat, short, pointed in front, with short but distinct canthus rostralis, and with the loreal region subvertical. Eye of moderate size; tympanum hidden. Upper parts smooth; abdomen coarsely granulated. Metatarsus without fringe or fold, and with a

single tubercle. Fingers not webbed; toes broadly webbed. Disks well developed. The length of the body equals the distance of the vent from the heel. Upper parts of a greenish white, with small black or brownish specks irregularly disposed; hinder part of the thigh not coloured; lower parts white.

Two specimens, presented by W. Ferguson, Esq., F.L.S.; the larger is 26 millims. long, the hind limb being 40 millims.

Ixalus hypomelas.

Snout not flattened, of moderate length, somewhat rounded in front, with distinct canthus rostralis, and with the loreal region subvertical. Eye of moderate size; tympanum hidden. Skin smooth. Metatarsus without fringe or fold, and with a single tubercle. Fingers not webbed; web of the hind foot rudimentary. Disks rather small. The length of the body is scarcely equal to the distance of the vent from the heel. Coloration varies: the most characteristic form is chocolate-brown above, with the sides and lower parts black, spotted with white; a fine white line runs along the middle of the back and of the abdomen, beginning from the snout, the abdominal line being frequently crossed by another white line, running from one fore leg to the other; metatarsus with a white line along its outer margin. All or some of these lines may be absent. Sometimes the upper parts are dark purplish (the snout being of a lighter colour) or purplish grey mottled with brown. In one variety, in which all the white lines are absent, the upper part of the snout as well as of the forearm is of a uniform greyish-white colour.

The largest of several specimens is 22 millims. long, the hind limb being 35 millims. We have received specimens of this species in Col. Beddome's and Mr. Ferguson's collections.

XL.—*Remarks on Mr. Carter's Paper "On the Polytre mata, especially with reference to their Mythical Hybrid Nature."*
By WILLIAM B. CARPENTER, M.D., F.R.S.

HAVING been prevented by absence on the Continent from perusing Mr. Carter's paper at the time of its publication, I take the earliest opportunity in my power of expressing the great interest with which I have read it, and my entire concurrence in that part of it which relates to the "mythical hybrid nature of *Carpenteria*." It was scarcely to be expected that when I first drew attention to the singularly aberrant

types of Foraminiferal structure which are presented in *Polytrema** and *Carpenteria*†, I should be able to give an exhaustive account of their structure and affinities. My specimens were then few in number, and were derived from a limited set of sources. And while I had not at that time recognized the presence of sponge-spicules either in the canals, chambers, or solid skeleton of *Polytrema*, I had found the chambers of every specimen of *Carpenteria* which I had then examined to be so universally pervaded by them, that I was disposed to agree with Dr. J. E. Gray in the idea that they properly belonged to the organism, which might thus be regarded as a connecting link between Foraminifera and Sponges,—this probability appearing to be strengthened by the curious resemblance in form which the conical *Carpenteria*, with its apical orifice, bears to the papilla of a Sponge with its terminal oscule. This suggestion, however, I put forth (as Mr. Carter truly says) with a certain reserve; and I held myself quite open to modify or withdraw it, as further evidence might indicate‡. Prof. Max Schlutze's paper of 1863 showed me that there was a closer affinity between *Polytrema* and *Carpenteria* than I had originally supposed. And the subsequent examination of a considerable number of specimens of both types which have come into my hands from various sources, has satisfied me on the following points:—

1. That the polymorphism of *Polytrema* is much greater than I was originally aware of, and that what Mr. Carter terms the "cavernous dilatations" of the interior, which I had only recognized as canals traversing the solid fabric, are often

* 'Introduction to the Study of the Foraminifera,' 1862, p. 235.

† Philosophical Transactions, 1860, p. 564; and 'Introduction,' p. 186.

‡ This is explicitly stated in my original description of *Carpenteria* (Phil. Trans. 1860). After referring to the opinion of Mr. Cuming and other experienced conchologists that the organisms in question belong to the sessile Cirripeds, I thus continue:—"Their true nature was first suspected by Dr. J. E. Gray, who was led by his study of them to consider them as the testaceous envelopes of a Rhizopod intermediate between *Sponges* and *Foraminifera*; the grounds on which he came to this conclusion being, that he found the shell to be multilocular and minutely foraminated like that of certain Foraminifera, whilst the fleshy substance occupying its chambers is strengthened with spicules like those of Sponges. Hence he considered this organism in the light of a Sponge enveloped in a shelly case with a single terminal oscule. My opinion as to its character having been asked by Dr. Gray, I soon found reason to agree with him in his general idea of its affinities; the structure of the shell being most characteristically *foraminiferous*, whilst the substance occupying its chambers is no less characteristically *spongy*. In communicating this result, however, to Dr. Gray, I thought it right to suggest the possibility that this spongy substance might be parasitic; the tendency of certain Sponges to find their way into very minute fissures and passages

found, especially in the spreading forms designated by Mr. Carter as *P. utriculare*, to be capacious chambers bearing a strong general resemblance to those of *Carpenteria*.

2. That the canals and chambers of *Polytrema* often contain Sponge-spicules, which are also not unfrequently incorporated with their walls; so that, as there can be no reasonable doubt of the *accidental* nature of the inclusion of these spicules in the interior of *Polytrema*, the probability is strong that their presence in *Carpenteria* is to be accounted for similarly.

This probability was further confirmed to me (3) by the examination of specimens of the typical *Carpenteria* that proved to be entirely destitute of these spongy contents, which, on the hypothesis of their "hybrid" nature, they ought always to exhibit.

I entirely and unreservedly surrender, therefore, the idea that *Carpenteria* has any affinity to Sponges, and fully admit, with Schultze and Carter, its affinity to *Polytrema*. But I still demur to that extinction of *Carpenteria* as a generic type which Mr. Carter proposes; and I trust that, in specifying my reasons for its retention, I shall not be thought to be influenced by any undue preference for the name which Dr. Gray complimented me by assigning to it.

If we abandon, in the taxonomy of FORAMINIFERA, every generic type which can be shown to have a close or even a continuously gradational affinity to some other, we shall be thrown back into hopeless confusion. It is absolutely necessary, for the natural grouping of their multiform varieties, to have *some* basis of arrangement; and this seems best obtained by adopting as genera those strongly diversified types which are capable of most definite characterization by fundamental differences in plan of growth, and by regarding these as centres round which the less-differentiated forms may be

having been observed by me in my researches on the structure of the shells of Mollusks. Dr. Gray, however, agreed with me in thinking this improbable, for reasons which will be presently stated" (p. 565). Among these reasons, it is now somewhat amusing to find the statement of Mr. Denis Macdonald, that, in the voyage of H.M.S. 'Herald' in the Australian Seas, "he met with various forms of branching Sponges, possessing a peculiarly solid calcareous skeleton, and in many instances appearing to present the same kind of transition from *Sponges* towards *Foraminifera*, that, if my view be correct, is afforded by *Carpenteria* from *Foraminifera* towards *Sponges*." These specimens having been kindly placed in my hands by Dr. Macdonald at a subsequent time, when I was investigating the structure of *Polytrema*, I at once recognized them as very characteristic representatives of that type, incrusting with a parasitic Sponge, which I placed in Mr. Carter's hands for description; so that this supposed link between *Sponges* and *Foraminifera* gave way as soon as it was properly tested.

grouped in accordance with the direction of their modification. Thus, taking the *Milioline* series as an illustration, we accept *Spiroloculina*, *Biloculina*, *Triloculina*, and *Quinqueloculina*, not (in the sense of D'Orbigny) as generic names of groups capable of being sharply differentiated from each other, but as designations of certain well-marked types that may be conveniently adopted as points of departure for the orderly arrangement of those multitudinous specific and varietal modifications which, when thus studied, are found to constitute a continuous nexus that defies all attempts at classification by strict definition. So, I should suppose, no one would think of abolishing generic types so strikingly differentiated as *Cornuspira* and *Orbitolites* because both of them in their earliest stage of growth often correspond with the *Milioline Spiroloculina*. Nor should we be wise in abandoning the generic distinction between *Orbitolites* and *Orbiculina* because, in the later stages of their growth, marginal fragments of the disks of these two types cannot be distinguished from each other. Nor, again, does the discovery by M. Munier-Chalmas of a type most curiously intermediate between *Peneroplis* and the spiral *Orbiculina* (the continuous chambers of the former being partly subdivided by transverse indentations of their walls, so as to take the form of moniliform rows of freely communicating chamberlets) invalidate the propriety of retaining those two well-characterized types as generic centres. The same is preeminently true of the *Cristellarian* and *Rotalian* groups, and still more, if possible, of those Arenaceous forms, often bearing a most curious isomorphic resemblance to the calcareous-shelled Foraminifera, which are among the most remarkable novelties brought to light by recent Deep-Sea explorations. In fact, if we say that in each of the principal series of FORAMINIFERA "every thing graduates into every thing else," we shall not be far from the truth.

If, then, we agree to retain as generic centres the forms most strongly differentiated in their plans of growth, I maintain that the typical *Carpenteria* is generically distinct from the typical *Polytrema*. The latter, as Mr. Carter truly says, is essentially a *branching* structure; and the base from which it rises, in all the instances in which I have examined it, has (like the primordial plane of *Tinoporos*) more or less of the "Planorbuline" arrangement, the Rotaline spiral very early giving place to the cyclical mode of increase. The upward growth of this branching structure essentially consists in a vertical piling-up of minute chambers resembling those of the basal disk; and the distinctive peculiarity of the typical *Poly-*

trema seems to consist in the grouping of these chambers round large canals, which traverse the stem and branches, and open at the extremities of the latter. Sometimes, however, *Polytrema* spreads itself out peripherally, without any branching, so as to form subconical expansions, only distinguishable externally from the outspread sessile forms of *Tinoporos* by the opening of canals at or near their apices; and in other instances it forms compact globose masses, only distinguishable externally by their sessile habit, and by the presence of canal-openings, from the ordinary globose forms of *Tinoporos*. The closest resemblance to *Carpenteria* is presented by that modification of *Polytrema* which is designated by Mr. Carter as *P. utricularis*; for in this we find large spreading cavities taking the place of the canals, and opening externally by prominent vents which bear a strong resemblance to those of *Carpenteria*. But, like the canals of the branching *P. miniacum*, these cavities do not (as it seems to me) form any part of the chamber-system, but are simply *interspaces* left in the midst of what would otherwise be (as in *Tinoporos*) a continuous pile of minute chambers resembling those of the original planorbiline base.

On the other hand, as I stated in my memoir of 1860, the arrangement of the primary chambers of the typical *Carpenteria* is distinctly spiral—the chambers all opening into the depressed umbilicus, as in *Globigerina**. This plan is clearly traceable through the entire growth of the organism,—the successive whorls spreading out by the rapid enlargement of the chambers, and each whorl enclosing its predecessor; so that, the base being progressively extended with the augmenting height, a cone is built up, having a prominent apex in place of the original depressed umbilicus. At the summit of this cone there is always an apical orifice (sometimes prolonged

*“I have fortunately been enabled to determine this point by the comparison of several specimens in different stages of evolution, and by the removal from older specimens of one whorl after another until the original nucleus was arrived at (an operation which has been very dexterously performed for me by my draughtsman, Mr. George West); and I can state without any hesitation that the early condition of this apparently anomalous organism accords with that of the *Helicostegæ* Foraminifera generally,—its approximation being the closest to *Rotalia* in its general form, but its tendency being rather towards *Globigerina* in this particular, that its chambers do not seem to communicate directly with each other, but that each has a separate external orifice directed towards the umbilicus.” (Phil. Trans. 1860, p. 567.) Unless Mr. Carter, by the dissection of a typical specimen of *Carpenteria* (such as one of those on Mr. Cuming’s *Porites*) can show that the above description is erroneous, I must take leave to maintain its title to stand, against his account of a supposed embryo of his *Polytrema balaniforme*.

into a tube) communicating with each principal chamber of the successive whorls; and thus the specially *Globigerine* type is maintained throughout. As the successive chambers enlarge, a tendency shows itself to subdivision into chamberlets by a thickening or infolding of their outer wall; but although this partial subdivision gives to the external surface an areolation closely resembling that of *Polytrema*, the resemblance is for the most part apparent only, the subdivision seldom going so far as to cut off these chamberlets from the general cavity of the chamber. The two types thus differ essentially, not merely in plan of growth, but in the relation of their small to their large cavities; for while the branching canals or utricular dilatations of *Polytrema* are mere *cavitary interspaces* in the midst of a fabric built up by the aggregation of minute chambers, the cavities of *Carpenteria* are its *true chambers* arranged in regular spiral succession, and are separated from each other by complete septa, whilst partially subdivided into chamberlets by imperfect septa. Hence, however strong the general resemblance between Mr. Carter's *Polytrema utriculare* and his *P. balaniforme* (= *Carpenteria*), I hold that their morphological difference is quite sufficient to justify the retention of *Carpenteria* as a distinct generic type—its alliance being rather with *Globigerina* than with *Polytrema*, and the latter, like *Tinoporos*, being an extraordinary development of the Planorbuline type.

If Mr. Carter can show that fundamental differences of similar importance exist between *Patellina* and *Conulites*, I shall willingly accept his plea for the retention of the latter genus, which I only merged in *Patellina* because it seemed to me (as to my coadjutors, T. Rupert Jones and W. K. Parker) to agree with that type in plan of growth, and to differ from it only in degree of development.

Both these opinions I hold (as I hope that I do all others) with a readiness to modify or surrender them as further extension of our knowledge in regard to the subjects of them may require. And in this connexion it gives me great pleasure to be permitted by my friend Mr. Carter to cite the following passage relative to my 'Introduction' from a letter he has been good enough to write to me on the questions under discussion:—

"Of course you feel interested in what you yourself have indicated in your 'Introduction' on *Polytrema* and *Carpenteria*; but the *title* itself of your work means no more; and as in natural science all is progressive, and as much due (and even often more) to those who have introduced a subject, as to those who have made the introduction a stepping-stone to

rectification or further discovery, what is written under such circumstances should always be considered *provisional*, and accepted with thankfulness, inasmuch as, according to the old proverb, we should not 'blame the bridge that carries us over.'

To the foregoing general survey of the relations of *Polytrema* and *Carpenteria*, I would now append two notes on points of detail.

1. I stated in my 'Introduction' (p. 236) that while "the whole shelly texture of *Polytrema* has ordinarily a less solid character than that of *Tinoporus*, although formed on a plan essentially the same," "we occasionally find an aggregation of calcareous substance in solid pillars exactly resembling those which we have seen in *T. baculatus* and in *Patellina Cooki*." This last statement, although borne out by a figure, is designated by Mr. Carter (p. 191) as "imaginary;" and taken in connexion with what follows, it certainly appears to me (and I think it would so appear to readers in general) as if Mr. Carter intended to impute to me that I had mistaken the small *hollow* pillars that pass between the earlier-formed stories of the fabric (which hollow pillars he likens, I think correctly, to those of *Parkeria*), for *solid* pillars resembling those of *Orbitoides*. Having forwarded to Mr. Carter the specimen on which my description and figure were based, I am authorized by him to state that he never intended to affirm that *Polytrema* contains no pillars that resemble, *so far as they extend*, those of his *Conulites* (= *Patellina*) or of *Orbitoides*, but merely meant that the solid pillars of *Polytrema*, being confined (where they exist) to the superficial layers, do not correspond with those of *Conulites* and *Orbitoides*, which range through their entire substance. Now I had never "imagined," much less affirmed, that the solid pillars of *Polytrema* extend through the fabric; on the contrary, I spoke of their presence as "occasional;" and it was in regard to their *texture* alone that I intended to liken them to those of the other types referred to—a likeness which Mr. Carter fully admits. I am happy to find, therefore, that our supposed difference on this point is only "imaginary."

2. On the subject of *Parkeria*, which is incidentally alluded to by Mr. Carter, it may be well for me to state that my description of it* is mainly founded on the *entirely uninfiltreated* specimen, preserving most unmistakably its original arenaceous structure, which was kindly placed in my hands by Prof. Morris, and that the accuracy of this description has been entirely confirmed by the examination of the gigantic

* 'Philosophical Transactions,' 1869.

arenaceous recent *Lituola* which my deep-sea explorations have supplied,—the sand-grains of *Parkeria*, however, chiefly consisting of phosphate and carbonate of lime, whilst those of *Lituola* are of quartz cemented with phosphate of iron. I must own myself unable to understand Mr. Carter's hypothesis of a "reticulated fibre converted by fossilization into calc-spar, and coated with a granular crystallization of yellowish calcareous material," and submit that no inferences from the appearances presented by a wholly or partially infiltrated specimen should be set against the facts readily discernible in one which shows every indication of having remained, save as regards the disappearance of the animal, exactly as it was when first formed.

XLI.—*Description of a new Frog from North-eastern Asia.*

By Dr. ALBERT GÜNTHER, F.R.S.

Rana Dybowskii.

Allied to *R. esculenta*. Snout depressed, rather pointed, of moderate length, with the caudus rostralis very obtuse. *Tympanum indistinct*, much smaller than the eye. The vomerine teeth form two short, *distinctly convergent* rows between the inner nostrils. A very faint glandular fold on each side of the back; otherwise the skin is smooth. Hind limbs of moderate length, the distance between vent and knee being half the length of the body. Tips of the fingers and toes not swollen; the latter broadly webbed, the web extending nearly to the tips of the fifth and third toes. No cutaneous fringe along the outer margin of the fifth toe. Metatarsus without lateral fold, but with two tubercles, the inner of which is oblong, the outer very small and scarcely distinct. The fifth toe is a little longer than the third, and the fourth much longer than either. Thumb of the male with two large swollen callosities. Vocal sacs small, internal, one below each angle of the mouth, with very small openings.

The specimen is nearly uniform olive-green above, with a few irregular black specks in the middle of the back. Lower parts white; throat and abdomen finely mottled with olive-green.

Length of the body 63 millims., of the hind limb 110, of the fourth toe 37.

We have received one adult male from the Warsaw Museum, which obtained it with other objects collected by Dybowski in Abrek Bay, near Wladivostok, in lat. 43° N.

XLII.—*Diagnoses of some Species of Mallophaga collected by the Rev. A. E. Eaton during the late Transit-of-Venus Expedition to Kerguelen's Island.* By Professor C. GIEBEL, of Halle.

THE following species will be fully described in the forthcoming work on the natural-history results of the Transit-of-Venus expeditions to Rodriguez and Kerguelen's islands, to be published by the Royal Society. The diagnoses are taken from the paper on the Philoptera from Kerguelen's Island, communicated by Professor Giebel to the Society for that work.

Docophorus dentatus, n. sp.

D. brevis, latus; capite truncato-trigono, marginibus temporalibus multisetosis, posticis bidentatis; antennis setaceis; signatura frontali feminis triangulari, in lineam mediam occipitalem exeunte; thorace brevi, lato; metathoracis hexagoni angulis posticis denticulatis; pedibus brevibus, tibiis multispinosis; abdomine orbiculari, maculis marginalibus intus rotundatis, ventralibus partitis. Mas obscurior, marginibus abdominalibus profunde crenatis, fasciis medio divisis.

Longit. corpor. 3-3.75 m. m., capit. 1.25 m. m., thorac. 0.75 m. m., abdom. 1.75 m. m.

Hab. On *Diomedea exulans*, March 1875.

Nirmus angulicollis, n. sp.

N. oblongus, fulvus, fulvo pictus; capite semielliptico, antice breviter rotundato, antennis ante medium insertis; prothoracis angulis anticis acute extantibus, metathoracis coarctati angulis obtusis; abdomine angusto, marginibus crenatis, maculis rectangularibus ventralibus bipartitis.

Longit. corpor. 3.25 m. m., capit. 0.50 m. m., thorac. 0.75 m. m., abdom. 2.00 m. m.

Hab. On *Diomedea exulans*, March 1875.

Nirmus setosus, n. sp.

N. flavus, fusco pictus; capite obtuse trigonali cordato, temporibus late rotundatis, multisetosis; prothorace lato, metathorace trapezoidali, angulis lateralibus obtusis, multis atque longis pilis instructis; abdominis oblongi marginibus obtuse crenatis, segmentis fusco vittatis.

Longit. corpor. 2 m. m., capit. 0.20 m. m., thorac. 0.20 m. m., abdom. 1.20 m. m.

Hab. On *Pelecanoides urinatrix*, October 1874.

Goniodes brevipes, n. sp.

G. capite et thorace flavis, fusco marginatis; abdomine albedo, maculis marginalibus fuscis oblique fusiformibus; capite antice parabolico, temporibus dilatatis, angulatis, postice in dentem prolongatis, antennis brevibus; prothorace transverse oblongo, metathoracis latioris lateribus angulatis, margine postico valde convexo; pedibus brevissimis; abdomine late ovali, marginibus subcrenatis, segmentis setigeris, ultimo lato emarginato. Femina.

Longit. corp. 1.50 m. m.

Hab. On *Aptenodytes longirostris*.

The genus was previously supposed to infest exclusively birds belonging to the Rasores.

Lipeurus clypeatus, Giebel, Insecta Epizoa, p. 236.

L. oblongus, fulvus, fusco pictus; clypeo excisuris lateralibus definitis; antennis gracilibus; prothorace trapezoidali, metathorace longiore; abdomine oblongo, angusto, marginibus profunde crenatis, nigro-fuscis, feminae fasciis fuscis.

Longit. corpor. 2.50 m. m., capit. 0.20 m. m., thorac. 0.35 m. m., abdom. 1.75 m. m.

Hab. On *Procellaria nereis*, November 1874, and on *Pseudoprión desolatus* in October.

XLIII.—*Remarks on Fishes, with Descriptions of new Species in the British Museum, chiefly from Southern Seas.* By Dr. ALBERT GÜNTHER, F.R.S., Keeper of the Zoological Department.

As the following notes are not exclusively devoted to a particular fauna, it may be useful to precede them with a list, in which the species mentioned in this paper are geographically arranged.

1. YARKAND.

Schizothorax Biddulphi, sp. n.

2. SOUTHERN INDIA.

Thynnichthys cochinesis, sp. n.

3. ISLAND OF RODRIGUEZ.

Mugil rodericensis, sp. n.

Myxus caecutiens, sp. n.

4. PERU.

Tetragonopterus alosa, sp. n.

Creagrutus nasutus, sp. n.

5. QUEENSLAND.

Apogon Gillii, Steind.

Atherinichthys nigrans, Rich.

Arrhamphus sclerolepis, Gthr.

6. SOUTHERN AUSTRALIA AND
TASMANIA.

Callanthias Allporti, sp. n.
Anthias Richardsonii, *Gthr.*
Serranus Dämeli, sp. n.
Sebastes percoides, *Soland.*
Seriola hippos, sp. n.
Holoxenus (g. n.) *cutaneus*, sp. n.
Percis Allporti, sp. n.
Centriscus scolopax, *L.*
Atherina hepsetus, *L.*
Trochocopus unicolor, sp. n.
Muraenichthys breviceps, sp. n.
Monacanthus melas, sp. n.
 — *Dämeli*, sp. n.

Anema macropterygium, *Schn.*
Leptoscopus macropygus, *Rich.*
 — *angusticeps*, *Hutt.*
Seriolaella, *Guichen.*
Platystethus Huttonii, sp. n.
Neophrynichthys (g. n.) *latus*, *Hutt.*
Crepidogaster Hectoris, sp. n.
Labrichthys celidota, *Forst.*
Bregmaceros punctatus, *Hutt.*
Rhombosolea tapirina, *Gthr.*
Scopelus Hectoris, sp. n.
Maurolicus amethystino-punctatus,
Cocco.
Syngnathus Blainvillianus, *Eyd.*
 & *S.*

7. NEW ZEALAND.

Chilodactylus spectabilis, *Hutt.*

8. KERGUELEN'S LAND.

Raja Eatonii, sp. n.

Raja Eatonii.

Allied to *R. Smithii*. Snout of moderate length, the anterior margins meeting at a right angle; the width of the inter-orbital space is two sevenths of the distance of the eye from the end of the snout. The anterior profile, from the snout to the angle of the pectoral fin, is slightly emarginate, the outer pectoral angle being rounded. The greater part of the upper surface of the body is smooth; minute spines are distributed between the eyes and in a narrow stripe along the margins of the body; a broad band of minute spines along the median line of the back and the upper surface of the tail; a single larger recurved spine in the middle of the back; a series of nine or ten rather small spines placed at a considerable distance from each other along the median line of the tail; no spines on the side of the tail. Lower parts smooth. Upper lip fringed on the side. Teeth pointed, conical, in about thirty series in the upper jaw. Male with a patch of claw-like spines on each pectoral fin. Brownish black above, with indistinct round whitish spots; whitish below, with some irregular brownish black spots; lower part of the tail brownish black.

A single adult male specimen was obtained by the Rev. A. E. Eaton in Royal Sound, Kerguelen's Land. It is $26\frac{1}{2}$ inches long, the tail measuring 14 inches; its greatest width is 18 inches.

Callanthias Allporti.

D. $\frac{11}{10}$. A. $\frac{3}{10}$. L. lat. 46.

The height of the body is one third, the length of the head one fourth of the total length (without caudal). Eye longer

than the snout, two sevenths of the length of the head, situated far below the upper profile. The maxillary does not extend to below the middle of the eye. Cleft of the mouth oblique, with the lower jaw slightly projecting, some of the lower canines horizontally projecting forwards. Praeorbital very narrow. The lateral line ascends from its origin towards the third dorsal spine, and runs close to the upper profile, the scales above it being minute. The scales on the head advance nearly to the end of the snout. Vomer with a transverse series of very strong conical teeth; a short patch of small teeth on the palatines; tongue smooth. Dorsal spines slender, gradually increasing in length, the last being as long as the head without snout. The soft dorsal and anal high. Caudal emarginate. Pectoral broad, rather shorter than the ventral, which extends to the vent. Uniform reddish (in spirits).

Two specimens, $9\frac{1}{2}$ inches long, from Tasmania; presented by Morton Allport, Esq.

The occurrence of this genus in the Tasmanian seas is another interesting instance of the affinity of the Antarctic and European fish-faunas. Only one species was previously known, *Callanthias peloritanus**.

Anthias Richardsonii, Gthr.

This fish occurs also on the coast of New Zealand, *Scorpius Hectori* of Hutton ('Fish. New Zealand,' p. 4, fig. 4) being evidently the same species.

Serranus Dämeli.

D. $\frac{11}{14}$. A. $\frac{3}{8}$. L. lat. 120.

The height of the body is contained thrice in the total length (without caudal), the length of the head twice and one third. Head strongly compressed, elongate. Snout rather pointed, the maxillary extending to behind the eye. Eye immediately below the upper profile, its diameter one sixth of the length of the head, and two thirds of that of the snout, more than the width of the interorbital space. The vomerine teeth in a narrow band, angularly bent; teeth on the palatine bones in a very narrow strip. The denticulations at the angle of the præoperculum are not coarser than those above. The second to sixth dorsal spines about one third the length of the head. Anal rays considerably longer than those of the dorsal fin. Caudal rounded. Body and fins blackish,

* By a misprint in Cat. Fish. i. p. 87 the lateral line of that species is stated to be 22-24; it ought to be 42-44.

with a few small round lighter spots on the side of the head and body. Back with some darker transverse spots; and a deep-black spot across the back of the tail. The spinous dorsal with a deep-black margin; the soft dorsal with a broad lighter margin.

One specimen, $9\frac{1}{2}$ inches long, from Sydney; sent by Hr. Dämel to the Godeffroy Museum, and now in the British Museum.

Apogon Gillii.

Apogonichthys Gillii, Steindachner, Wien. SB. 1867, lv. p. 11, fig. 1.
Mionorus lunatus, Krefft, Proc. Zool. Soc. 1867, p. 942.

D. 6 | $\frac{1}{9}$. A. $\frac{2}{8-9}$. L. lat. 27. L. transv. 3/11.

The height of the body is contained twice and two thirds in the total length (without caudal), the length of the head twice and a half. Both margins of the præoperculum entire. Upper profile of the snout concave. Snout pointed, as long as the eye, with the lower jaw prominent. The maxillary does not quite reach the vertical from the hind margin of the eye. Dorsal spines moderately strong, as long as the rays, the second and third longest. Caudal fin rounded. The lateral line extends to the root of the caudal. Brownish, irregularly mottled with darker; a pair of dark spots on the root of the caudal.

Two specimens, $2\frac{5}{8}$ inches long, found by Hr. Dämel at Rockhampton, Queensland; type of *Mionorus lunatus*, 6 inches long, from Cox River.

Sebastes percoides auct.,

= *Sebastes Alporti* (Castelnau).

Seriola hippos.

D. 7 | 25. A. 2 | 17.

Scales minute. The height of the body is contained twice and one third in the total length (without caudal), the length of the head thrice and one third. The snout is short and high; the upper profile of the head parabolic, so that the fish resembles *Caranx hippos*. Jaws equal in front; the maxillary extends to below the middle of the eye; its extremity dilated, as broad as the præorbital above it. Eye far below the upper profile of the head. Angle of the præoperculum rounded. The first dorsal is low, its spines pungent, the fifth (which is the longest) as long as the eye. Anterior rays of the soft dorsal and anal somewhat higher than the others.

Caudal deeply forked. Pectoral broad, and rather short, shorter than the ventrals. Silvery, back greenish. The upper half of the body with five rather broad black cross bands: one in front, and one below the spinous dorsal, and three below the soft dorsal. A similar, but indistinct, band above the eye. The spinous dorsal and ventrals black.

One specimen, 8 inches long, sent from Sydney by Herr Dämel to the Godeffroy Museum. This species agrees in the number of fin-rays so well with *S. gigas*, that for some time I was in doubt whether it was not the young of that species, which is known from very large examples only. However, the form of the snout is most peculiar in the present example, and not likely to change with age.

Chilodactylus spectabilis (Hutton, 1872, Febr.).

This name is to be adopted instead of *Ch. Allporti* (Gthr. 1872, Sept.).

HOLOXENUS (g. n. Cirrhitid.).

Body compressed, covered, like the fins, with loose skin, which is either finely granular or provided with minute scales. The greater part of the spinous dorsal forms a separate fin, some of the posterior spines being continuous with the soft fin. Three anal spines. Caudal rounded. Pectoral rays simple, not prolonged or thickened. Eye small. Mouth of moderate width, with bands of villiform teeth. Gill-opening very wide. Four gills, with a cleft behind the fourth. Pseudo-branchiæ.

Holoxenus cutaneus.

D. 7 | $\frac{3}{10}$. A. 9. C. 12. P. 11. V. $\frac{1}{5}$.

The height of the body equals the length of the head, and is two fifths of the total (without caudal). Head strongly compressed, with the small eye situated in the anterior half, not far below the upper profile, which is concave. Snout of moderate length; mouth oblique, with the lower jaw somewhat prominent. Vertical fins high; the anterior dorsal with subsemicircular outline, with pungent spines, the first of which is inserted above the eye, the third and fourth being the longest. Caudal peduncle narrow. The pectoral and ventral extend to the anal fin; the ventral attached in its entire length to the abdomen. Uniform whitish (in spirits).

Two specimens, the larger of which is 10 inches long, from Tasmania; presented by Morton Allport, Esq.

This is one of the most singular fishes of the Tasmanian fauna. At the first glance the observer is inclined to refer it

to the Scorpænidæ or Pediculati; but there is no bony stay for the præoperculum, which is not armed, and the fore limb is not pediculated. Its nearest allies are evidently the Cirrhitidæ, although in this family it stands isolated on account of its divided dorsal, small eye, slender lower pectoral rays, and almost scaleless body. Placed at the end of that family, it forms a passage to the Scorpænidæ.

Anema monopterygium.

After having reexamined a number of examples of this fish, I cannot agree with Capt. Hutton that two species are confounded under this name. The filament within the mouth of these fish appears often to be accidentally lost, and is probably reproduced.

Leptoscopus.

I regard *L. Huttonii* (Haast, Trans. N. Z. Inst. v. p. 275) as identical with *L. macropygus*, and *L. Robsonii* (Hector, 1875) as the young of *L. angusticeps* (Hutton, 1873). I am indebted to Dr. Hector for a specimen of this *L. Robsonii*, which was obtained in Cook's Strait.

Percis Allporti.

D. 5 | 21. A. 16. L. lat. 62. L. transv. $3\frac{1}{2}/15$.

The height of the body is one fifth, the length of the head one fourth of the total length (without caudal). Snout longer than the eye, which is one fourth of the length of the head. Spinous dorsal continuous with the soft, the spines being subequal in length; sometimes, probably in the male, the first spine is longest. Caudal fin subtruncated. Greenish or yellowish olive (in spirits), with seven black cross bars on the back; an indistinct blackish blotch on the root of the upper caudal rays. Upper half of the caudal variegated with yellowish and brown in the female; in the male the entire fin is nearly uniform blackish.

Two specimens, 11 inches long, from Tasmania; presented by Morton Allport, Esq.

SERIOLELLA.

Additional examples of various ages of the species of *Neptomenus* (Gthr.), from New Zealand and Tasmania, have convinced me of the identity of this genus with *Seriolella* (Guichen.). In young age the præoperculum is distinctly denticulated, radiating bony spicules projecting beyond its

margin ; with advancing age the interspaces between the projections are filled up with bone. That this genus belongs to the Carangidæ I have already mentioned in 'Proc. Zool. Soc.' 1869, June 10.

Platystethus Huttonii.

D. 13 | 36. A. $\frac{3}{32}$. L. lat. 90.

Body much compressed, its height being one third, the length of the head one fourth of the total (without caudal). Eye of moderate size, two ninths of the length of the head, situated a little before the middle of the head, not far below the upper profile. Præorbital at least as wide as the eye. Mouth oblique, with the lower jaw very prominent, very narrow, the maxillary not extending to the front margin of the eye. Dorsal spines feeble, of moderate length ; the soft dorsal and anal low. Anal spines short, but stronger than those of the dorsal fin. Pectoral broad, rounded, half the length of the head. Ventrals small. Caudal deeply forked. Silvery ; back above the lateral line greenish ; the spinous dorsal black.

Two specimens, $6\frac{1}{2}$ inches long, from Dunedin, New Zealand, were sent by Capt. Hutton.

Centriscus scolopax (L.).

This European species occurs also in Tasmania. One specimen sent by Morton Allport, Esq.

NEOPHYRNICHTHYS, Gthr. (g. n. Psychrolutid.).

Head broad and depressed ; skin naked. Canine teeth none ; palate smooth. Gill-covers without spines. Two dorsals, the first formed by nine flexible spines. Ventrals close together, thoracic, rudimentary. Three gills and a half ; pseudobranchiæ. Gill-opening extending to the lower angle of the pectoral.

Neophrynychthys latus.

D. 9 | 17. A. 14. P. 23. V. 2.

The whole fish is enveloped in a loose, smooth skin. Head very broad, the interorbital space being especially wide and flat ; snout short, rounded, with the lower jaw projecting beyond the upper. The cleft of the mouth reaches to below the front margin of the eye, which is lateral and of moderate size. Pectorals very large, extending somewhat beyond the origin of the anal. Ventrals very short, externally simple,

but really consisting of two rays. Caudal subtruncate. Brown, covered all over with round whitish spots.

One specimen, $6\frac{1}{2}$ inches long, from Dunedin, obtained from the Otago Museum. This fish has been named by Capt. Hutton *Psychrolutes latus*; and, from a careful comparison with *Psychrolutes paradoxus*, I can confirm the correctness of his view as regards the affinity of these two fishes; but the presence of a well-developed first dorsal appears to me to demand the separation of the New-Zealand fish into a distinct genus. The discovery of this fish led me to reconsider the position which the family Psychrolutidæ ought to take in the system. As the absence of the first dorsal cannot be retained as one of the characters of the family (which would connect it with the Gobiesocidæ), I think those fishes ought to be removed from the division of *Gobiesociformes* to that of the *Cotto-scombriformes*, where it would follow the *Batrachidæ* *.

Crepidogaster Hectoris.

D. 7. A. 8.

Snout flattened, not produced, its length being not quite twice the diameter of the eye, or equal to the width of the interorbital space. The length of the head is two sevenths of the total (without caudal). Caudal peduncle slender, longer than the caudal fin, the short dorsal and anal being widely separated from the latter fin. Ventral sucker small, not broader than long. Red.

One specimen from the southern shore of Cook's Strait, 26 lines long; presented by Dr. Hector, C.M.G.

Atherina hepsetus (L.).

A specimen from Tasmania, sent by Morton Allport, Esq., is most probably identical with this European species. But as it has 72 scales in the lateral line, it will be necessary to compare more specimens in order to finally decide on this identification.

Atherinichthys nigrans (Rich.).

The fish on which Count Castelneau has bestowed the new generic name of *Zantecla* is this species or one very closely allied to it.

* In my systematic synopsis of the families of Acanthopterygian fishes a misleading error has crept in (p. ix), the family Psychrolutidæ being characterized by "Ventrals none," instead of "No adhesive ventral apparatus." Also the diagnosis of the fourteenth division should be corrected by striking out the words "or entirely absent."

Mugil rodericensis, sp. n.

Allied to *M. Troscheli*, *Smithii*, and *compressus*, but with a narrower and longer caudal peduncle.

D. 4 | $\frac{1}{8}$. A. $\frac{3}{8}$. L. lat. 30. L. transv. 11.

The height of the body is a little more than the length of the head, and one fourth of the total (without caudal); the head is two thirds as high as long; the diameter of the eye is one fourth of the length of the head, and contained once and three fourths in the width of the interorbital space. Eyelids not developed. Upper profile of the head and nape nearly straight. Præorbital scaly, emarginate and finely denticulated. Snout a little shorter than the eye; the maxillary extends beyond the præorbital, and its extremity is uncovered; upper lip thin. There are twenty-one scales between the snout and the dorsal fin. The least depth of the tail is less than one half of the length of the head; and the caudal peduncle is considerably longer than deep. The spinous dorsal is higher than the soft; the spines are strong, the length of the first exceeding that of the postorbital portion of the head; the base of the first spine a little nearer to the root of the caudal than to the end of the snout. The soft dorsal and anal nearly entirely scaleless; the anterior third of the anal in advance of the origin of the soft dorsal. Caudal fin forked. Pectoral shorter than the head. Coloration uniform.

One specimen 10 inches long and several young ones were collected by Mr. Gulliver in fresh water in Rodriguez.

Myxus cœcutiens.

D. 4 | $\frac{1}{8}$. A. $\frac{3}{8}$. L. lat. 43. L. transv. 14.

Teeth very small, movable, bent, those of the upper jaw in a single series; a notch in the middle of the upper jaw to receive the mandibular symphysis. Lower jaw with a similar series of horizontal teeth; other, smaller teeth behind appear to be destined to replace those in function. Lower surface of the mandible without transverse folds. Two round, hard, apparently toothless, naked patches on each side of the palate. The maxillary does not quite extend to the front margin of the eye. Snout obtuse, shorter than the eye, which is two sevenths of the length of the head and two thirds of the width of the interorbital space. Eye with a broad anterior and posterior adipose eyelid. The depth of the body is nearly equal to the length of the head, which is two sevenths of the total length (without caudal). Pectoral extending to the commence-

ment of the spinous dorsal, which corresponds to the thirteenth scale of the lateral line. Dorsal spine moderately strong, the length of the first being more than half the length of the head. Caudal fin deeply emarginate. Coloration uniform.

Two specimens, 5 inches long, were collected by Mr. G. Gulliver in fresh water in Rodriguez.

Labrichthys celidota (Forst.).

The specimens described by New-Zealand naturalists as *L. psittacula* are not the Australian species so named by Richardson; they appear to me to be the adult of *L. celidota*, in which the dark lateral spot has disappeared or is disappearing. The true *L. psittacula* has one and a half series of scales between the lateral line and dorsal fin; *L. celidota* two and a half.

Trochocopus unicolor.

D. $\frac{11}{11}$. A. $\frac{3}{11}$. L. lat. 45.

Eight longitudinal series of scales between the lateral line and spinous dorsal. Snout rather obtuse, the small eye being nearly in the middle of the length of the head. The height of the body is a little more than the length of the head, and one third of the total (without caudal). The membrane behind each dorsal spine deeply excised. Dorsal spines short and stout. Coloration uniform brownish black.

One specimen, $14\frac{1}{2}$ inches long, sent by Herr Dämel from Sydney to the Godeffroy Museum.

Bregmaceros punctatus.

In a small collection of fishes from Cook's Strait, received from Dr. Hector, I have found an example of the interesting fish described by Capt. Hutton as *Calloptilum punctatum* (Trans. N.Z. Inst. v. p. 267, pl. 11). I do not think that it should be generically separated from *B. Maccllellandii*—the actual separation of the soft dorsal into two fins being evidently an individual character, as in our specimen the two portions are connected by intermediate rudimentary rays. A similar interruption, though much less perfect, can be seen also in the anal fin. In the latter fin I count 57 rays, and in the anterior portion of the dorsal 22, Capt. Hutton giving them respectively as 44 and 11. The long isolated ray in front of the anal, shown in the figure given by Capt. Hutton, is not present in our specimen. I have also to add that minute teeth are present in both jaws, and that the gill-membranes are separate to the chin.

Rhombosolea tapirina (Gthr.).

We have received from Capt. Hutton, under this name, a specimen with the eyes on the left side and with two ventrals. I believe that he is right in considering it to be merely an accidental variety, the development of a second ventral being in connexion with the reversal of the sides.

Scopelus Hectoris.

D. 12. A. 16. L. lat. 39.

The height of the body is two ninths of the total length (without caudal), the length of the head two sevenths. The least depth of the tail is less than half the height of the body. Eye rather large, two sevenths of the length of the head, or one half of its distance from the end of the operculum. Posterior margin of the præoperculum obliquely descending backwards. Snout very short, obtuse, with the lower jaw scarcely projecting. Cleft of the mouth slightly oblique. The maxillary reaches to the angle of the præoperculum, and is scarcely dilated behind. Origin of the dorsal fin nearer to the end of the snout than to the root of the caudal, above the root of the ventral; its last ray is just in front of the vertical from the first anal ray. Pectoral fin short, scarcely reaching the ventral. Scales perfectly smooth, those of the lateral line rather smaller than the others.

One specimen, $2\frac{1}{3}$ inches long, from the southern side of Cook's Strait, New Zealand; presented by Dr. Hector, C.M.G.

Maurolicus amethystino-punctatus, Cocco.

Having seen a specimen of *M. australis*, described by Dr. Hector in Trans. N.Z. Inst. vii. p. 250, and presented by him to the British Museum, I believe it to be identical with the Mediterranean species named by Cocco. The number of fin-rays is difficult to ascertain whenever the specimens are not well preserved; but the New-Zealand specimen appears to agree with the European species also in this respect.

Tetragonopterus alosa.

D. 11. A. 29. L. lat. 40. L. transv. 8/7.

The height of the body is contained twice and three fourths in the total length (without caudal), the length of the head four times. Interorbital space convex, its width being one third of the length of the head, of which the diameter of the eye is one fourth. The upper profile is very little concave

above the parietal region. The maxillary extends beyond the vertical from the front margin of the eye. Origin of the dorsal fin vertically behind the root of the ventrals. The pectoral reaches to or a little beyond the base of the ventrals. An indistinct dark spot behind the shoulder, above the lateral line; and a large band-like black spot on the caudal peduncle, continued as a band along the middle of the fin.

Two specimens from Monterico, Peru, sent by Professor Taczanowski, $5\frac{1}{2}$ inches long.

Creagrutus nasutus.

B. 4. D. 10. A. 13. V. 8. L. lat. 39. L. transv. $4\frac{1}{4}$.

The height of the body is contained thrice and one third in the total length (without caudal), the length of the head four times. Snout convex, less obtuse than in *C. Mülleri*, equal to the diameter of the eye, which is one fourth of the length of the head. Interorbital space rather flat, its width being more than the diameter of the eye. The lower infraorbital is not nearly so broad as in *C. Mülleri*, leaving a large portion of the cheek before the angle uncovered, and not reaching the lower præopercular limb. Teeth as in *C. Mülleri*. The dorsal fin commences a little nearer to the snout than to the root of the caudal fin, and a little before the vertical from that of the ventral. Caudal fin forked. Anal commencing behind the dorsal. Pectoral as long as the head without snout, and extending to the ventral. Ventral shorter than pectoral, reaching to the vent. Sides and belly silvery. A more or less distinct shining band runs from a black humeral spot to the middle of the root of the caudal fin.

Monterico, Peru. Several specimens sent by Professor Taczanowski, 4 inches long.

Arrhamphus sclerolepis (Gthr.).

We have received a third specimen of this singular fish through the Godeffroy Museum; it was obtained by Hr. Dämel at Rockhampton, and differs from the typical specimens in having the lower jaw projecting to the length of $\frac{2}{3}$ of an inch. The entire fish is about 9 inches long.

Schizothorax Biddulphi.

D. 10. A. 7.

Allied to *Sch. Hodgsonii*, but with the scales of minute size. Mouth inferior, as long as broad; the upper jaw much pro-

jecting beyond the lower. Head low, elongate; snout very long, but much shorter than the postorbital portion of the head, the hind margin of the orbit being in the anterior half of the head. The fold of the lower lip does not extend across the symphysis. Barbels longer than the eye, which is of small size. Origin of the dorsal fin in advance of the base of the ventral, and a little nearer to the end of the snout than to the root of the caudal. The osseous dorsal ray is very strong and long, armed with strong teeth. Anal fin narrow, not nearly reaching the caudal. The height of the body is nearly equal to the length of the head, which is one fifth of the total (without caudal). Interorbital space broad, very slightly convex. Anal scales but little developed. Coloration uniform.

Two specimens (skins) were presented by Capt. Biddulph; one was obtained by him on the Kashgar river, the other in Yarkand. The larger is $15\frac{1}{2}$ inches long.

Thynnichthys cochinensis.

D. 12. A. 7. L. lat. ca. 110.

The height of the body is contained thrice in the total length (without caudal), the length of the head thrice and two thirds. The diameter of the eye is two ninths of the length of the head, and less than that of the snout. Origin of the dorsal fin but very little in advance of the root of the ventral, somewhat nearer to the end of the snout than to the base of the caudal. Caudal peduncle rather deep; caudal fin broad, deeply cleft. Coloration uniform.

This species has much smaller scales than any of its congeners, *Th. thynoides* and *harengula* having 60, and *Th. polylepis* 75 transverse series.

One skin, 8 inches long, from Cochin; purchased.

Muranichthys breviceps.

The origin of the dorsal fin is twice as distant from the vent as from the gill-opening. The length of the head is only one third or two sevenths of the distance of the gill-opening from the vent, or one eleventh of the total length. Snout very long and narrow, the cleft of the mouth extending to behind the eye. Teeth biserial.

Distinguished from *M. macropterus* by its comparatively shorter head and longer snout.

One specimen, 20 inches long, from Tasmania; presented by Morton Allport, Esq. A second, smaller example of unknown origin.

Syngnathus Blainvillianus (Eyd. & S.).

Of this fish, which hitherto has been found on the west coast of South America only, we have received an example from Cook's Strait, New Zealand, through Dr. Hector.

Monacanthus melas.

D. 34. A. 34.

Skin velvety, without distinct scales. Shape oblong, the height of the body being a little less than one third of its length (without caudal), or two sevenths of the total length. Snout long, the distance of the eye from its end being contained thrice and four fifths in the length of the body; upper profile very convex. Gill-opening below, and partly in advance of, the eye. Root of the pectoral beneath the hinder part of the orbit. Dorsal spine long and slender, situated above the hinder part of the eye, its length being contained once and a half in the depth of the body and in the length of the head; four rows of very small barbs, the two anterior close together, all being rather indistinct. Caudal with the margin rounded. Dorsal and anal fins higher anteriorly than posteriorly. Ventral spine small, fixed. Colour brownish black, with two whitish bands across the chin. Dorsal spine and caudal black; the other fins light-coloured.

One specimen, 14 inches long, from Tasmania; presented by Morton Allport, Esq.

Monacanthus Dämeli.

D. 30. A. 28.

The entire head and body coarsely granular, each granule terminating in a spine. Tail not armed. The depth of the body is more than half the total length (without caudal). Snout rather produced, with the upper profile slightly concave. Gill-opening below the middle, root of the pectoral below the posterior, half of the eye. Dorsal spine above the middle of the eye, long, as long as the distance from the gill-opening to the snout, armed with four rows of barbs, of which the anterior are much smaller than the posterior, the anterior rows being closer together than the posterior. Caudal fin rounded. Dorsal and anal low. Ventral spine short, fixed, with very short spikes. Colour uniform blackish grey.

One specimen, 6 inches long, sent from Sydney by Hr. Dämel to the Godeffroy Museum.

This fish appears to be the same as one described by Castelnau under the name of *M. brunneus*, in Proc. Zool. Soc. Victor. 1873, p. 145; but as this author has employed the same name in the same volume (p. 108) for another species, a change is necessary for the present species.

XLIV.—On the Urogenital Apparatus of a Blennioid Fish from Tasmania. By Dr. ALBERT GÜNTHER, F.R.S.

THE so-called urogenital or anal papilla is, as is well known, most conspicuous in the Gobiidæ and Blennidæ, although not exclusively confined to those families. In some of the genera it is a sexual character; in others it is almost as much developed in the female as in the male. In *Clinus despicillatus*, from South Australia and Tasmania, it is a sexual character, the female showing in its place merely a simple short perforated fold of the skin. But the male of this species has it developed in a very extraordinary manner; and, more especially, the internal portion of the duct shows a very singular structure, which does not appear to have been recorded hitherto. In a specimen $14\frac{1}{2}$ inches long* the papilla lies with the vent in a rather deep circular hollow, and is encircled by a loose fold of the skin. The papilla itself consists of two parts—a posterior tapering portion, perforated at its extremity and 5 lines long, and an anterior shorter and broader portion longitudinally grooved behind, the posterior portion fitting into the groove. The anterior portion would appear to form a support to the posterior during the act of fecundation.

On opening the abdominal cavity we find that the common canal for the vasa deferentia and the urethra is not a simple membranaceous tube, but on its ventral surface overlaid with an extremely thick muscular mass, the whole organ having the shape and size of a very large bean, the muscle forming the convex portion, whilst the canal runs along the concave posterior margin. This muscle in a longitudinal section is 3 lines thick in its middle; its outer surface is covered by a shining tendinous layer, which, becoming thicker towards the vertebral column, is finally attached to the base of the anterior hæmal spine. The muscular fibres take their origin from the tendinous surface of the organ.

The canal, which in the external papilla is very narrow, widens considerably within the abdomen; and its cavity is occupied by a complex network of loose fasciculi rising from the mucous membrane with which the cavity is clothed, but leaving an open main channel along the middle of the cavity. The effect of this arrangement is obvious: the semen accumulates first in the wide and spongy cavity of the common duct; this is compressed by the muscle, the fluid being thus ex-

* For this, as well as a female of the same size, I am indebted to Morton Allport, Esq., of Hobart Town.

pelled with considerable force through the narrow tube of the papilla.

It is not improbable that this fish is viviparous, and, consequently, that copulation is necessary for the fecundation of the ova. Both our specimens appear to have been obtained at a season remote from that of propagation, as the testes, as well as the ovaries (which are contained in thick membranaceous sacs), were remarkably small in proportion to the large size of the fishes.

XLV.—*Diagnoses of new Species of Mollusca and Echinodermata from the Island of Rodriguez.* By EDGAR A. SMITH, F.Z.S.

THE following species form part of the collections made at the island of Rodriguez by Messrs. George Gulliver and H. H. Slater, the naturalists sent by the Royal Society with the British expedition for observing the Transit of Venus. Only those species are here mentioned which are apparently undescribed, as it is purposed to publish elsewhere complete accounts of all the specimens obtained at the island.

Rhizochilus (Coralliophila) squamosissimus, sp. n.

Testa ovato-fusiformis, aliquanto umbilicata, alba; spira elevata, turrita; anfractus 7 convexi, costis spiralibus inæqualibus pulcherrime squamatis, irregulariter alternatim majoribus cincti, et plicis longitudinalibus obliquis clathrati; anfr. ultimus costis spiralibus circiter 26 ornatus, ventricosus, inferne angustatus; apertura ovato-pyriformis, alba, longitudinis totius $\frac{2}{3}$ vix æquans; labrum margine crenulato; columella alba, callo lævi induta; canalis angustus, obliquus, leviter recurvus.

Long. 31 mill., diam. 16; apertura long. 19, diam. 9.

(Coll. by Slater.)

The spiral ribs are most beautifully scaled, the imbrications being very close together; the longitudinal plications are rather oblique and gradually further apart as the labrum is approached.

Melania rodericensis, sp. n.

Testa subulata, pallide olivacea, strigis longitudinalibus purpureo-fuscis irregulariter picta, et circa basim anfr. ultimi fascia lata coloris saturatoris cincta, frequenter corio limoso rubro induta; anfractus 11, convexiusculi, sutura leviter obliqua discreti, liris transversis tenuibus plicisque longitudinalibus supra liras paululum

granosis ornati; apertura ovata, superne acuminata; columella arcuata, alba.

Long. 16 mill., diam. 5; apertura long. 5, diam. $2\frac{1}{2}$.

Var. major long. 23 mill., diam. 7.

(Coll. by Gulliver.)

This species has a close resemblance to certain varieties of *M. fasciolata* of Oliver, which inhabit Egypt.

Vaginula rodericensis, sp. n.

Corpus elongatum, utrinque rotundatum, postice leviter angustatum et acuminatum, superne rotundatum, lateraliter carinatum; pallium supra et infra minutissime granulatum, testaceum, irregulariter confertim nigro tessellatum vel punctatum, infra paulo pallidius, marginibus lateralibus haud nigro-punctatis; pes angustus latitudinis corporis $\frac{1}{4}$ adæquans, testaceus, usque ad extremitatem corporis fere productus; tentacula oculifera nigrescentia; caput tentaculaque buccalia flavo-testacea; orificium femineum paulo pone medium corporis situm.

Long. 30 mill., diam. 10. (specim. in alcohol. serv.).

(Coll. by Gulliver.)

The mantle is rather broader at the anterior extremity than posteriorly, where it is more acutely rounded.

Diplodonta lateralis, sp. n.

Testa alba, transverse globoso-ovata, antice angustata, postice latissime rotundata, valde inæquilateralis; margo dorsalis utrinque paululus declivis et rectiusculus; valvæ tenuiter concentricè striatæ, hic illic fortius; umbones haud prominentes, conspicuo excentrici; impressio muscularis antica elongata angustiuscula, postica aliquanto latior.

Long. 18 mill., latit. $20\frac{1}{2}$, crass. 11.

(Coll. by Slater.)

D. coreensis of Adams and Reeve approaches the present species somewhat in form; but the umbones are not so lateral and the anterior end is broader. Within the valves, parallel with the pallial impression on the side towards the umbones, there is a second impression, which is punctured with small pits; but probably this is only an individual peculiarity.

Avicula fusco-purpurea, sp. n.

Testa inæqualvis, perobliqua, postice peroblique alata, striis concentricis confertis regulariter sculpta; color externus fusco-purpureus, antice interdum pallescens; rostrum valvæ dextræ mediocriter breve, paululum declive, confertim rugosè lamellosum; valvæ sinistræ angustum, magnum; cauda inconspicua; ala per-

obliqua, imo recurva, in margine postico valde sinuata; margo valvarum cardinalis rectus; margarita pulcherrime iridescens, a limbo fusco-purpureo, antice pallidior, posticeque latissimo cincta.

Long. max. 55 mill., diam. 35.

(Coll. by Slater.)

Comatula indica, sp. n.

Rays thirty; disk small, convex, subpentagonal; dorsal cirri —?, probably about forty-five; radialia two, the axillary radiale without a syzygium; between this and the next bifurcation are two joints; and after two more segments the two innermost arms bifurcate; none of the brachial axillary joints has a syzygium; every third segment above all the axillaries with a syzygium; and on the arms beyond these the syzygia are at very unequal distances, the first one being separated by as many as twenty joints, but generally by about fourteen; then nearer the extremity of the arms they are rather more proximate, there being from six to ten intermediate joints. The second pinnulæ very long, and composed of much-elongated joints. Colour pale purplish brown, with the sutures of the arm-joints blackish brown. Length of rays about 6 inches (153 mill.); diameter of disk 6 mill.

(Coll. by Mr. H. H. Slater.)

The disk is covered with deep little pits, about forty-five in number, which have been the sockets of the dorsal rays. The second pinnulæ, which are conspicuously long (about 17 mill.), are situated on the first and second joints, above these, which always have a syzygium—or, in other words, on the fourth and fifth segments, above the axillaries.

XLVI.—*Description of a new Species of Talitrus from Rodriguez.* By EDWARD J. MIERS, F.L.S.

Talitrus Gulliveri, sp. n.

Slender, smooth, with the buccal organs considerably projecting, as in *T. locusta*. Superior antennæ scarcely as long as the cephalon, and about reaching to the extremity of the second joint of the inferior antennæ, with seven joints exposed; the basal very short, the two next longer, subequal, together about as long as the four terminal joints, of which three are equal and the last minute. Inferior antennæ slender, not as long as the pereion, with the basal joint of the peduncle very short, the second joint more than half the length of the

third joint; the flagellum about eighteen-jointed, and rather longer than the peduncle. Gnathopoda of both pairs small and weak; the first pair with the three terminal joints short, subequal, and not dilated; the second pair (in some specimens) longer, with the propodos slightly dilated and the dactylos quite rudimentary (as in *T. platycheles*). First three pairs of pereiopoda short; fourth and fifth pairs considerably longer, with the basa moderately developed. First three segments of the pleon with the posterior margin straight, the infero-posterior angle acute and, in the third segment, slightly produced backward. The distal extremities of the joints of the antennæ, the pereiopoda, and the rami of the pleopoda are fringed with short hairs.

Hab. Rodriguez. This species was found by Mr. Gulliver under stones in damp places, but never observed actually in the water.

I feel no hesitation in referring this species to the genus *Talitrus*, as in none of the specimens are either pair of gnathopoda largely developed and subcheliform as in other genera of Orchestiidæ. It differs from the common European *T. locusta* in its much shorter and slenderer inferior antennæ, and in the form of the segments of the pleon. It seems to be more nearly allied to *T. platycheles*, Guérin, from South Europe; but from this species it differs in the proportional length of the joints of the peduncles of the antennæ, in the longer second pair of gnathopoda, the much greater length of the fourth and fifth pairs of pereiopoda, &c.

XLVII.—*Preliminary Notice of new Species of Lepidoptera from Rodriguez.* By ARTHUR GARDINER BUTLER, F.L.S., F.Z.S., &c.

As some time will elapse before the detailed account of the collections made by the Naturalists accompanying the Transit-of-Venus expeditions will be published by the Royal Society, diagnoses of the new species of Lepidoptera, Orthoptera, and Hemiptera are submitted in this and the following paper.

Noctuidæ.

Genus CARADRINA.

Caradrina exposita, n. sp.

Primaries glossy brown, reniform spot indistinct, a brown streak below it; a waved dark brown transverse line towards the base; a transverse postmedian line, arched, with its lower

extremity straight, followed by a series of black points; an irregular dusky discal band, zigzag externally; a marginal series of black dots; the margin indicated by a clay-coloured line; fringe shining brown, darker at base: secondaries shining pale brown, with deeper-coloured outer border; marginal characters and fringe as in primaries: body pale olive-brown, abdomen greyish; palpi black, with white-brown tips: wings below shining brownish, a dusky spot on the discocellulars; an oblique black costal litura in primaries, followed by a continuous discal series of black dots upon the nervures; an ochraceous marginal line and a marginal series of black dots; secondaries paler than primaries: body shining whitish. Expanse of wings 1 inch.

(Coll. by Gulliver.)

Allied to *C. conformis*.

Genus DIOMEA.

Diomea bryophiloides, n. sp.

Primaries rounded at apex, smoky brown; external area darker, crossed by a blackish tapering band bounded externally by whitish dots; several costal spots of the same colour: secondaries pale brown; margin, veins, and a spot on the discocellulars dusky: body smoky brown, abdomen pale; palpi whitish above, blackish below; primaries below paler than above, markings indistinct, a marginal series of black dots; secondaries sordid white; costal area irrorated with brown; basal area ochraceous; a black discocellular spot; two irregular discal brown lines; outer border grey; a marginal series of black dots; legs spotted with ochraceous; coxæ tufted: body below whitish varied with brown, sides of pectus ochraceous. Expanse of wings 11 lines.

(Coll. by Gulliver.)

Genus HOMOPTERA.

Homoptera turbida, n. sp.

Primaries cinereous, crossed by undulating brown lines; a blackish line at the base, followed by a dark oblique brown band, the outer edge of which is straight, and bounded towards costa by a white streak; reniform spot ill-defined, confounded with a brown costal patch crossed by pale lines; the latter bounded externally by an abbreviated narrow white streak; postmedian line slender, black, sinuated at its upper end, regularly undulated from the first median to the inner margin; outer border broadly grey; a submarginal black line, a marginal series of yellowish spots; margin indicated by a reddish

brown line; fringe brown, with basal ochraceous line: secondaries pale buff, internal area (excepting the abdominal region) and the outer border cinereous, crossed by parallel undulated brown bands; two parallel subanal black lines, between which is a brown line; marginal characters as in primaries: head, palpi, and collar pale reddish brown; tegulæ and thorax greyish brown; abdomen pale brown, three dorsal greyish tufts; two subanal dusky bands, the inner one broad; anal tuft tipped with brown: wings and body below pale buff, markings only indicated on the apical half of primaries and costa of secondaries, the latter covered with hair; an apical marginal sinuated black line. Expanse of wings 1 inch 10 lines.

(Coll. by Gulliver.)

Apparently allied to *H. Vinsonii* of Guénée, but certainly distinct.

Tineina.

Genus LAVERNA.

Laverna plumipes, n. sp.

Primaries shining brown, irrorated with black; a subapical black spot; fringe grey: secondaries sericeous pale brown, the apical area darker; fringe pale brown: head and thorax olive-brown, abdomen pale brown: wings below shining pale brown: body and legs below shining whitish; tibiæ of second pair of legs with a long terminal pencil of hair-scales between the spines; tibiæ of hind pair densely clothed with long projecting hairs. Expanse of wings 10 lines.

(Coll. by Gulliver.)

My thanks are due to Lord Walsingham for kindly pointing out the affinity of this species to *Laverna phragmitella*.

XLVIII.—*Preliminary Notice of new Species of Orthoptera and Hemiptera collected in the Island of Rodriguez by the Naturalists accompanying the Transit-of-Venus Expedition.*
By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

ORTHOPTERA.

Genus NEMOBIUS.

Nemobius luteolus, n. sp.

Stramineous; vertex of head greyish; pronotum irrorated with brownish, with a lateral slender ridge and a central depressed line; posterior abdominal segments greyish; cerci as long as oviduct, hairy; oviduct castaneous below and at the tip; tegmina nearly extending to the end of abdomen, pale

stramineous; tibiæ of hind legs with three pairs of spines, also several terminal shorter spines. Length of body 5 millims., of oviduct 2.

(Coll. by Gulliver.)

The single example is somewhat shrunken, and may have been killed before attaining its full coloration.

Genus PHISIS.

Phisis spinifera, n. sp.

Female. Testaceous, pronotum oblong, greyish, with carinated margins; abdomen greyish; oviduct stramineous; the femora of the two anterior pairs of legs with two converging longitudinal ferruginous lines above, of the first pair with six exterior and five interior lateral spines, distal end terminating on each side in a conical denticle; tibiæ with seven spines on each side; femora of second pair with seven exterior short spines, inferior margin denticulated; tibiæ with six exterior and five interior spines, longer than in the femora; femora of hind pair reddish, spinulose below; tibiæ denticulated. Length of body 19 millims., of oviduct 9.

(Coll. by Gulliver.)

More robust than *P. pectinata*, rather differently coloured; anterior femora with strong terminal conical denticles.

Genus EPACHROMIA.

Epachromia rodericensis, n. sp.

Male. Pale carneous; pronotum and head above brown, adorned with an X-shaped marking, intersected by a longitudinal fascia, pale carneous edged with black; pronotum with a lateral oblique black streak, meso- and metanota testaceous, with lateral black spots; knees black at the sides; tibiæ with three black spots below, spines black; tegmina with the basal half coriaceous, brown, inner border whitish, base whitish-speckled, a white subquadrate costal spot; apical half pale brownish hyaline, crossed by ill-defined irregular white bars; veins dark brown; wings hyaline white, veins black. Length of the body 12 to 18 millims.

(Coll. by Gulliver.)

This species does not vary in coloration.

Genus BACILLUS.

Bacillus incommodus, n. sp.

"Green, with red antennæ, when alive."

Ochreous, clouded with purplish brown; eyes black; head

truncate-ovate, with central and lateral longitudinal depressed lines, longer than the pronotum; antennæ with twenty-four joints, basal joint broad, depressed; pronotum quadrate, with obtusely carinated margins; two longitudinal series of four obtuse well-developed tubercles; a central depression; mesonotum dorsally carinate, covered with tubercles; a series of lateral tubercles between the pairs of legs; tegmina small; wings minute, coriaceous; anterior abdominal segments roof-like, laterally carinated; anal styles lanceolate; anterior legs considerably the longest, the femora strongly excavated and rugulose at the base, with two internal longitudinal marginal series of denticles; all the legs parallelopipedous, obtusely carinated; posterior femora denticulated below. Length 3 inches 10 lines.

(Coll. by Gulliver and Slater.)

This species is broader than any other *Bacillus* known to me; but it has all the characters of that genus.

HEMIPTERA.

Genus REDUVIUS.

Reduvius laniger, n. sp.

Densely clothed with testaceous hair; antennæ slender, the three basal joints amber-yellow, remaining joints blackish; head castaneous; eyes blackish; rostrum pale castaneous, dark at the tip; thorax testaceous, with two nearly parallel longitudinal piceous bands, anterior lobe with a central longitudinal fossa; posterior lobe with a central depression; scutellum piceous, pale at the tip; corium of hemelytra testaceous, with two blackish spots and a cuneiform whitish spot between them; membrane dull purplish black; abdomen above amber-yellow, with marginal brown spots, below piceous, with a yellowish band on each side; pectus shining black; legs amber-yellow; the femora with central and terminal brown bands. Length $6\frac{1}{2}$ millims.

(Coll. by Gulliver.)

Genus VELIA.

Velia infernalis, n. sp.

Velvety black above, two grey spots on the front of the thorax, slaty grey below; sides of pectus whitish, anal segments of venter brown; legs black above, brownish below; the base of the antennæ, the coxæ, and the base of the femora orange-yellow. Length 4 millims.

(Coll. by Gulliver.)

Allied to *V. nigricans* of Burmeister.

Genus SIGARA.

Sigara felix, n. sp.

Ovate, piceous; head rather wider than the thorax; vertex of head and sides of tegmina whitish testaceous, below greyish brown; legs fawn-colour; face rugose, vertex with slender transverse irregular impressions; thorax transversely striated; tegmina punctured, setose. Length 2-3 millims.

(Coll. by Gulliver.)

Similar in coloration to *S. minutissima*; but smaller and comparatively broader.

PHYSOPODA.

Genus APTINOTHRIPS.

Aptinothrips fasciatus, n. sp.

Blackish piceous, glabrous; wings hyaline; bases of antennal joints, eyes, ocelli, and five broad abdominal bands crystalline white; frons fulvous; antennæ 7-jointed, basal joint conical, the second to fourth obconical, fifth to seventh fusiform; the terminal joint terminating in an acute point; head rounded, truncate in front and behind, with a central obtuse carina and an oblique stria behind each eye. Length 3 millims.

(Coll. by Gulliver.)

COCCIDÆ.

Genus COCCUS.

Coccus ceratiformis, n. sp.

Female. Irregularly elliptical; above with posterior central depression; thinly covered with a fine powdery, silvery, waxy efflorescence, which conceals the coloration; when this is removed the insect is bright yellow, often with the central area largely piceous; about nine segmentations traceable; under surface somewhat concave; head sinuate in front, with an angular frontal depression, in front of which is an obtuse ridge; rostrum situated in the fore part of a deep obovate depression; antennæ 9-jointed, pale testaceous, sparsely clothed with setæ; legs pale testaceous, rather long (extending beyond the sides of the body in small examples), apparently with three tarsal joints and two terminal claws; pediferous lobes very prominent. Greatest length 3 millims.

(Coll. by Gulliver.)

I cannot identify this species with any of those described by Messrs. Icery and Signoret.

BIBLIOGRAPHICAL NOTICE.

Allgemeine Zoologie, oder Grundgesetze des thierischen Baues und Lebens, von H. ALEXANDER PAGENSTECHER. Erster Theil. Svo. Berlin: Wiegandt, Hempel, and Parey, 1875.

THE book promises to be one of the best text-books of the principles of zoology that we possess. Its author is in favour of the doctrine of the origin of species by evolution; but this does not hinder his giving a most impartial statement of the facts and inferences upon which a philosophical zoology must be founded. The general principle upon which he has worked may be expressed as follows in his own words:—"Nature can only be described. Explanations, the establishment of causalities and purposes, mechanical, dynamical, monistic, and dualistic systems are attempts at the description of nature. The most useful of them will be that which furnishes the most complete result in the simplest and most easily intelligible way."

Starting from this view of the natural-history problem, Prof. Pagenstecher describes in his second book the properties of animal bodies in general, commencing with the ultimate simple constituents of the body, passing to the combination and differentiation of these constituents to form composite living bodies, then discussing the idea of animal individuality and polymorphism (or, as he calls it, pleomorphism), and, finally, the morphological arrangement of the parts of which the bodies of animals are composed. The arrangement and treatment of the matter in this book makes it an admirable summary of the broad principles of animal morphology.

In the third book (the last in the part now before us) the author treats of the limitation and classification of the animal kingdom; and this leads him to give an historical account of the doctrine of the species from the earliest periods to the present day. His concluding remarks upon this subject are excellent, and show strikingly the moderation of his tone. He says:—"There is no doubt that species are not eternal, and that they are variable. The duration of the individual species with all their peculiarities, or even the duration of a part of the specific peculiarities, such as finds expression in the characters of genera or families, and therefore the duration of genera or families, is very unequal. Some are long-lived, others not, without one being able to see the causes of this clearly from the surrounding conditions. The changes which have occurred in the appearance of the animal and vegetable world in the course of the geological epochs agree with what we know of changes by variability, of metamorphoses in developmental history, and of difference in nearly allied forms; but they go beyond these. At least much in the fossil forms stands for the present uncombined with the living. The action of external circumstances upon the form and structure of animals has not yet been sufficiently investigated; in all cases there is in opposition to their consequences a very powerful agent, which we name specific persistence." These views are further de-

veloped by the author; but the preceding passage may suffice to indicate his general opinion on this knotty subject. The remainder of the book is devoted to a consideration of the principles of classification, and a discussion of the boundary between animals and plants. We look forward to the publication of the second part of Prof. Pagenstecher's book, and recommend it with confidence to the notice of the readers of the 'Annals.'

MISCELLANEOUS.

Organic Remains in the Metamorphic Rocks of Harris.

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

GENTLEMEN,—It may interest the readers of the 'Annals' to know that we have recently discovered evidence of life in the so-called "Laurentian Rocks" of Harris, in the Hebrides. The specimens in question are as clearly organic in their nature, and as well preserved in their minute structure, as is the case with Silurian or Devonian fossils of an analogous structure (such, for example, as *Stromatopora*). At present we have merely made a preliminary microscopic examination of the specimens; and we simply wish, therefore, to draw attention to the fact, so interesting in view of recent discussions, that unequivocal organic bodies occur in such ancient deposits as the lowest metamorphic rocks of Harris. We may add, however, that the specimens are little altered, the skeleton of the fossil being calcareous, apparently dolomite, and exhibiting all the minute details of its structure; whilst the chambers are filled, as so commonly in organic remains from younger deposits, with transparent silica. Finally, though apparently differing from it in important respects, we believe that our specimens will contribute powerfully to the solution of the controversy which has been of late years carried on as to the true nature of *Eozoon*.

We remain, Gentlemen,

Yours faithfully,

H. ALLEYNE NICHOLSON,
JAMES THOMSON.

Reproduction of Amblystoma.

By M. BLANCHARD.

The Mexican *Amblystoma*, the adult form of the axolotl, has just deposited eggs for the first time in the menagerie of the Museum. The fact is of considerable importance, as it does away with the ideas which have arisen with regard to the sterility of adult Batrachia which displayed extreme fecundity while they remained in the condition of larvæ.

The researches of M. Aug. Duméril upon the axolotls will not be

forgotten. These Batrachia, furnished with branchiæ, reproducing in a very usual fashion, seemed to have attained their definitive form; and in consequence of this belief they were classed in a particular group, the Perennibranchia. In 1865 M. A. Duméril saw the axolotls lose their branchiæ and become transformed in the same way as the larvæ of the Tritons and Salamanders; they became *Amblystomata*, the name given long before to certain Batrachia the metamorphoses of which were not known. For more than ten years these animals displayed no aptitude for reproduction.

In the autumn of 1874 the new menagerie of the Museum was established; and then it was endeavoured to furnish the animals with varied situations in order that they might follow the impulses of their nature; from this moment the Amblystomes have led a more active life. M. L. Vaillant, who was in August last, as Professor at the Museum, called to the direction of the Menagerie of Reptiles, has taken all imaginable care for the observation of biological phenomena; and it is thus that he has just obtained the reproduction of the Amblystomes. He proposes to follow, with all possible attention, the phases of the development of the larvæ, which, no doubt, will soon be hatched.

Henceforward we have evidence that the Batrachian which is successively axotl and *Amblystoma* does not by any means depart from the category of many cold-blooded animals, which, being capable of reproducing when young, nevertheless do not cease to be fertile when they are completely adult.—*Comptes Rendus*, March 27, 1876, p. 916.

On supposed Embryos of Ichthyosaurus.

By Prof. PETER MERIAN.

In 1824, in his memoir 'De Ichthyosauri speciminibus,' and again in 1828, in his fossil Reptilia of Württemberg, J. G. Jäger gives a plate showing a small *Ichthyosaurus* enclosed within the ribs of another specimen about four times as large. As the head of the smaller individual was directed towards the posterior extremity of the larger one, Jäger thought that it might be the skeleton of an embryo still in its original position within the body of the mother, and hence that the *Ichthyosaurus* in question might be viviparous. This view he laid before the meeting of German naturalists in 1842, and afterwards published in the 'Münchener gelehrte Anzeigen' in 1852 (p. 33), when he also called attention to a similar observation made in England by Mr. J. Channing Pierce, and communicated by him to this Journal (*Ann. Nat. Hist.* ser. 1, vol. xvii. p. 44, 1846).

M. E. Meyrat, of Birsfelden, has obtained from the Upper Lias of the neighbourhood of Ohmden in Württemberg (the same bed that furnished Jäger's specimen) a fine perfect skeleton of *Ichthyosaurus avirostris*, within the ribs of which there is a smaller skeleton apparently of the same species; but in this case the head of the small specimen is turned towards the front of the larger one. Professor Merian thinks that this position of so large an individual is hardly com-

patible with its being an embryo, and that it is more probable that the enclosed skeleton is that of a small individual which had been swallowed by the larger one as food. The specimen is in the Museum at Geneva.—*Verhandl. der Naturf. Gesellschaft in Basel*, part vi. p. 343, 1875.

On the Periodical Movements of the Leaves in Abies Nordmanniana.

By M. J. CHATIN.

Abies Nordmanniana is a Conifer which is now widely diffused, on account of the elegant coloration of its leaves, of which the lower surface is whitish, while the upper surface is of a fine deep green.

Now if this tree is observed early in the morning, or in the decline of the day, its foliage appears uniformly whitish; but in the middle of the day the green tint seems general. On attempting to explain this difference of coloration, it is found to result from a special position of the leaves, which varies during the day and during the night: in the former case the leaves are spread out upon the branch and present their upper surface, producing the greenish aspect of the foliage; during the latter period, on the contrary, it is the lower surface that is presented to the spectator; and this causes the whitish tint of the *Abies*.

Thus there is a *diurnal* and a *nocturnal position*. This merits particular attention on account of the phenomena which cause it: we see the leaves, which are at first horizontal, gradually erect themselves upon the branch, so as to become often nearly perpendicular to the branch; but at the same time this movement of erection is accompanied by a movement of torsion impressed upon the basal part of the leaf, and which may frequently traverse an arc of 90 degrees. In this respect the leaves of the upper branches seem to undergo a sort of accommodation which enables this torsion to persist in them, at least partially. This, however, is a peculiar fact which I shall only indicate at present, with the intention of treating it soon in more detail in another communication, in which I shall have the honour of presenting to the Academy the results furnished by experiments which will soon be completed, and which I have undertaken with the object of ascertaining, in *Abies Nordmanniana* and some other allied forms, the causes and mechanism of the phenomena here mentioned, and the analysis of which enables me to examine, in their principal details, these *movements of torsion*, upon which vegetable physiology possesses but few data. From another point of view their study enables us to extend to the Gymnosperms the existence of the spontaneous movements which old observers have indicated in many Dicotyledons, which M. Brongniart has described in several Monocotyledons, and which, as the present example clearly shows, occur in the three great divisions of phanerogamous plants.—*Comptes Rendus*, January 10, 1876, p. 171.

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XLIX.—Notes on Otto Hahn's "*Microgeological Investigation of Eozoon canadense.*" By WILLIAM B. CARPENTER, M.D., F.R.S. *

HAVING neither the time nor the ability for a full criticism of the elaborate paper of Dr. Hahn (its Mineralogical details lying entirely outside the scope of my inquiries, which have had reference only to Organic structure), I yet think it desirable to specify some of the points as to which the author seems to me to have failed to apprehend the probative value of what has been advanced by Dr. Dawson and myself on the other side.

1. Dr. Hahn takes as the basis of his discussion the short account of the structure of *Eozoon* contained in the fourth

* The first sentence of the "Remarks" of Profs. King and Rowney in the last Number of the 'Annals' makes it necessary for me to explain that I have *not* (as asserted by them) "withdrawn from the Eozoic contest," but that I simply decline to continue it with *them*. I can have "no common basis of agreement" with any persons who accuse me of inventing facts and manufacturing figures to support those inventions, and who claim to pronounce *ex cathedra* upon the "impossibilities" of the structure of *Foraminifera*—a group as to which my thirty years' study has satisfied me that our knowledge is yet in its infancy. My personal self-respect forbids me to allow the truthfulness of my statements, as to what is clearly shown by specimens in my possession, to be called in question by those who have not seen those specimens, though repeatedly invited to inspect them; whilst argument is obviously thrown away upon antagonists who simply meet it by the assertion of their own or some one else's infallibility. It will be seen in the conclusion of the present "Notes," that *facts* are altogether opposed to the *dicta* of the Galway Professors.

edition of my 'Microscope and its Revelations,' published as far back as 1868; and has not noticed either the "New Observations" which I published in the 'Annals of Natural History' two years ago (June 1874), or the reproduction of them contained in the fifth edition of my 'Microscope,' published nearly a year and a half since. Dr. Dawson's still more recent 'Dawn of Life' of course receives no notice.

Hence the structural facts which I hold to be all but demonstrative of the Organic origin of the calcareous layers of the Ophicalcite of Canada are altogether ignored in Dr. Hahn's discussion. Of these facts I shall recall two:—(1) the existence, in the best-preserved specimens, of a calcareous layer immediately surrounding the chamber-cavities, which shows a parallel *nummuline tubulation* (not filled up by serpentine infiltration) as distinct as that of any recent *Nummulite*; and (2) the existence of a *relation between the canal-system and the chamber-cavities*, through the medium of this layer, so *precisely resembling* that which obtains in *Calcarina*, that its peculiarity constitutes a most significant indication of Foraminiferal structure. Now as I described this very relation more than ten years ago* on the basis of decalcified specimens, though it was only in 1874 that my reexamination of the large series of transparent sections in my possession gave me the additional evidence of it which I described and figured in my "New Observations," I cannot but feel surprised that Dr. Hahn should assert (p. 271) not only that the canal-systems "are never continued into the chambers," but that they "have no relation at all to these,"—the precise contrary of the latter statement being the fact.

2. The gist of Dr. Hahn's paper, so far as I understand it, lies in the affirmation that all the appearances seen in the specimens which he has himself examined are not merely explicable on the hypothesis of purely Mineral agency, but are incapable of being otherwise accounted for. This argument I had thus answered by anticipation in my "New Observations" (*loc. cit.* p. 469):—"My contention is, therefore, that the hypothesis of the Foraminiferal origin of *Eozoon canadense* entirely accords with the features alike of the general and of the minute structure of the best-preserved specimens of this body, and that it is the *only* hypothesis which fits *all* the facts of the case; whilst the hypothesis of subsequent metamorphic change, which has every probability to recommend it, fully accounts for all the appearances on which the Anti-Eozoonists rely as evidence of its Mineral origin." The evidence adduced

* Proc. of Geol. Soc. Jan. 10, 1866, p. 222.

by Dr. Hahn as to the mineralized condition of the Eozoic Ophicalcite merely bears upon its *present metamorphic condition*, and proves nothing in regard to its *original* character; as to which, as in all similar cases, our conclusions must be drawn from the examination of specimens which show the *least* evidence of metamorphism. Suppose that there were found, somewhere in the Carboniferous series, an extensive calcareous deposit, including a number of masses whose general character seemed Vegetable, though not conforming to any known type; and suppose, further, that on an examination of their internal substance, a large proportion of them proved to consist (as often happens) of calcspar, with quartz or other crystalline minerals scattered through it; whilst others, again, exhibited obscure and uncharacteristic traces of woody or cellular structure;—would not the discovery of a single well-preserved fragment, showing an unmistakable *vegetable tissue*, be regarded by every Palæontologist as adequate evidence that even the completely mineralized specimens were true *fossils*, not mere *pseudomorphs*?

3. It is affirmed by Dr. Hahn (p. 274) that “for every part of a rock the *presumption* is in favour of mere rock-formation.” He would seem, therefore, entirely unaware of the weight of evidence which has been gradually leading Geologists of the largest knowledge and ripest judgment to the conclusion that, in the case of *calcareous* rocks, the presumption is *all the other way*. No one, of course, doubts that inorganic Limestones may have been formed in old times, as they are being formed now, by simple deposit from waters holding an excess of carbonate of lime in solution. But, on the other hand, the resemblance of the organic calcareous deposits at present in process of formation upon the sea-bed, to the various calcareous strata of former epochs, taken in connexion with the knowledge we now possess in regard to the modes in which the traces of original organic structure may be obliterated by various forms of metamorphic action, afford a presumption in favour of the *organic* origin of any Calcareous rock-formation; the strength of which presumption is somewhat in the proportion of the extent which the *Globigerina*-deposit of our great Oceans, and the vast accumulation of the *débris* of Coral within the Barrier-reef of New Holland, bear to the local Travertine limestones of Italy—being almost as strong, in fact, as the presumption that a bed of Graphite or Anthracite, showing no trace of a Coal-plant, represents an antecedent Vegetation. On Dr. Hahn’s method of reasoning, the statuary-marble of Carrara, which is a rock of a finely crystalline texture, like that of loaf-sugar, showing little or no trace of bedding, and

containing prisms of crystallized quartz, must be regarded as a mere rock-formation, a product of purely Mineral agencies. But Geologists who have carefully studied it are satisfied of its stratigraphical continuity with a limestone of whose organic origin there can be no reasonable doubt; and they find an adequate reason for its metamorphism in the intrusion of the igneous rocks which it adjoins.

4. Again, Dr. Hahn leaves altogether out of view the *general* evidence of the organic nature of *Eozoön* afforded by the disposition of the beds of Eozoic Limestone, which strongly impressed Sir William Logan (than whom no judge could have been more competent) with its similarity to a Coral-reef. And, in like manner, he takes no account of the conformity in the condition of its calcareous lamellæ to that of the earliest *undoubted* fossils (*Stromatopora*, *Receptaculites*, &c.) of the Silurian limestones, which has been specially urged by Dr. Dawson. Neither does he give any evidence of having himself instituted such comparisons, which have obviously a very important bearing on the question; nor does he show that he has given any attention to the manner in which indubitably Organic structure and Mineral arrangement may be blended in the same fossil,—a point (notably seen in Echinoderm fossils) to which I have myself repeatedly drawn attention in the course of this controversy. To him, as to others who take the same side, evidence of Mineralization seems sufficient to settle the whole question; and nothing ought to be accepted as a Fossil, which does not exhibit *all* the structural characters of the organism it is affirmed to represent. I could scarcely have supposed that any person trained in habits of scientific reasoning could have expressed himself as follows:—"It is only if *all* the essential characters of the Foraminifer, and indeed each for itself, are no mere rock-structures, that the proof from analogy is carried at least to a high degree of probability. *But if the inorganic nature of only one is proved, the chain of evidence is broken*" (p. 275). In other words, no fossil can be accepted as such, however close may be its morphological correspondence with some recent type, if its originally organic structure has given place to crystalline aggregation; and the multitudes of shells preserved in Oolitic beds, whose external forms are most perfectly preserved, but whose shell-substance is represented by large crystals of calcite resembling brown sugar-candy, must be regarded, according to Dr. Hahn, as mere *pseudomorphs*!

5. The following extract will afford to the Palæontologist some means of judgment as to Dr. Hahn's qualifications to discuss a question which is at least as much Palæontological

as Mineralogical :—“ The same structure, and especially the same structures *together* (as is admitted by Carpenter and his allies), occur neither in extinct nor in living organic creatures ; but it is rather stated that the individual parts of the *Eozoon*-structure are only to be recognized in *different* kinds of Foraminifera. This circumstance alone makes the proof very doubtful ” (p. 274). One would think that Dr. Hahn had never heard of the Palæozoic *Cystideans*, which are referable to no existing Order of ECHINODERMATA, but seem to have combined some of the distinctive characters of each ; or of the Palæozoic *Graptolites*, which, if HYDROZOA, differ essentially from all existing types of that group ; or of the Palæozoic *Trilobites*, which cannot be referred with certainty to any existing Order of CRUSTACEA. And he seems quite unaware that it is rather the rule than the exception for the early forms of any type to present characters *in combination*, which are later distributed among distinct groups. The Mammalia of the Paris Tertiaries, and the great Fish-Lizards of the Secondary period, long since furnished examples of this ; numerous additional cases of it have been from time to time brought into prominence by Prof. Owen ; and it had been pointed out by Bronn as the usual order of Palæontological succession, long before the “ Evolution ” doctrine furnished its probable rationale. How familiar the idea has now become to Palæontologists is evidenced by the currency which the term “ synthetic types ” has gained among them. Hence that *Eozoon* combines characters which are separately met with among several existing types, so far from “ making the proof very doubtful,” rather furnishes an argument *in favour* of the Foraminiferal nature of *Eozoon*.

6. And, lastly, as Dr. Hahn’s account of the *genesis* of *Eozoon* differs fundamentally from that of Profs. King and Rowney, and as some of our own most eminent British Mineralogists agree with Dr. Sterry Hunt in the conviction that no conceivable combination of purely Mineralogical agencies can account for the structural peculiarities of *Eozoon*, I venture to assert that so far from Dr. Hahn having succeeded in proving (as he claims to have done) “ that there is no gigantic Foraminifer in Serpentine limestone,” he has simply shown how entirely inadequate Mineralogical investigation is *per se* to settle the question. I am perfectly aware of my own ignorance of much that Mineralogists and Petrologists can adduce on their side. And I am not without hope that the matter may be taken up *judicially* by a competent tribunal, in which Mineralogy, Geology, and Zoology shall be adequately represented, and the verdict of which will command general respect.

Since the above was written, I have to add that in a new type of incrusting Foraminifer discovered by Prof. Möbius, of Kiel, in 1874, upon a coral-reef off Mauritius, and of which he has been kind enough to send me a specimen, I find not merely a near approach to the mode of growth of *Eozoon*, but peculiarities of structure (some of them closely resembling the Eozoic) which fully justify my refusal to be bound down by our present very limited knowledge as to the "possibilities" of *Foraminifera*. These I shall point out as soon as the publication of Prof. Möbius's description of his *Rhaphidodendron album* shall leave me at liberty to do so.

L.—On the Anthribidæ of New Zealand.

By D. SHARP.

AT the present time the insect-fauna of New Zealand seems to be receiving a fair share of the attention to which it is entitled by its intrinsic importance. It is well known to naturalists that the fauna and flora of the islands in question possess many features of peculiar interest; and there is reason to suppose that when the insect-fauna is adequately known it will be seen to accord in its character with the other component groups of the fauna and flora.

In the present paper I deal with the species of the family or subfamily of Coleoptera known as Anthribidæ; and though I have only twelve new species to describe, I have not found my task an altogether simple one. The greatest difficulty I have had to contend with has been that of ascertaining the limits of the genera and larger groups in use for the purpose of classification. The family Anthribidæ itself is separated only in a vague and uncertain manner from some of the other families of Coleoptera; indeed by some authorities it is considered to be only a subfamily of Curculionidæ; while those who accept the name as representing a distinct family are not altogether agreed as to the amount of its components—Lacordaire, for instance, excluding from it *Urodon*, which is included in the family by C. J. Thomson.

At present, however, about 430 described species compose the family; and these species are distributed among no less than 108 genera, being an average of just four species to a genus. The study of these genera and their groups is attended with great difficulties; for they are divided from one another

by no strongly marked peculiarities, and in many cases the generic characters vary from species to species of the same genus in a very marked manner, as may be readily seen by any one who will make a slight examination of four or five of our European species of *Tropideres* (such as *T. cinctus*, *T. sepicola*, *T. niveirostris*, and *T. albirostris*).

I am acquainted with seventeen species of the family from New Zealand; and on examining these with a view to giving names to the new ones and indicating their affinities, I found myself, as I have said, to have undertaken a task which I could not readily execute with satisfaction. For I found these seventeen species to display such a wide range of difference in their structural characters, that it was clear that, in conformity with the recognized systematic arrangement of the species composing the family, they would have to be ascribed to a considerable number of distinct genera; and on a further examination the fact was also revealed that only a very few of the species could be placed satisfactorily in already established genera. And, again, on attempting to arrange these New-Zealand species with a view to grouping them into genera, I found that, even omitting all consideration as to their relations with insects found outside New Zealand, the task was no easy one, owing to the fact I have above alluded to, viz. the variation of generic characters from species to species. This point was rendered very evident to me by my examination; and when I considered it in connexion with the additional fact that it is certain that a good many more species of the family than are yet known to me exist in New Zealand, it became quite clear to me that I could not deal with the generic questions in any thing like a satisfactory manner, and that, if I attempted to meddle with these at all, I should very probably only encumber the nomenclature of entomology with a number of indefinite names.

I have therefore adopted a course which I hope will facilitate the study and advance our knowledge of these insects, and yet will cause no difficulty to the students and systematists who are to follow me. I have drawn up descriptions of the new species, and given what I hope will prove to be a useful and permanent name to each of them, by using the term "*Anthribus*" as the first part of the permanent appellation of each species; while as regards the few already described species, I have left their names intact as originally given to each by its describer; and in my descriptions of new species I have, where it appeared important to do so, given also its most important structural characters. To complete

the work, I have drawn up a table which will, I hope, facilitate the preliminary determination of the species; and in this table I have also indicated what appears to me at present to be the most convenient grouping or synthesis of the species.

Previous to the researches of the last few years only two species of this family had been described from New Zealand, viz. *Anthrribus incertus*, White, and *A. phymatodes*, Redt. White's species, I believe, is not among those I am acquainted with; and his description offers as striking an example as could well be pointed out of the use of hastily selected and indefinite terms for what purports to be a scientific description.

Redtenbacher's description of *A. phymatodes*, on the other hand, is a very good one; but yet I have some little doubts whether the species to which I have given that name be really the one intended by the talented Austrian entomologist (the sad news of whose death has reached me while writing these lines); for his description indicates a rather larger insect, and one having a more uneven surface of the thorax than the specimens before me.

Three species of the family have been previously described by myself, two of them with the generic name *Lawsonia*, which Mr. Pascoe, who is a great authority on this family, states to be synonymous with his *Exillis*, Lacordaire having assigned that genus an erroneous position as regards one of its important and easily seen structural characters. I do not on this account consider it necessary to change at present the names of my two species; but in case it should be ultimately considered that this should be done, I will take the opportunity to propose the name of *Exillis Lawsoni* in place of that of *Lawsonia longicornis* used in the present paper.

Mr. Pascoe himself has recently described a species of the family; and as he has kindly sent me a type thereof, I am certainly right as to the insect to which I apply his name.

I acknowledge with great pleasure the kindness of Capt. T. Broun, of Tairua, and Mr. T. Lawson, of Auckland, who have collected the insects here described. Each of these entomologists has discovered so many interesting and unexpected additions to the New-Zealand insect-fauna that it is to be hoped they will continue their researches, and so acquire for us a knowledge of many species which, if not speedily accumulated, will become extinct, as has already, indeed, been the case with many species of some other insular faunas, as well as with some of the most interesting of the larger components of the New-Zealand fauna.

Table.

I. Antennæ inserted at sides of rostrum or head. (Species 1 to 11.)

A. Thoracic carina not contiguous with elytra. (Species 1 to 8.)

Group 1.

* Eyes entire.

Sp. 1. Eyes oval, elytra almost even . . . *Anthribus Browni*.

Sp. 2. Eyes oval, elytra with elevations . . . *Anthribus bullatus*.

Group 2.

Sp. 3. Eyes circular and very prominent . . . *Anthribus vates*.

• ** Eyes emarginate.

† Thorax punctured.

Group 3.

Sp. 4. Eyes slightly emarginate; 9th joint of antennæ only a little longer than the two following ones together . . . *Anthribus discedens*.

Sp. 5. Eyes distinctly emarginate; 9th joint of antennæ gradually thickened from base to apex, at most only a little longer than the two following ones together . . . *Anthribus hetera*.

Sp. 6. Eyes distinctly emarginate; 9th joint of antennæ thickened at extremity only, twice as long as the two following ones together . . . *Anthribus phymatodes*.

†† Thorax without punctures.

Group 4. Genus *Lawsonia* (?*Exillis*, Pascoe).

Sp. 7. Ninth joint of antennæ only a little longer than the two following ones together . . . *Lawsonia variabilis*.

Sp. 8. Ninth joint of antennæ much longer than club . . . *Lawsonia longicornis*.

B. Thoracic carina contiguous with base of elytra. (Species 9-11.)

* Eyes emarginate.

Group 5. Genus *Etnalis*.

Sp. 9. Hind angles of thorax spinous . . . *Etnalis spinicollis*.

** Eyes entire.

Group 6. Genus *Cratoparis*, Lac.

Sp. 10. Hind angles of thorax obtuse . . . *Anthribus altus*.

Sp. 11. Hind angles of thorax acute . . . *Anthribus Huttoni*.

II. Antennæ inserted on the front of rostrum or head, near to the edge but nearer to the middle than the eye is. (Species 12-17.)

A. Thoracic carina contiguous with elytra. (Species 12-15.)

* Antennæ thickened at extremity, but not clubbed.

Group 7. Genus *Aræocerus*.

Sp. 12. Eyes very prominent . . . *Aræocerus pardalis*.

** Antennæ with ninth joint much thicker than eighth.

† Eyes rather large, but scarcely prominent.

Group 8.

Sp. 13. Elytra without bullæ near apex . . . *Anthribus crassus*.

Sp. 14. Elytra with bullæ near apex . . . *Anthribus nanus*.

†† Eyes small, but prominent.

Group 9.

Sp. 15. Thorax without sculpture . . . *Anthribus atomus*.

B. Thoracic carina not contiguous with elytra. (Species 16 and 17.)

Group 10.

Sp. 16. Thorax shining, sparingly punctured . *Anthribus inflatus*.

Sp. 17. Thorax not shining, densely rugose . *Anthribus rugosus*.

Anthribus Brouni, n. sp.

A. capite rostrato, oculis prominulis, ab antennis remotis, oblongus, variegato-tomentosus, antennis pedibusque testaceo fuscoque variegatis; elytris punctato-striatis. Long. corp. $2\frac{1}{2}$ –4 m. m.; antennarum $1\frac{2}{5}$ –3 m. m.

Antennæ variable in length, yellowish, the joints more or less marked with dark fuscous, so as in some individuals to be nearly entirely black, the three apical joints forming a broad, flat club; first joint short, only moderately thickened; second rather longer than first, third longer and more slender than second; eighth distinctly stouter than the preceding joints. Head distinctly rostrate, the rostrum dilated towards the apex; its front margin slightly emarginate behind the labrum; the eyes prominent, oval, widely separated; the antennæ inserted at the sides, very near the apex, and separated from the eye by a space about equal to the length of the eye; the antennal cavities elongate foveæ, and abruptly limited behind; its surface densely and rather finely rugose-punctate, and bearing hairs a little variegated in colour. Thorax about as long as broad, much narrowed towards the front, its carina moderately distant from the elytra and gently bent forwards along the sides without forming an angle; the sides of the thorax behind the carina a good deal narrowed; the surface is densely but rather indistinctly rugosely sculptured, and bears variegated hairs as its clothing. Elytra much variegated, the sides and extremity being darker than the discoidal part, and near the sides there is a slight metallic appearance; they bear rows of punctures, which are rather coarse, but much obscured by the clothing. The legs are yellowish, more or less variegated with dark marks. Tarsi rather slender, second joint rather deeply emarginate, third small.

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

Obs. I. This species varies much in size and in the development of the antennæ, and also a good deal in colour. The specimens which I consider to be females are small, and the antennæ are shorter and more slender than in the other sex; the rostrum also varies much in length.

Obs. II. This species in general structure much resembles *Tropideres niveirostris*, the antennæ of the two species being very similar. The rostrum, however, is much more produced in *A. Brouni*; and its form, as well as that of the head, is different; the eyes are more entirely lateral in *A. Brouni*, and the antennal cavities are different in form. *Tropideres sepicola*, however, in all these respects appears to approach *Anthribus Brouni* more closely; so that the generic qualifications (if I may use this term) of *A. Brouni* must be considered doubtful.

Anthribus bullatus, n. sp.

A. capite breviter rostrato, oculis prominulis, oblongus, variegato-tomentosus, antennis pedibusque testaceis; elytris pone medium quadrifasciculatis; pygidio quadrato. Long. corp. 2½ m. m.

Antennæ formed much as in *A. Brouni*, but with the joints of the club more laxly articulated, and with the eighth joint scarcely differing from the seventh. Rostrum similar in form to that of *A. Brouni*, but yet much shorter, so that the posterior margin of the antennal cavities is near to, though quite distinctly separated from, the eye; it bears two patches of dense white pubescence, which are conjoined behind though divergent in front. Thoracic carina distinctly sinuate on each side, and without any angle, and very gradually bent forwards. Elytra rather densely clothed, the shoulders and apex paler than the other parts, just above their declivity with a dense pencil of dark hairs, and with another but less distinct pencil just behind the middle; pygidium yellowish, quadrate; ventral plate of apical segment of hind body prominent and peculiarly flattened in the middle; basal joint of hind tarsus scarcely longer than second and third together.

Tairua: a single individual sent by Captain Broun. I believe it to be a male; and it is very probable that the peculiar form of the apex of the abdomen is peculiar to that sex.

Obs. Though much resembling the *Anthribus Brouni*, the *A. bullatus* is readily distinguished therefrom by the short broad rostrum and by the waved thoracic carina.

Anthribus vates, n. sp.

A. capite rostrato, oculis perconvexis, piceus, tomento griseo fuscoque vestitus; prothorace conico, angulis posterioribus minus discretis, carina ab elytrorum humeris remota. Long. corp. 5 m. m.

Antennæ moderately stout, shorter than the body, obscure reddish; second joint rather elongate, third nearly one and a half times length of second. Head with a short, broad rostrum; antennal cavities large but not sulciform, placed quite at the side of rostrum, and distinctly prolonged on its under face, the space separating the hind edge of these cavities from the eye small but distinct; the eyes are almost hemispherical. Thorax conical, not quite so long as broad; its carina in the middle is separated by a short distance only from the base of the elytra, but is curved so that its angle is twice the distance from the elytra that the middle is; the angle of the carina is almost a right angle (but not sharply marked), and it is only produced a very short distance forwards along the side; behind the carina the sides of the thorax are narrowed, so that a very evident gap is left on each side, between the angles of the thorax and those of the elytra. The elytra are covered with a dense variegated tomentum, which conceals their lines of punctures.

Tairua: a single male specimen sent by Captain Broun. The ventral segments in this sex are distinctly flattened and impressed along the middle.

Obs. Though this species in general structure is closely allied to *A. Huttoni*, it is very readily distinguished therefrom by the difference in the form of the basal parts of the thorax. The legs and antennæ are similar in structure to those of *A. Huttoni*, but are rather stouter, and the second joint of the antennæ is more elongate in *A. vates*. *Anthribus incertus*, White, is possibly an allied but rather larger species.

Anthribus phymatodes, Redt. (?).

A. oblongus, angustulus, pube grisea leviter variegata vestitus; antennis pedibusque testaceis, his fusco maculatis; elytris quadricalliosis, callositatibus posterioribus pone medium sitis. Long. corp. 3-4 m. m.

Antennæ elongate, reddish. Eyes moderately deeply emarginate; upper border of antennal cavity near, but distinctly separated from the eye. Thorax as long as broad, its carina very distinct, quite separated from the elytra, forming a rounded angle at the side, and extending forward about halfway to the front of

thorax; hind angles of thorax quite indistinct, and not applied to shoulders of the elytra, so that a gap or notch is left on each side between the thorax and elytra; its surface is covered with fine, greyish, somewhat variegated hair-like scales. Elytra rather long and narrow, clothed with somewhat variegated greyish scales, and in front of the extremity bearing a transverse blackish mark; they bear near the suture four rather strongly elevated callosities, the scales on which are black; the front pair of these elevations are near the base, the hind pair just behind the middle. The legs are yellowish, with indistinct darker marks.

Sent from Tairua by Captain Broun.

Obs. I. I have seen only three mutilated individuals of this species: two of them bear a pair of strongly elevated tubercles on the head just anterior to the eyes; the other specimen is smaller, and has the head and rostrum narrower, and has no trace of the tubercles just mentioned. It is perhaps a female, while the larger individuals are no doubt males.

Obs. II. This species is very distinct from *Lawsonia longicornis* and *variabilis*, by its tuberculated elytra, by the differently formed basal portion of the thorax, by the differently shaped eyes, and by the greater space between these and the upper margin of the antennal cavities.

Anthribus hetera, n. sp.

A. oblongus, angustulus, pube grisea leviter variegata vestitus; antennis testaceis, clava nigricante, et articulis 3^o-8^m apicibus nigris, iisdem apicibus vix nodosis, pedibus testaceis, nigro maculatis; elytris quadricalliosis, callositatibus posterioribus pone medium sitis. Long. corp. 3 m. m.

Antennæ just about as long as the insect (3 millims.), yellow, with the club black, and the apex of each joint from the third to the eighth also black, but the extremity of each of these joints only indistinctly nodose, the ninth joint not quite so long as the tenth and eleventh together.

Tairua: a single individual sent by Captain Broun.

Obs. This insect differs from *A. phymatodes* only in the colour and form of the antennæ; and if the individual of that species with untuberculated head prove to be only an undeveloped male, then *A. hetera* will perhaps be found to be only the female of *A. phymatodes*.

Anthribus discedens, n. sp.

A. oculis vix emarginatis, oblongus, pube grisea et nigro-fusca vestitus; antennis pedibusque rufis, illis articulis apice, his

femoribus medio fuscis; elytris basi bicallosis. Long. corp. $3\frac{1}{2}$ m. m.

Antennæ elongate and slender, reddish; joints 3-8 each a little thickened, but scarcely nodose at their apex; ninth joint quite as long as the tenth and eleventh together; antennal cavities large, their upper edge approaching very close to the eye: the eye itself is scarcely emarginate. The thorax is not quite so long as broad, is densely and rather coarsely punctured, and clothed with variegated hair-like scales; its carina distinct and forming an obtuse angle on each side. Elytra with rows of rather strong punctures, clothed in large part with blackish hair-like scales, and elsewhere with similar but greyish hairs, at the base with a pair of quite distinct callosities, and with indications of a second pair of callosities just on the middle.

Tairua, a single specimen sent by Captain Broun.

Obs. The different form of the eye very readily distinguishes this from the other allied species; the form of the thorax is similar to that of *Lawsonia longicornis* rather than to that of *A. phymatodes*. At first sight it would be thought that the eye in this species is not emarginate; but on a comparison with allied species it is seen that we have here an emarginate eye, in which there is a concomitant change of form, so that it appears like a round eye with a pointed projection above the cavity for the antennæ.

Anthribus altus, n. sp. (*Cratoparis*).

A. oblongus, dense tomentosus, antennis pedibusque testaceis, fusco variegatus, illarum clava fusca; rostro ante oculos fovea minuta, oblonga; elytris basi bicallosis, pone medium penicillis duobus. Long. corp. 4 m. m.

Antennæ shorter than head and thorax; second joint oval, about as long as first; of the following joints, 3-8, each is a little shorter than its predecessor, 9-11 forming an abrupt, loosely articulated club. Rostrum short and broad, a good deal constricted in front of the eyes, and in the middle showing a small oblong depression. Thorax not so long as broad, a good deal narrowed in front, its disk forming an indistinct elevation or callosity; elytra with the basal part on each side the scutellum much elevated, and behind the middle each bearing an elevated tuft of pubescence; they, like the rest of the surface, are densely clothed with tomentum, and show a more or less distinct circular mark between the four elevations. Legs yellowish and not very distinctly spotted.

Two individuals have been sent me by Captain Broun; I do not know their sex.

Obs. I. This species seems to agree very well with the characters assigned by Lacordaire to the genus *Cratoparis*, except that it has the rostrum decidedly contracted at its base.

Obs. II. The two individuals before me are very different in the colour of their clothing, though they agree exactly in other respects.

Anthribus Huttoni, n. sp.

A. capite rostrato, oculis prominulis, cinereo-, griseo- fuscoque tomentosus; antennis femoribusque piceis, tibiis tarsisque rufescentibus; prothorace conico, angulis posterioribus acutis, carina basi subcontigua. Long. corp. $4\frac{1}{2}$ m. m.

Body clothed with grey, ashy, and fuscous hair-like scales, which form on the elytra an indistinct tessellated pattern. Antennæ dark red or pitchy, either shorter than the length of the insect, or nearly reaching that length; they are moderately stout; second joint about equal in length to the first, rather more slender than it; third joint longer than any of the others; eighth joint similar in shape to the seventh, and but little shorter than it; ninth almost triangular, becoming gradually broader from its base to its extremity; the three apical joints form a rather broad, flattened club, of variable length. Head in front of the eyes with a broad flat rostrum, which is a little dilated towards the extremity, its front edge being scarcely emarginate; the antennal cavities are near the apex of the rostrum, rather widely separated from the eye; they are foveiform, being slightly prolonged towards one another on the under face of the rostrum; the eyes are large and prominent, not emarginate, their front part encroaching a little on the front of the rostrum. Thorax only about half as broad at its front margin as at its base, its carina very close to the elytra (but not applied to them) in front of the scutellum, then gently sinuate on each side so as to form the hind angle of the thorax, which is acute and extends quite as far outwards as the shoulder of the elytra; the lateral portion of the carina forms the lateral margin of the hind portion of the thorax, and does not extend quite so far forwards as half the length of the thorax. The elytra are very convex transversely, and so densely clothed that their sculpture is quite obscured. The legs are long and slender, and the basal joint of the tarsi is as long as the three following together.

In the male the antennæ are variable in length, but are generally longer and stouter than in the female; in this latter sex also they appear to be variable in their development. The two sexes may be readily distinguished by the form of the last

ventral plate, which in the female is much more elongate than in the male, and is shaped so that its middle part forms a sort of projection.

Auckland and Tairua: sent by Mr. Lawson as well as by Captain Broun, but apparently rare.

Obs. I. In certain specimens the elytra are marked by a dark transverse fascia across the middle, of which there is no trace in other specimens.

Obs. II. This species is one whose position in the accepted classification of the group I should find it very difficult to define. In respect to the peculiar form of the hind angles of the thorax, and the position of the thoracic carina, it forms a decided point of connexion with *Etnalis spinicollis*, from which, however, it is very distinct by reason of its emarginate eyes and more rostrate head.

Obs. III. I have named this interesting species in honour of Captain F. W. Hutton, of Dunedin, to whom science is largely indebted for its recent progress in New Zealand.

Anthrribus crassus, n. sp.

A. capite haud rostrato, oculis subconvexis, brevis, transversim convexus, niger, nigro-tomentosus et minus distincte cinereo-maculatus; elytris disco fascia abbreviata transversa, cinerea; antennarum basi tarsisque rufo-testaceis. Long. corp. 2 m. m.

Carina of thorax quite basal; antennæ inserted at inner margin of eyes. Head small, and much inserted in thorax, with a fine, dense, and indistinct punctuation. Eyes rather large, but not very prominent, their inner edge scarcely rounded and taking an oblique direction; along this inner edge of the eye and at some little distance behind its most anterior part is the point of insertion of the antennæ; there is no distinct cavity for their reception. The parts of the mouth are very small, and the front of the clypeus is truncate. The antennæ are pitchy, except the two basal joints, which are yellowish; they are slender, and about as long as the thorax; the first joint is rather slender, and has its inner edge only moderately curved; the second joint is about as stout as the first, and rather shorter than it; joints 3-8 are very slender, each is distinctly shorter than its predecessor, the eighth being but short; joints 9, 10, and 11 form a long, slender, and very laxly articulated club, each of them being quite narrow at the point of insertion. Thorax rather large, a good deal narrowed towards the front, the disk a little elevated, covered with a dense, fine, rugose sculpture, and only with excessively indistinct pubescence; its carina is close to the elytra, and follows the direction

of their base so as to form the hind angle of the thorax, which is about a right angle; it is continued at the sides not quite halfway forward to the front; this part of it, however, is but little conspicuous. Elytra clothed with a fine black pubescence, and on the middle with a small ash-coloured mark; the basal part of each near the suture is a little elevated, and the rest of the surface is rather uneven with indistinct elevations and depressions; the rows of punctures are distinct, but not very regular. The pygidium is moderately large; and the penultimate dorsal segment appears to be grooved in the middle for the apex of the elytra. The legs are nearly black, except the tarsi, which are reddish. The anterior coxæ are quite contiguous; the middle and hind coxæ are rather widely separated. The second joint of the tarsus is but little distinctly emarginate; the third joint is small and cleft to the base, so as to consist of two narrow lobes.

Tairua (a single individual sent by Capt. Broun).

The nearest described ally of this species is probably the *Dysnos semiaureus* of Pascoe, from the Malay archipelago. The appearance of that species is said to be that of a Scolytid; *Anthribus crassus* suggests to me rather the appearance of a minute *Chlamys*-like insect. The fine pubescence, which forms on the thorax and elytra indistinct pale spots, only strikes the eye when a careful glance is directed to them.

Anthribus nanus, n. sp.

A. capite haud rostrato, oculis subconvexis, piccus, transversim convexus, vix distincte tomentosus, antennarum basi, tarsisque rufotestaceis; elytris superficie valde inæquali. Long. corp. $1\frac{2}{3}$ m. m.

This species appears to be very closely allied to *Anthribus crassus*, but is smaller, and has the surface of the elytra much more uneven, there being before the apex some elevations which do not exist in *A. crassus*; this unevenness of their surface renders the lines of punctures very irregular. The pale spots of fine pubescence seen in *A. crassus* appear to be absent in my individual of *A. nanus*.

Tairua. A single individual sent by Captain Broun; it shows me no indication of its sex.

Anthribus atomus, n. sp.

A. capite nullo modo rostrato, oculis minoribus, sat convexus, oblongus, transversim convexus; prothorace sericeo-opaco, impunctato, setis depressis pallidis parce vestito; elytris fere nudis, striatis, striis indistincte punctatis. Long. corp. 1 m. m.

Antennæ as long as the thorax, yellowish, with the club
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darker; the joints 1 and 2 largely developed, and together almost as long as joints 3-8, which are small; of these each is a little shorter than its predecessor, and also very slightly stouter; joints 9-11 form a rather large flat club, the first two of these joints being transverse. Thorax not so long as broad, its front part greatly deflexed, its carina contiguous with base of elytra; its surface without sculpture, but exhibiting a peculiar silky opacity, and clothed with distinct scanty hairs. Elytra rather deeply striated, but the striæ only indistinctly punctured. Legs rather long, yellowish.

Sent both from Auckland and Tairua by Messrs. Lawson and Broun.

Obs. I. This minute little species, which is of the size and form of an *Atomaria*, is variable in colour and size. Sometimes it is nearly entirely black, with the legs and basal portion of the antennæ paler; in others the general colour of the upper surface is yellow, with the middle of the thorax and variable marks on the elytra of a dark colour.

Obs. II. In this species the diminution of the head and rostrum seems to reach the greatest point it attains in the Anthribidæ. The antennæ are inserted in a cavity situated at the inner side and front part of the eye, which is small, but prominent, and about circular in form. The natural position of the head seems to be that of deflection or inflection; and the prosternum is much reduced in size, so that in the position of repose the head is brought near to the mesosternum. The basal line of the thorax is curved forwards along the sides, but is fine and indistinct; the front coxæ are contiguous, and the middle ones are only a little separated from one another; the metasternum is very short; the penultimate dorsal segment of the hind body is deeply grooved for the extremity of the elytra, and the groove extends to the basal part of the pygidium. The basal joint of the tarsi is rather small; the second is distinctly emarginate; and the exposed part of the third joint is scarcely so large as the second.

I do not know any very near ally of this insect, of which the place in classification at present should be near to *Choragus*. It is undoubtedly closely allied to *Anthribus inflatus*, but differs therefrom by the diminished basal portion of the prothorax.

Anthribus inflatus, n. sp.

A. capite haud rostrato, oculis minoribus sat convexis, piceus, nitidus, nudus, antennis pedibusque testaceis, illarum clava infuscata; prothorace parce punctato, lateribus rotundatis, carina a basi sat remota; elytris minus fortiter striato-punctatis. Long. corp. $1\frac{1}{2}$ - $1\frac{2}{3}$ m. m.

Var. Prothoracis marginibus et elytrorum basi apiceque plus minusve dilutioribus.

Antennæ about as long as the thorax, yellow, with the club infusate, the joints bearing fine and somewhat scanty, but quite distinct outstanding setæ; first joint dilated towards the extremity, and rounded on the inner side; second joint almost as long as first and rather more slender than it; joints 3-8 slender, each shorter than its predecessor; joints 9-11 forming a rather large, loosely jointed club, the middle joint being transverse. Eyes rather prominent, but small and transverse; the antennæ inserted just at their inner and front edge; the rostrum very short and rather sparingly punctured. Thorax rather large, convex, longer than broad, the sides curved; the carina not close to the base in the middle, and curved away from it towards the sides, and appearing not to be distinctly bent up, but gradually curved forwards, and quite indistinct in its lateral portions; the surface of the thorax is covered with moderately coarse but rather distant punctures. The elytra are short and convex, curved at the sides, and each one bears nine rows of shallow, moderately coarse punctures. The legs are yellow, but the knees and the apex of tibiæ and base of the tarsi are a little infusate.

Sent from the Northern Island both by Messrs. Broun and Lawson. Though I have examined several individuals, I see no external sexual marks.

Obs. The nearest ally of this species as yet known is doubtless the *Notioxenus rufopictus*, Wollaston; but the *Anthribus inflatus* differs, I judge, from that species by the form of the basal portion of the thorax. The carina in *A. inflatus* is simply curved, so that its lateral portions are more distant from the elytra than the middle portion is; behind this carina the basal part of the thorax is depressed, and at the sides is much narrowed towards the base. The metasternum in *A. inflatus* is excessively short, and the legs are long; the second joint of the tarsi is smaller than usual in the Anthribidæ, so that the third joint about equals it in size.

Anthribus rugosus, n. sp.

A. piceus, opacus, antennis pedibusque testaceis, elytris testacco signatis; thorace dense, fortiter profundeque punctato; elytris striatis, striis profunde impressis fortiterque punctatis, interstitiis angustis. Long. corp. $1\frac{1}{2}$ m. m.

Antennæ yellow, with the club more obscure in colour; rostrum and vertex coarsely punctured. Thorax with a very dense and coarse punctuation, and bearing a few fine hairs. Elytra black, with two small spots at the base of each and a

very large apical patch yellow; they bear each nine broad and deep striæ, so that the interstices between these are very narrow; the striæ also are coarsely punctured. Legs yellow, with the knees and tarsi a little infuscate.

Tairua (a single specimen sent by Captain Broun).

Obs. In size, form, and structure this species seems almost exactly similar to *A. inflatus*; but the sculpture of the upper surface is extremely different.

POSTSCRIPT.

Since the preceding paper left my hands I have received from Capt. Thomas Broun a few species of New-Zealand Coleoptera; and among them are three very interesting new Anthribidæ. The descriptions of these I have thought it well to publish in company with those of the preceding species; and as they are not indicated in the tabular arrangement, I have pointed out the nearest ally of each. Captain Broun informs me that he can at present give no further information as to the habits of these three species, than that they are found on birch and are excessively rare.

Anthribus spinifer, n. sp.

A. capite longius rostrato, oculis convexis, niger, fusco-nigro tomentosus; capite ad oculorum margines, prothorace basi utrinque scutelloque tenuiter ochraceo lineatis; coleopteris brevibus latis, sutura medio acute elevata, apice bipenicillata. Long. corp. (rostro incl.) 5 m. m.

Antennæ reaching to the back of the thorax, black, with the eighth joint clothed with white hairs; first and second joints rather long, about equal to one another; of 3-8 each is a little shorter than its predecessor; eighth joint slender, much longer than broad; ninth joint dilated gradually from base to apex, distinctly longer than broad; tenth transverse; eleventh longer than tenth. Head produced into a rostrum, which is greatly dilated at the extremity and is rather shorter than the thorax; the eyes are quite entire, very prominent, and nearly circular; the antennæ are inserted near the apex, quite at the sides, in short cavities which are very slightly prolonged backwards and downwards: it is black in colour, with a line of yellow scales at the inner margin of each eye. Thorax a good deal narrower than the elytra, rather longer than broad; the carina distant from the base, nearest to it in front of the scutellum, and gradually curved forwards towards the sides, and not continued forwards after the termination of the curve:

in front of the curve it is a good deal narrowed towards the front, and is constricted behind the curve; it is impunctate and clothed with a very fine black tomentum; at the base, at a distance from the middle on each side, is a patch of yellow scales; and there are some yellow scales in front of the scutellum, which is densely covered with yellow tomentum; there are also some indications of these marks being carried forwards towards the front of the thorax. Elytra short and broad, and quite rounded at the extremity, bearing rows of distant punctures and clothed with a fine dark tomentum, and with a pale mark at the humeral angle; just about the middle of the suture is a large elevation, which is furcate at its apex, and clothed with a long pointed pencil of black tomentum. Tarsi nearly black, variegated with white hairs. Under surface impunctate and sparingly clothed with very fine tomentum.

A single individual has been sent me by Captain Broun, labelled no. 167.

Obs. This very curious species should be placed, in my arrangement, at the head of the New-Zealand species, on account of its elongate rostrum; I anticipate, however, that it will prove to be more nearly allied to *Anthribus vates* than to *A. Brouni*, on account of the form of its thorax and antennæ.

Anthribus ornatus, n. sp.

A. capite breviter rostrato, oculis rotundatis convexis, robustus, latior, elytris tuberculis sex magnis; dense subtiliterque scabropunctatus, olivaceus, subtus pallide tomentosus, in rostro et ad marginem anteriorem prothoracis albido-tomentosus, tuberculis plus minusve aureo-vestitis; tibiarum apice tarsisque nigris; antennis medio testaceis, basi apiceque fuscis. Long. corp. 7½ m. m.

Rostrum short and very broad; mandibles very broad; antennæ inserted at the sides in a large fovea, widely separated from the eye, which is moderately large, very prominent, and nearly circular. Antennæ short; the two basal joints rather slender, the second rather the longer; of 3-8 each is a little shorter but not broader than its predecessor; 9-11 forming a stout club, the eleventh being the largest of the three. The rostrum bears a deep fovea on the middle; and round this is a space clothed with nearly white scales. Thorax sinuate at the sides and much depressed at the front angles; the carina strongly elevated, very near to the elytra except in the middle, it forms on each side a well-defined right angle, and is continued forwards to near the front; the disk of the thorax bears two coarse tubercles or angular elevations, it is of a greenish colour, densely and finely punctured, and clothed with very fine hairs, with a dense patch of irregular shape at the front

angles nearly white, and at the base on each side of the middle with some golden-coloured hairs, and with some similar ones about the tubercles. Elytra with a very fine and dense punctuation, and with some rather larger punctures, which are indistinctly arranged in rows; each one bears three very large tubercles placed at a little distance from the suture, and each is notched at the base so as to expose the rather large and elevated scutellum; the suture just behind the scutellum is elevated, and there is a fine but distinct sutural stria; the surface bears extremely short and fine and indistinct pale hairs, which are more conspicuous about the tubercles than elsewhere. Under surface rather densely clothed with a pale grey pubescence. Legs pale green, with the apex of the tibiæ and the tarsi black.

Obs. This very remarkable insect is readily distinguished by the rounded scutellar angles of the elytra; its place among the New-Zealand species at present known is next to *Anthribus altus*, and, in the present state of the classification of the Anthribidæ, should find its place near the species of *Cratoparis*.

Anthribus rudis, n. sp.

A. oblongus, fuscus, variegato-pubescent, prothorace macula basali albida; elytris tuberculatis, tuberculis fulvo-tomentosis; metasterno medio rugoso-punctato. Long. corp. $4\frac{3}{4}$ m. m.

Antennæ about as long as head and thorax, rather stout, obscure reddish in colour; second joint about equal to first; ninth joint longer than broad, gradually dilated from the slender base to the broad apex; tenth shorter than ninth, slightly longer than broad; eleventh smaller than tenth, obtusely pointed. Head distinctly rostrated, but the rostrum broad and short, hardly longer than broad; the eyes narrow oval, convex, very obliquely placed, not emarginate. Antennæ inserted at a distance from the eyes in a rather large cavity at the side, the hind part of which is slightly directed down; the surface is covered with a somewhat variegated pubescence, and is finely carinate on the middle near the front. Thorax almost as long as broad, a good deal narrowed towards the front; the surface uneven, but not distinctly tuberculate, covered with a rather variegated pubescence, in which a white spot at the base is very conspicuous; on each side of this white spot is a smaller black one; the carina is placed at a distance from the base, and is a little sinuate or waved, is more distant from the elytra at the angles than in the middle. Elytra rather short and broad, their surface uneven, it being elevated into some indistinct tubercles, which are clothed with a tawny tomentum; the rather coarse rows of punctures are concealed by a rather

dense, somewhat variegated tomentum. The metasternum bears very coarse punctures, which on the middle are rugose; the legs are reddish, and not very distinctly variegate.

A single individual, sent by Captain Broun, with the number 120 attached.

The species is allied to *A. Brouni* and *A. bullatus*, but is larger than either of those species; the uneven elytra and coarsely punctured sternum distinguish it from the former species; from *A. bullatus*, to which it is probably more closely allied, the much larger size and the light-coloured tomentum on the elytral elevations readily distinguish it.

LI.—*Preliminary Notice of new Species of Arachnida and Myriopoda from Rodriguez, collected by Messrs. George Gulliver and H. H. Slater.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

As some time will elapse before the detailed account of the collections made by the Naturalists accompanying the Transit-of-Venus expeditions will be published by the Royal Society, diagnoses of the new species of Arachnida and Myriopoda are submitted in this paper.

ARACHNIDA.

Genus SPHASUS.

Sphasus? extensipes, n. sp.

♀. Cephalothorax testaceous, irregularly pentagonal, almost flat; a longitudinal ridge from behind the eyes to beyond the caput: eyes black, placed upon a whitish elevation on the front of the caput; the anterior pair very minute, in the centre of the face, the others considerably larger and forming a transversely hexagonal figure: front margin of face projecting in the centre, behind the projection a V-shaped depression: abdomen testaceous, subcylindrical, flattened below, tapering slightly towards the posterior extremity: legs pale ochraceous; the tibiæ and metatarsi of the two anterior pairs fringed with brown bristles; front pair very like those of *Miagrammopes*; palpi short, pale ochraceous, with blackish tips; maxillæ and falces pale brown; pectoral plate elongate hexagonal; ventral surface of abdomen with three central longitudinal grey lines. Length 7 millims.; relative length of legs 1, 4, 2, 3.

(Coll. by Gulliver.)

Genus *SALTICUS*.*Salticus baptizatus*, n. sp.

♀. Cephalothorax inverted bell-shaped, dark shining piceous, with a whitish submarginal line, bordered within laterally by a rather wider tawny line; a minute cruciform amber-coloured spot in the centre of the caput, two lateral crescent-shaped fawn-coloured spots (one on each side) clothed with white scales, and a leaf-like fawn-coloured patch in the centre of the thoracic region, the front of which is depressed; the hinder part and apex of the thoracic patch clothed with whitish scales; falces, maxillæ, labrum, femora, tibiæ, and metatarsi of anterior legs castaneous; pectoral plate fusiform, testaceous; last three pairs of legs and tarsi of anterior pair amber-yellow, claws black; palpi whitish: eyes opaline, forming an oblong across the caput; relative sizes as follows— anterior central pair, posterior, lateral anterior, lateral intermediate: abdomen elliptical, dark brown, with a lateral whitish line and a broad, white-edged, irregular, central testaceous streak; ventral surface whitish, striated with brown at the sides; a central ferruginous streak; region of spinnerets testaceous. Length 9 millims.; relative length of legs 1, 4, 2, 3.

(Coll. by Gulliver.)

This species has the general coloration of the much smaller species figured in Lucas's 'Algeria' under the name of *S. testaceolineatus*.

Salticus rodericensis, n. sp.

♀. Cephalothorax dark piceous, clothed with testaceous hairs; a central longitudinal reddish castaneous streak from the back of the caput to the posterior margin; eyes opaline; falces, labrum, maxillæ, legs above, femora and tibiæ below, and epigyne castaneous, clothed with testaceous hairs; tarsi testaceous, with black claws; abdomen ovate, dark brown, pilose, with a dorsal testaceous streak interrupted by angulated lines at its inferior extremity, and intersected by a black line; two arched black lines spotted with testaceous from the sides of the testaceous streak to the spinnerets; pectoral plate, coxæ, trochanters, and venter fawn-coloured, base of venter white; a central tapering grey streak. Length 10 millims.; relative length of legs 1, 2, 4, 3.

(Coll. by Gulliver.)

Apparently allied to *S. intentus* of Cambridge.

Salticus scabellatus, n. sp.

♀. Oculiferous region of cephalothorax black, bounded by a crescent-shaped reddish castaneous belt; thoracic region dark piceous; eyes opaline; palpi testaceous; falces, labrum, maxillæ, and anterior tibiæ dark piceous; legs above fawn-coloured, pectoral plate and legs below paler; abdomen grey, subpyriform, its base black; a central pale brown longitudinal stripe, bounded laterally by four black spots, which form a square; venter pale brown, speckled with dark brown, a central line and the margins dark grey. Length 8 millims.; relative length of legs 4, 1, 3, 2.

(Coll. by Gulliver.)

Seems to be allied to *S. exilis* of Cambridge.

Genus PHOLCUS.

Pholcus vexillifer, n. sp.

♀. Cephalothorax inverted heart-shaped, waved at the ends, bright reddish castaneous; caput ascending, with the front margin and a central marking yellowish; eyes upon elevations of the surface, those of the lateral groups forming triangles, anterior pair of eyes small; falces blackish, yellowish at base; maxillæ and labrum tawny; pectoral shield pyriform, yellowish; legs pale amber-yellow, clothed with whitish hairs and black spines; palpi testaceous, with piceous tips: abdomen subcylindrical with a wavy outline, above testaceous, with a central stellate streak, several oblique lines, and the borders brown, posterior extremity testaceous; underside the same colour, with the base and a central streak greyish brown. Length 10 millims.; relative length of legs 1, 2, 4, 3.

(Coll. by Gulliver.)

Genus META.

Meta vacillans, n. sp.

♂ ♀. Cephalothorax smoky testaceous, obovate, truncated at the ends, depressed behind; caput ascending, convex, with a marked depression on each side; a central longitudinal ridge; eyes black, in two slightly arched series: abdomen cylindrical, testaceous, with two central lines and a broad undulated longitudinal dusky band, bounded by three black spots on each side; the sides silvery; underside black, with a silvery line on each side: legs long, slender, testaceous, paler below, blackish at the joints, sparsely dotted with long spines; palpi slender,

testaceous; male palpus with a clavus resembling the head of a vulture, covered with long bristles; falces subcylindrical, testaceous, about nine teeth on their inner margins; pectoral plate pentagonal scutiform, testaceous. Length of body 6 millims.; relative length of legs 1, 2, 4, 3.

(Coll. by Gulliver.)

Genus TETRAGNATHA.

Tetragnatha Nero, n. sp.

♂ ♀. Cephalothorax fusiform, truncate at each end, narrowed in front, with a slender marginal ridge; caput ascending, bounded behind by one or two depressed diverging lines, and with a central depressed spot; centre of thoracic region depressed; eyes black; palpi long and slender, of the male with a globose clavus with white cap, and held by finger-like processes; falces with ten central teeth on each inner margin, and two terminal teeth, the longer one of which projects forwards on each side of the movable fang, the latter black; but the remainder of the cephalothorax and its members tawny; the palpi, coxæ, and trochanters pale; pectoral plate deep castaneous; abdomen pale brown, irrorated with æneous, subcylindrical, a darker dorsal line. Length of body, ♂ 8 millims., ♀ 12; relative length of legs 1, 4, 2, 3.

(Coll. by Gulliver.)

Genus NEPHILA.

Nephila instigans, n. sp.

♀. Cephalothorax oblong, wider behind than before, laterally convex, contracted behind the caput, dull mahogany-red, but the back of thoracic region shining black, with a deep central depression; caput ascending, covered with black bristles, which also form a central longitudinal line; legs bright ochre-yellow, sprinkled with black spines; the tarsi and metatarsi castaneous, clothed with brown hair; proximal extremities of the femora blackish; basal half of palpi yellow, nearly smooth, apical half castaneous, clothed with black bristles; falces dark reddish castaneous, with three teeth on each inner margin; pectoral shield heptagonal subpyriform, black, with central orange longitudinal streak; abdomen sandy brown, with a quadrangle of four punctures; region of epigyne blackish. Length 19 millims.; relative length of legs 1, 2, 4, 3.

(Coll. by Gulliver.)

This species does not possess the usual tufted legs.

Nephila ardentipes, n. sp.

♀. Cephalothorax black, hairy, oblong, with convex margins, contracted behind the caput; two central shining black tubercles; a deep excavation at the back of the thoracic region; caput ascending, laterally excavated; oculiferous tubercles shining; palpi cylindrical, mahogany-red, hairy at the base, the last three joints black and hairy: abdomen greyish testaceous, silvery pubescent; the dorsal region subochraceous, enclosing a quadrangle of four black spots in front and two parallel rows of black spots behind, where it is also bounded by six black spots, three on each side; sides covered with parallel, irregular, interrupted black lines; underside brownish, dark towards the base and crossed by a yellow band, beyond which is an area enclosed by black dots and shaped like a heraldic shield: legs robust, hairy, mahogany-red; the apices of the femora, knees, apices of tibiæ, the tarsi, and metatarsi black, the black parts densely hairy; maxillæ black, with reddish margins; pectoral plate heptagonal, with eight tubercles, three of which are prominent and form a triangle; falces black, with three marginal teeth. Length 36 millims.; relative length of legs 1, 2, 4, 3.

(Coll. by Gulliver.)

Most nearly allied to *N. nigra* of Vinson; but with the abdomen smaller and not clouded with black, and the legs altogether redder. I have examined thirty-seven examples, but have seen no variation.

Genus *MIAGRAMMOPES*.*Miagrammopes Gulliveri*, n. sp.

Allied to *M. Thwaitesii* of Cambridge, but differing as follows:—cephalothorax longer and broader, more angular when seen laterally, and with convex rather than concave margins; caput longer, rather higher than the thoracic region, more convex in front, testaceous, with silvery reflections and a whitish hind border; eyes black, forming a convex series across the back of the caput; lateral eyes twice as large as the central pair, the latter far apart; legs amber-yellow, the femora notched at the distal extremity, the intermediate joints shorter than in *M. Thwaitesii*, the tarsi of the hind legs broader, claws black; palpi short, slender, hairy, testaceous; falces small, movable fang picuous; sternum somewhat different in form; abdomen nearly twice as long as the cephalothorax, testaceous, with a central blackish line wider than in *M. Thwaitesii*; and not throwing off downward branches; basal

region less contracted, lateral margins subangulated in the middle, whence they converge towards the hinder extremity; ventral surface slightly concave, testaceous, with two longitudinal brown lines; spinners concealed by dense hairs, which converge towards the central line. Length 6 millims.; relative length of legs 1, 4, 2, 3.

(Coll. by Gulliver.)

ACARIDÆ.

Genus HOLOTHYRUS.

Holothyrus? testudineus, n. sp.

Carapace ovate, convex, conical in front, fawn-coloured, clouded with brown, smooth and shining, with well-defined lateral carina; legs rather short and robust; ventral surface flattened and shining behind, with an apparently hinged oblong projecting anterior plate, wider in front than behind; body in front concave, with *only three pairs of legs*, their relative size 3, 2, 1; antennæ with hairy terminal joint. Length $\frac{3}{4}$ millim.

(Coll. by Gulliver.)

Although fourteen examples of this species have come, not differing in size or structure, I have been unwilling to erect a new genus for its reception. From many points which it appears to have in common with *H. coccinella* of Mauritius, I think it possible that it may turn out to be an immature condition of that species.

MYRIOPODA.

Genus STRONGYLOSOMA.

Strongylosoma erucaria, n. sp.

Deep chocolate-brown; under surface, legs, lateral wings, and hind margins of the segments pale testaceous; segments glabrous, first dorsal segment with well-defined lateral carina; preanal segment terminally rostriform. Length 8 lines, width 1 line.

(Coll. by Gulliver.)

Genus CAMBALA

Cambala nodulosa, n. sp.

Reddish testaceous; dorsal segments with a lateral grey stripe; first segment longitudinally multisulcate; remaining segments crossed by two rows of tubercles, between which, on each segment, is a depressed line; posterior margins narrowly reborded. Length 8 lines, width 1 millim.

(Coll. by Gulliver.)

Genus *SPIROSTREPTUS*.*Spirostreptus avernus*, n. sp.

Black, legs and antennæ castaneous; forty-three dorsal segments; first segment smooth, with narrow marginal ridge; remaining segments rugulose and depressed in front, smooth behind, striated at the sides; preanal segment produced into a point behind. Length 13 lines, width 1 line.

Cascade Valley. (Coll. by Gulliver.)

Spirostreptus sorornus, n. sp.

Colour and general structure of the preceding; forty-nine dorsal segments, which are not rugulose in front. Length 1 inch 9 lines, width 3 millims.

(Coll. by Slater.)

Possibly *S. nigerrimus* of Newport, only a fragment of which now stands in the collection; so that the number of segments cannot be satisfactorily ascertained.

Spirostreptus Gulliveri, n. sp.

Olivaceous; dorsal region dark; eyes black; face, margins of first dorsal segment, and hind margins of other segments tawny; legs reddish tawny; fifty-seven dorsal segments, first segment with square anterior angles, above which are four depressed lines; marginal ridge feebly developed; each of the remaining segments crossed by a depressed line, behind which they are swollen; sides striated as usual; preanal segment slightly produced, with bisinuate hind margin. Length 2 inches 4 lines, width 5 millims.

(Coll. by Gulliver.)

Spirostreptus simulans, n. sp.

Olivaceous; a dorsal series of dark spots in front and a continuous lateral series of blackish spots; first segment clouded with brown behind; forty-three dorsal segments, first segment with marginal ridge feebly developed; remaining segments rugulose and depressed in front; preanal segment regularly arched. Length $10\frac{1}{2}$ lines, width 2 millims.

(Coll. by Gulliver.)

Genus *SPIROBOLUS*.*Spirobolus Hecate*, n. sp.

Shining black; front margins of the segments below casta-

neous; fifty-nine dorsal segments; lateral wings of first segment quadrisulcate in front; remaining segments swollen behind, laterally striated; preanal segment deeply bisinuated behind. Length 4 inches $\frac{3}{4}$ lines, width 7 millims.

(Coll. by Gulliver.)

EURLITHOBIUS, n. gen.

Lithobio affinis, multo latior, segmentis viginti; antennarum articulis septendecim, quorum decem primoribus et postremo distinctis, aliis inconspicuis; oculis utrobique quatuor; pedum paribus uno et viginti, latis, breviusculis.

Gen. typ. *E. Slateri*.

Eurylithobius Slateri, n. sp.

Fawn-coloured, legs and ventral surface testaceous; dorsal segments gradually narrowing towards each extremity, with two longitudinal depressed lines and a lateral marginal ridge; terminal segment subconical behind. Length of body 1 inch, including hind legs 1 inch 8 lines; width in the centre $4\frac{1}{2}$ lines.

(Coll. by Slater.)

Genus RHOMBOCEPHALUS.

Rhomboccephalus smaragdinus, n. sp.

Anterior half of body emerald-green, posterior half olive-green; segmental incisions deeper-coloured; legs pale greenish, in twenty pairs; posterior pair without denticles; preanal plate oblong. Length of the body $10\frac{1}{2}$ lines.

(Coll. by Slater.)

Genus MECISTOCEPHALUS.

Mecistocephalus Gulliveri, n. sp.

Amber-coloured, legs paler; head reddish castaneous; forceps of mandibles black, the latter with about four teeth; head below deeply excavated; dorsal segments with a deep longitudinal sulcus; forty-eight pairs of legs. Length 1 inch 1 line.

(Coll. by Gulliver.)

Seems allied to *Geophilus insularis* of Lucas.

LII.—*Preliminary Notice of new Species of Hymenoptera, Diptera, and Forficulidæ collected in the Island of Rodriguez by the Naturalists accompanying the Transit-of-Venus Expedition.* By FREDERICK SMITH.

IN anticipation of a detailed account of the collections made in the Island of Rodriguez by Messrs. Gulliver and Slater, I hereby submit diagnoses of the new species of the orders examined by me.

Formicidæ.

Tapinoma pallipes.

Worker. Length $1\frac{1}{2}$ line. Head and thorax reddish brown, abdomen dark brown; eyes black; mandibles and antennæ pale testaceous. Thorax rounded anteriorly, slightly narrowed posteriorly, with the metathorax obliquely truncate; the legs, petiole, and squama pale testaceous, the latter rounded above. Abdomen smooth, shining, and impunctate.

(Coll. by Gulliver.)

Tapinoma fragile.

Worker. Length 1 line. Head brown, smooth, and shining, the eyes black; mandibles white and pellucid, antennæ also white. Thorax pale brown, the sides and metathorax darker brown; the prothorax rounded in front; the metathorax oblique and concave; the legs, petiole, and squama pale testaceous, nearly white. Abdomen brown, smooth, and shining, palest at the base.

Found under bark; very like the preceding species, but smaller; the legs and antennæ pellucid. (Coll. by Gulliver.)

Monomorium impressum.

Female. Length $1\frac{3}{4}$ line. Head and abdomen dark fusco-ferruginous. The clypeus, mandibles, and antennæ flavo-testaceous; ocelli distinct, with an impressed line in front of the anterior one extending to the insertion of the antennæ; the apex of the scape and the club of the flagellum slightly rufo-fuscous. Thorax narrower than the head and one third longer; the prothorax rounded in front, the sides nearly parallel, slightly narrowed towards the metathorax; the legs pale testaceous, the femora rufo-testaceous; the tarsi colourless and pellucid; the thorax testaceous, as well as the nodes of the petiole. Abdomen oblong-ovate, as long as the head and thorax.

Male. Length $1\frac{1}{4}$ line. Dark fusco-ferruginous; mandibles and antennæ rufo-testaceous; ocelli prominent, with a deeply impressed line in front of the anterior one. Thorax oblong, narrowed posteriorly; the wings colourless hyaline; legs white, with the femora slightly fuscous in the middle. Abdomen oblong-ovate, smooth, and shining.

Found under bark. (Coll. by Gulliver.)

Monomorium elongatum.

Female. Length 2 lines. Reddish brown; head oblong, slightly narrowed behind the eyes, truncate posteriorly; ocelli glassy, the anterior one placed in a deep fossulet; mandibles and antennæ pale rufo-testaceous. Thorax oblong, narrowed behind; the metathorax truncate; legs pale rufo-testaceous, the femora slightly fuscous. Abdomen oblong-ovate, smooth, and shining, with a thin scattered pubescence.

Worker. Length 1 line. Reddish brown, shining, with the mandibles, antennæ, and legs pale testaceous; the head oblong, the sides nearly parallel, truncate behind, with the angles rounded. Thorax strangulated a little beyond the middle; the metathorax without spines. Abdomen ovate, smooth, and shining.

(Coll. by Gulliver.)

Scoliidæ.

Scolia rufa, St.-Fargeau.

Male. Length $7\frac{1}{2}$ lines. Black, the pubescence fulvo-ferruginous; the face densely pubescent; the clypeus and mandibles yellow, the former with a large triangular black macula in the middle, the latter rufo-piceous at their apex and narrowly so on their lower margin; the head pubescent behind. Thorax pubescent, the metathorax densely so; wings fusco-hyaline, the nervures black; slightly iridescent; the anterior legs with the tips of the femora above, also the tibiæ and tarsi above, yellow; the tips of the joints of the tarsi black; the intermediate and posterior tibiæ yellow above, their tarsi entirely so, with the tips of the joints black; all the calcaria pale testaceous. Abdomen with broad yellow fasciæ, the fasciæ emarginate in the middle and at the sides; the apical segment black, smooth, shining, with a few strong punctures at the base, the rest of the abdomen with scattered shallow punctures; beneath, the segments have narrow yellow apical marginal fasciæ, and are fringed with fulvous pubescence.

(Coll. by Gulliver.)

Sphegidaë.*Pelopæus convexus.*

Male. Length 5-6 $\frac{1}{4}$ lines. Head and thorax blue; abdomen and legs deep blue. The face with silvery-white pubescence; a thin griseous pubescence on the cheeks. Thorax—the mesothorax evenly punctured and convex, with a central impressed longitudinal line, without any trace of longitudinal channels; rather strongly, but not very closely, punctured, on the disk a few transverse irregular carinæ; wings subhyaline, with their apical margins clouded; the thorax has a thin, sparing, griseous pubescence; the apex of the metathorax with bright silvery pubescence; the tibiæ have the calcaria black.

(Coll. by Slater.)

Ophionidaë.*Paniscus perforator.*

Female. Length 6 lines. Rufo-ferruginous; the face and scape of the antennæ in front yellow; the space between the ocelli black. Thorax—the sides, the sutures on the mesothorax, and the scutellum paler than the disk; wings hyaline and iridescent; the stigma and nervures rufous; the legs and abdomen rufous, the latter slightly fuscous at the apex.

(Coll. by Slater.)

This species is like *P. melanopus*, Brullé; but all its tarsi are rufous, as well as the nervures of the wings; in *P. melanopus* they are black. Brullé's species is from Mauritius.

Muscidaë.*Pollenia basalis.*

Length 4 lines. Dark blue, with shades of green on the disk of the thorax; the face and cheeks luteous, and clothed with short, dense, yellow pubescence; at the end of the facialia a black bristle on each side; antennæ in deep facial grooves, slightly yellow at the base, third joint long, arista longly plumose; palpi luteous, with black bristles; frons black and more than a quarter the width of the head; wings hyaline, with their base fuscous; the transverse vein at the end of the wing nearly rectangular below and much curved above, leaving the cell open; the lower transverse vein very oblique. Abdomen with a little short luteous pubescence at the apex and also beneath; alulæ dirty white.

(Coll. by Slater.)

Sarcophaga mutata.

Female. Length 5 lines. Black, thinly clothed with black hairs and bristles; the face and cheeks with a covering of bright silvery pile; the margins of the facial groove fringed anteriorly with short black bristles; eyes dark reddish brown; the base of the antennæ black, the third joint tawny and with a long plumose black bristle at the base; frons with a broad black stripe running from the antennæ to the vertex. Thorax tawny above and with three black longitudinal stripes; the lateral margins set with black curved bristles; legs black and with a number of black bristles; wings subhyaline, the veins black; the transverse vein at the end of the wing straight above, oblique and curved below; the lower transverse vein evenly waved; the alulæ white. Abdomen tessellated with black and silvery pile, covered with short black hairs, and having a few long black bristles at the apex; there are also four long curved black bristles on the hinder margin of the scutellum.

(Coll. by Gulliver.)

Sapromyza squalida.

Male. Length 2 lines. Pale brown; frons yellow, with a dark brown central line; two long bristles at the hind corner of the eye, and two between them and the antennæ; face pale yellow; peristoma with a row of small bristles. Antennæ yellowish, brown above, the second joint with long black bristles beneath, at the end; arista black, yellow at the base and plumose; the palpi yellow. Thorax with obscure pale (almost white) longitudinal stripes; the scutellum pale brown, its outer margin and a central longitudinal line pale yellow. Legs yellow; the tibiæ have all a preapical bristle; the anterior femora with scattered bristles, the intermediate pair with a row of bristles in front near the tip. Wings faintly yellowish, middle transverse veinlets darkened, and yellowish spots at the tip of the lower transverse veinlet and at the tips of the second and third veins, and also on those veins some distance from the tips, and on the second vein opposite where the first vein ends in the costa. Abdomen brownish yellow and thinly sprinkled with short black hairs.

(Coll. by Gulliver.)

Forficulidæ.*Forficula (Brachylabis) varicornis.*

Length $4\frac{1}{2}$ lines; forceps 1 line. Nigro-piceous, shining; the palpi, mouth, and legs pale testaceous, the prothorax rufo-

piceous; antennæ 15-jointed, joints twelfth and thirteenth white, five or six of the basal joints rufo-piceous, as are also the palpi; the prothorax oblong-quadrate, narrowly margined, and with a longitudinal impressed line not extending to the posterior margin; not winged; the abdomen smooth and shining; the basal half of the segments with fine shallow punctures; the apical segment with a deeply impressed longitudinal line, its posterior margin emarginate; the forceps very stout, triangular at the base, curved inwardly beyond the middle, acute at the apex, their inner margin crenulated.

(Coll. by Gulliver.)

This species has a close general resemblance to *F. maritima*.

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

[Continued from p. 305.]

[Plates XXI.—XXV.]

Genus CLISIOPHYLLUM.

Clisiophyllum, Dana (in parte), Explor. Exped. vol. viii. Zoophytes, p. 361, pl. xxvi. fig. 6 (cæt. exclus.), 1846.

Gen. char. Corallum simple, cono-cylindrical, or turbate. Epitheca complete, sometimes thin, sometimes thick, marked with constrictions and accretion-ridges. Calice of variable depth, its floor exhibiting a conical boss in the centre. The surface of the boss is marked with a system of spirally bent or sometimes straight lamellæ, which are attached to the inner margins of the primary septa by the intervention of a system of delicate dissepiments, and, on the other hand, pass upwards to a median columellar crest on the crown of the boss. Septa well developed, of two orders, the primary septa never extending further inwards than near to the outer margins of the central boss. Internal structure triareal. Central area ("interlamellar space") formed partly by a system of vertical, spirally twisted or straight lamellæ, and partly by a system of vesicular tabulæ, which intersect the former obliquely, and are directed upwards and inwards to join in the columellar line. Intermediate area ("interocular space") formed by an outward extension of the tabulæ in large nearly horizontal vesicles. External area ("interseptal space") formed

by minute vesicular tissue, the vesicles of which are arranged in oblique rows directed outwards and upwards.

The corallum in *Clisiophyllum* is invariably simple; and only those examples in which the calice is well preserved afford any external indication of its singularly complex interior constitution. The form of the corallum is usually more or less conical, generally curved, and rarely attaining a large size. The epitheca is variable in thickness, and is usually marked by numerous encircling striæ and annulations of growth.

The calice is circular, sometimes deep and sometimes shallow, its margins thin, or at other times thick and everted. From the centre of the floor of the calice rises a prominent conical boss or tent-shaped mass, the summit of which shows a longitudinal crest, while its surface is marked, in well preserved examples, by spirally twisting or straight ridges which pass from its base to its crown (Pl. XXII. fig. 1). This tent-shaped boss has been regarded as the upper extremity of a gigantic columella or pseudo-columella; but its true constitution is rendered apparent by means of transverse and longitudinal sections. When examined in longitudinal section, the centre of the boss is seen to be formed by a columellar lamina, which extends as a continuous line (Pl. XXI. figs. 2 A & 4) from the bottom of the visceral chamber to the summit of the calicine dome, where it appears as the median crest above spoken of. This median crest has been stated to become directly continuous with one of the primary septa; but we have been unable to confirm this observation; and, in point of fact, sections indicate clearly that the columellar line is confined to the centre of the visceral chamber. The outer portions of the boss and its downward continuation are minutely vesicular, and are formed by the intersection and combination of two different sets of plates. One of these can only be seen in cross sections (Pl. XXI. figs. 1-3), and consists of a series of vertical, more or less spirally twisted lamellæ, which have usually been regarded as the inward prolongations of the primary septa. They are, however, in reality, wholly independent of the septa, with which they are never connected, except it be by means of a few flexuous and delicate dissepiments, to which they are always much inferior in number. It is the plates of this series, also, which form the radiating ridges on the surface of the conical boss within the calice. The plates of the *second* series are seen in transverse sections (Pl. XXI. figs. 1-3) as a series of delicate, somewhat curved laminæ, which run across and closely intersect the spaces between the lamellæ of the *first* or vertical series; but they are most characteristically displayed in longitudinal sections. When viewed in this

way (Pl. XXI. figs. 2 A & 4), they are seen to form a series of very delicate inosculating tabulæ, which are directed in an *ascending* manner from the exterior of the central area towards the columellar line, with which they finally become connected. By their intersection and conjunction they give rise to a series of minute lenticular vesicles, which are arranged in oblique rows which have a direction *inwards and upwards*. It is to the central elevation and ascent of these vesicular tabulæ that the prominence of the conical boss in the floor of the calice is due. We may add that we have used the word "tabulæ" in this connexion advisedly, since we feel satisfied that the ascending vesicles of this central area are really formed by a modification of structures homologous with the tabulæ of other forms.

Immediately external to the central vesicular area is found a narrow zone ("interocular space"), into which, as shown by cross sections (Pl. XXI. figs. 1-3), the inner extremities of the primary septa are continued. When viewed in longitudinal sections (Pl. XXI. figs. 2 A & 4), this intermediate area is found to be formed by an outward prolongation of the tabulæ, which are now nearly horizontal, and are so connected as to give rise to a series of vesicles of conspicuously larger size than those of the central and external areas.

The septa are numerous, and the primaries extend from the inner surface of the wall to near the margins of the central area, where they cease to exist, a few of them sometimes becoming connected here by means of intermediate dissepiments with the vertical and twisted lamellæ of the centre. The secondary septa alternate with the preceding, and vary much in length, being sometimes short, and at other times fully half as long as those of the first cycle. In the outer two thirds of their extent the septa are united by very numerous delicate rectangular or angular dissepiments, which exist in much diminished numbers between the inner ends of the septa. There is thus formed a dense external zone of vesicular tissue, which is seen in longitudinal sections (Pl. XXI. figs. 2 A & 4) to be formed of lenticular cells arranged in oblique rows having a direction *outwards and upwards*, and thus opposite to the inclination of the vesicles of the central area. Within this external zone, also, the septa become extremely delicate, assuming the form of well-developed laminae as they pass inwards.

The genus *Clisiophyllum* was originally proposed by Prof. Dana (*loc. cit. supra*), and was defined as follows:—"Cyathophyllidæ simplicissimæ, ramosæ, aut aggregato-glomeratæ. Corallum cellis radiatis, medio interno septis sursum conver-

gentibus; axe nullo; lateribus omnino cellulosis." From his short description it appears that Dana included under this name both simple and compound corals, having a central area composed of septa and cells converging upwards (but without a distinct columella), an external vesicular area, and a calice with a conical prominence at the bottom, about which the lamellæ sometimes appear twisted. One of the three figures given by Dana as illustrative of the genus is undoubtedly a true *Clisiophyllum* as at present defined; and it may with great probability be surmised to be the form now known as *C. coniseptum*, Keys., which, in this case, must be regarded as the type of the genus. The other two figures represent a compound coral, apparently a species of *Lonsdaleia*.

Milne-Edwards and Haime defined the genus *Clisiophyllum* (Brit. Foss. Cor., Introd. p. lxx, 1850) as follows:—"Corallum simple, turbinate. Septa well developed, and rising towards the centre of the calice so as to form a spurious columella, but not twisted." Subsequently (Pol. Foss. des Terr. Pal. p. 409) they enlarged their previous definition somewhat, whilst preserving its essential features, and, in particular, retaining the erroneous view that the subconvolute laminæ of the central area are the primary septa. The species which they select as the type of the genus (viz. *C. Danaanum*) is stated to possess a large and deep fossula—a very unusual feature in the genus.

At the same time Prof. M'Coy (Brit. Pal. Foss. p. 33, 1851) defined the genus *Clisiophyllum* as follows:—"Corallum simple, branched, or aggregate, with vertical radiating lamellæ; a thin epitheca or outer wall; *internal structure*:—(vertical section) central area composed of small vesicular plates and cells converging or arching upwards towards the centre, so as to form a conical boss in the cup; no distinct central axis; outer area of small cellular structure, inclining in the opposite direction or upwards and outwards; separation between these areas formed by an intermediate area of larger, nearly horizontal cellular structure; (horizontal section) a large central area of small, irregular, cellular texture, from which the primary lamellæ radiate to the outer walls; intermediate zone with few vesicular plates between the lamellæ; outer zone having the primary and secondary lamellæ connected by very numerous vesicular plates." It will be seen from the above that most of the essential features in the structure of *Clisiophyllum* are rightly represented in the descriptions and figures given by M'Coy. More especially has he the merit of clearly recognizing the triareal structure of the corallum. The chief defects of his definition lie in his supposition that the ascending

lamellæ of the central area are truly the septa, and in his not having detected the constant presence of a columellarian line in the centre.

At a later period, Mr. Billings (Can. Journ. new ser. vol. iv. p. 128, 1859) defined the genus as similar in structure to *Zaphrentis*, except in the possession of an exterior zone of vesicular tissue and in having the tabulæ "elevated in the centre so as to form a small conical protuberance in the bottom of the cup." A single species, from the Devonian formation of Western Ontario, was referred to the genus under the name of *C. oneidaense*. We have satisfied ourselves, however, from the examination of a large number of specimens, that the structure in *C. oneidaense*, as well as in the related *C. pluriradiæ*, Nich., is essentially different from that of *Clisiophyllum* proper; and we propose to found for these two forms a new genus under the name of *Acrophyllum**.

The definition of the genus *Clisiophyllum* given by Prof. De Koninck (Anim. Foss. Nouv. Recherches, prem. partie, p. 39, 1872) is in most respects similar to that given by Milne-Edwards and Haime. The septa are described as extending to the centre of the calice; and the columellar plate is stated to be a prolongation of the principal septum.

Much the same view of the structure of the genus is taken by Dybowski (Mon. der Zoanth. scler. rug. p. 82, 1873), who places *Clisiophyllum* in the immediate neighbourhood of *Lithostrotion*, and defines it as having septa which closely embrace a freely projecting columella, and elevate themselves to form collectively an eminence in the centre of the calice.

When we come, however, to investigate the affinities of *Clisiophyllum*, it is at once evident that it has little real relationship with *Lithostrotion*. Not only is the latter invariably

* A brief diagnosis of this genus may advantageously be appended in this connexion:—

ACROPHYLLUM, Thomson and Nicholson.

Gen. char. Corallum simple, turbinate, or cylindro-conical. Epitheca thin, with numerous encircling striæ and annulations of growth. Central area occupied by strong tabulæ, which are not vesicular, and are very strongly elevated centrally, and at the same time more or less twisted with a spiral bending, so as to give rise to a central funnel-shaped and obliquely contorted eminence. This eminence is formed solely by the elevation of the successive tabulæ; and no vertical plates take part in its formation as is the case in *Clisiophyllum*. The septa are well developed, lamellar, usually prolonged over the upper surfaces of the tabulæ in the form of striæ which extend nearly to the centre. External area traversed by the septa, which are united by comparatively remote angular dissepiments. No columella. A well-marked septal fossette.

Type sp. *Acrophyllum oneidaense*, Bill.

compound, but it possesses no representative of the great central cellular mass, formed by obliquely ascending and vesicular tabulæ, and traversed by vertical lamellæ, which is so characteristic of the former. On the other hand, a relationship of real affinity subsists between *Clisiophyllum* and *Lonsdaleia*, the great central columella of the latter representing the central vesicular mass of the former, and being in many respects formed in nearly the same way, though on a much smaller scale. *Lonsdaleia*, however, is distinguished from *Clisiophyllum* by being always compound, by increasing by calicular gemmation, and by the fact that the wide and loose vesicular tissue of the outer area is not traversed by the septa, which thus are not in connexion with the wall.

The genus *Cyclophyllum*, Duncan and Thomson, though in some respects allied to *Clisiophyllum*, is distinguished from it by the fact that the bottom of the calice exhibits a secondary circular cup, in place of the conical boss of the latter. On section this cup is seen to be the upper extremity of a great central tube, which passes downwards to near the lower extremity of the visceral chamber. The boundaries of the central tube are formed by a distinct accessory wall; and its enclosed space is filled with delicate vesicular tissue, becoming more or less irregular and spongy in the centre. The genus *Aulophyllum*, Edw. & H., is separated from *Clisiophyllum* by characters very much the same as those which serve to distinguish *Cyclophyllum* from the same, especially by the fact that, in common with *Cyclophyllum*, it possesses a secondary cup in the centre of the calice, in place of a conical boss.

The genus *Clisiophyllum*, finally, is more or less intimately related to several groups of forms which we shall proceed to describe under the names of *Dibunophyllum*, *Aspidophyllum*, *Kumatiophyllum*, and *Rhodophyllum*. All these forms may be unhesitatingly regarded as being modifications of a common type; and it need, therefore, excite no surprise to find that the ground-plan of their organization is the same. At the same time the differences which separate these several groups from one another and from *Clisiophyllum* are constant in a large number of individuals in each case, and are easily recognized in typical examples. We cannot, therefore, avoid recognizing the actual existence of these groups as natural assemblages, irrespective of the fact that specimens can be procured which are intermediate in their structural characters between these groups, and thus link them on to one another. As these forms also are separated from one another by characters which can be readily determined in practice, we have judged it better to assign to each group a distinctive name. In so doing, how-

ever, we do not necessarily contend that these groups attain to the conventional rank of *genera*. Believing that the terms "genera" and "subgenera," as applied to inosculating groups like the one we are now considering, possess a purely artificial value, we are not concerned to contend for the employment of the one term rather than the other. We are, however, of opinion that the use of subgenera in palæontological investigations has proved itself by experience rather a hindrance than a help to progress; and we have therefore preferred to leave these groups in the position of "generic types" until some strict and explicit definition of the terms "genus" and "subgenus" may fortunately be agreed upon.

The genus *Clisiophyllum* is stated to range from the Upper Silurian to the Lower Carboniferous. The true affinities of the Silurian forms, however, cannot be regarded as altogether free from doubt; and it is singular, if they have been rightly determined, that no representatives of the genus (as here defined) have hitherto been detected in the richly fossiliferous deposits of the Devonian period.

Genus DIBUNOPHYLLUM, Thomson and Nicholson.

(*δῖς, twice; βουνός, hill; φύλλον, leaf.*)

Gen. char. Corallum simple, turbinate, or cono-cylindrical. Epitheca complete, thin, with numerous encircling striæ and annulations of growth. Calice of variable depth, usually shallow, exhibiting centrally at the bottom a rounded eminence, which is slightly raised above the inner margins of the primary septa, and is always divided by a distinct longitudinal mesial line separating the eminence into two equal halves. The calcine eminence is formed partly by a median elevation of the tabulæ, and partly by a series of somewhat irregular vertical lamellæ, which are united with the inner edges of the primary septa by subconvolute plates, but are altogether independent of these structures, and appear on the surface of the boss as so many ridges radiating from the margins of the central area to the sides of the mesial crest. Septa well developed, generally of two orders; the secondary septa short or wanting, and the primary septa invariably falling short of the central area. Interseptal dissepiments scanty and remote in the intermediate area between the inner ends of the primary septa, but very abundant in the external area, where they form a dense vesicular tissue, appearing in longitudinal sections as minute lenticular cells arranged in oblique rows directed upwards and outwards. Longitudinal sections also

show an intermediate area ("interocular area") of irregularly vesicular tabulæ, and a central area of anastomosing concave tabulæ, which are on the whole directed upwards, and are intersected by several incomplete columellarian lines, or rarely by one such line. Transverse sections show that the central area is divided into two equal portions by a median lamina which extends completely across it, and one extremity of which points to a well-developed septal fossula.

In the general features of their internal structure the forms which we have grouped together under the name of *Dibunophyllum* present a close resemblance to those which properly belong to *Clisiophyllum*; but they are nevertheless separated by characters sufficiently distinct and easily recognizable to warrant their being placed in a section by themselves. The species of *Dibunophyllum* agree with those of *Clisiophyllum* in their triareal structure, as shown in longitudinal sections. They both possess an outer area of numerous minute vesicles arranged in oblique rows pointing upwards and outwards, an intermediate area formed by loosely and irregularly anastomosing tabulæ, and a central area formed by vesicular tabulæ, which, though more or less strongly elevated centrally, are at the same time concave, and are intersected by a series of vertical lamellæ. In both groups, again, we find an essentially similar arrangement and a like development of the septa—those of the first cycle, extending from the wall to near the outer margins of the central area, having the form of well-developed laminae internally, but becoming more delicate as they pass outwards, and more numerous intersected by the angular dissepiments; whilst those of the second cycle are very short, and may be wanting altogether.

With these points of resemblance there are the following differences to be noted in the structure of the forms respectively referable to *Dibunophyllum* and *Clisiophyllum*:—(1) The central area in both genera is formed by the intersection of a system of vesicular tabulæ with a system of vertical lamellæ. In *Dibunophyllum* this area is seen in transverse sections (Pl. XXV. figs. 1, 2, 3 A, 5) to be divided into two equal halves by a complete mesial septum, no such structure existing in *Clisiophyllum* proper; whilst the lines representing the cut edges of the vertical laminae are much more irregular in the former than in the latter, and are devoid of any spiral bending. (2) One extremity of the mesial septum just spoken of as dividing the central area in *Dibunophyllum* is invariably directed towards a well-marked septal fossula (Pl. XXV. fig. 1). (3) Longitudinal sections show that the

central area in *Clisiophyllum* is intersected by a single, continuous columellarian line. The same appearances are occasionally, though rarely, exhibited in *Dibunophyllum*; but more commonly (Pl. XXV. fig. 4 A) there are several of such lines in the latter, and these lines are discontinuous. (4) The floor of the calice in *Clisiophyllum* exhibits an acutely conical boss, the surface of which presents a number of spirally twisted ridges, which are the free edges of the vertical lamellæ of the central area, and are directed in a radiating manner towards a point on the summit of the boss. The floor of the calice in *Dibunophyllum*, on the other hand, exhibits a low rounded boss (Pl. XXIV. fig. 4), which is only slightly elevated above the inner edges of the primary septa, and is invariably divided into two equal moieties by a longitudinal mesial ridge; whilst the ridges representing the free edges of the vertical lamellæ of the central area radiate, without any tendency to become spirally twisted, from the margins of the eminence, till they become attached to the two sides of the mesial ridge. (5) The tabulæ of the central area in *Dibunophyllum*, though on the whole elevated centrally, are typically markedly concave, with their concavities directed upwards (Pl. XXV. fig. 4 A), the reverse of this condition obtaining in *Clisiophyllum*. (6) Lastly, the secondary septa are much less perfectly developed than is usually the case in *Clisiophyllum*, being either unrecognizable, or only traced with difficulty in the dense vesicular tissue of the outer area.

Upon the whole the above-mentioned distinctions appear, in our opinion, of sufficient weight to warrant the establishment of the group which we have termed *Dibunophyllum*. At present we are only acquainted with the genus as occurring in the Lower Carboniferous rocks.

Genus ASPIDOPHYLLUM.

Aspidophyllum, Thomson, Proc. Phil. Soc. Glasgow.

The essential structure of the corallum in this group agrees with that which has been already described as characteristic of *Clisiophyllum* and *Dibunophyllum*; and it will therefore be probably sufficient to point out here the peculiarities which may be regarded as distinctive of *Aspidophyllum* as compared with the preceding groups:—(1) The corallum in *Aspidophyllum*, like that of *Clisiophyllum* and *Dibunophyllum*, is triareal in composition; and the structure of the *external* and *intermediate* areas is essentially identical in the three groups. The chief points which distinguish *Aspidophyllum* are those

connected with the *central area*. As exhibited in longitudinal sections (Pl. XXIII. fig. 1) the central area in these forms is constituted by a succession of extremely close-set tabulæ, somewhat concave, with their convexities directed downwards, and intersected by two or three parallel, nearly continuous columellar lines. (2) As exhibited in transverse sections (Pl. XXIII. figs. 1 A, 2, 3 A, 4) the central area is seen to be formed by the tabulæ just mentioned, together with a series of vertical lamellæ which (as in *Clisiophyllum* and *Dibunophyllum*) are wholly independent of the primary septa, except so far, that they are occasionally connected with them by subconvolute plates. The cut edges of these lamellæ, as seen in section, show that their number is comparatively small, and that they radiate, usually without twisting, from the margins of the central area towards the centre; whilst they are united laterally by a number of closely arranged curved lines, representing the cut edges of the tabulæ, and invariably directed with their concavities outwards. (3) The median member of this comparatively small system of vertical lamellæ is invariably the most strongly developed of all, but it never extends across the central area as a complete mesial septum (as in *Dibunophyllum*). It is invariably directed towards the dorsal or convex side of the corallum, and is continued in all cases for a certain distance into a well-marked septal fossula. (4) As the consequence of the peculiarities in the internal structure of the central area in *Aspidophyllum*, the resulting eminence in the floor of the calice presents certain features which readily distinguish it from the same eminence in *Clisiophyllum* and *Dibunophyllum*. The calicine boss (Pl. XXIII. figs. 2 A, 5) constitutes a prominent helmet-shaped eminence, which is neither conical as in *Clisiophyllum*, nor simply rounded as in *Dibunophyllum*, but is dome-shaped on the ventral or concave side of the corallum, and slopes down on the dorsal or convex side to the inner margin of the primary septa. The free edges of the vertical lamellæ of the central area appear on the surface of the boss as so many keeled ridges, which are not spirally bent as in *Clisiophyllum*, and do not meet on the two sides of a central ridge as in *Dibunophyllum*. The median ridge, however, representing the median lamella, passes over the boss, and descends into the fossula on the dorsal side of the corallum.

So far as our present researches have extended, the corals which belong to this section are confined to the Lower Carboniferous rocks.

EXPLANATION OF THE PLATES.

(Unless otherwise stated, all the figures are of the natural size.)

PLATE XXI.

- Fig. 1.* *Clisiophyllum Keyserlingi*, M'Coy (?), transverse section of an extremely large example. Lower Carboniferous, Auchenskeoch, Dalry, Ayrshire.
- Fig. 2.* Transverse section of a smaller example of the same species; 2 A, longitudinal section of the same, showing the columellarian line and the convex elevated and vesicular tabulæ of the central area. Lower Carboniferous, Broadstones, Beith, Ayrshire.
- Fig. 3.* *Clisiophyllum bipartitum*, M'Coy, transverse section a little below the calice; 3 A, 3 B, 3 C, transverse sections of the same corallum at different heights, showing the different stages of growth. Lower Carboniferous, Broadstones, Ayrshire.
- Fig. 4.* Longitudinal section of *C. bipartitum*, M'Coy, showing the triareal structure; 4 A, transverse section of the same, showing the great disproportion between the number of the primary septa and the number of the vertical lamellæ of the central area. Lower Carboniferous, Broadstones, Ayrshire.
- Fig. 5.* *Clisiophyllum*, sp., transverse section; 5 A, longitudinal section of the same. Lower Carboniferous.
- Fig. 6.* *Clisiophyllum*, sp., transverse section. Lower Carboniferous, Brockley, Lesmahagow.

PLATE XXII.

- Fig. 1.* *Clisiophyllum*, sp., showing the external aspect and the conical boss in the floor of the calice; 1 A, transverse section of the same. Lower Carboniferous, Broadstones, Ayrshire.
- Fig. 2.* *Clisiophyllum*, sp., transverse section. Lower Carboniferous, Langside, Beith, Ayrshire.
- Fig. 3.* *Clisiophyllum coniseptum*, Keys., longitudinal section; 3 A, transverse section of the same. Lower Carboniferous, Langside, Beith, Ayrshire.

PLATE XXIII.

- Fig. 1.* *Aspidophyllum Koninckianum*, Thoms., longitudinal section; 1 A, transverse section of the same. Lower Carboniferous, Thirdpart, Beith, Ayrshire.
- Fig. 2.* *Aspidophyllum elegans*, Thoms., transverse section; 2 A, calice of the same, showing the helmet-shaped calcine boss. Lower Carboniferous, Thirdpart, Beith, Ayrshire.
- Fig. 3.* A young example of the preceding species, showing the helmet-shaped boss; 3 A, transverse section of the same. Lower Carboniferous, Brockley, Lesmahagow, Lanarkshire.
- Fig. 4.* *Aspidophyllum*, sp., transverse section. Lower Carboniferous, Brockley, Lesmahagow.
- Fig. 5.* *Aspidophyllum*, sp., external aspect, showing the calcine boss in profile; 5 A, transverse section of the same. Lower Carboniferous, Brockley, Lesmahagow.

PLATE XXIV.

- Fig. 1.* *Aspidophyllum Huxleyanum*, Thoms., transverse section, enlarged; 1 A, transverse section of the same, natural size. Lower Carboniferous, Thirdpart, Beith, Ayrshire.
- Fig. 2.* *Aspidophyllum*, sp., transverse section. Lower Carboniferous, Gateside, Beith, Ayrshire.
- Fig. 3.* *Dibunophyllum Muirheadi*, Nich. & Thoms., transverse section; 3 A, longitudinal section of the same. Lower Carboniferous, Gateside, Beith, Ayrshire.
- Fig. 4.* *Dibunophyllum*, sp., view of the interior of the calice, showing the arrangement of the ridges formed by the free edges of the vertical lamellæ of the central area; 4 A, transverse section of the same. Lower Carboniferous, Langside, Beith, Ayrshire.

PLATE XXV.

- Fig. 1.* *Dibunophyllum*, sp., transverse section, showing the mesial lamina which divides the central area; the septa become vesicular and broken up towards the circumference by the great development of the dissepiments. Lower Carboniferous, Langside, Beith, Ayrshire.
- Fig. 2.* Transverse section of a young form of *Dibunophyllum*; 2 A, external aspect of the same, showing the interior of the calice.
- Fig. 3.* *Dibunophyllum M^r Chesneyi*, Nich. & Thoms., showing the interior of the calice; 3 A, transverse section of the same; 3 B, longitudinal section of the same, showing the unusual fact that there is but a single columellarian line, as in *Clisiophyllum*. Lower Carboniferous, Brockley, Lesmahagow.
- Fig. 4.* *Dibunophyllum Muirheadi*, Nich. & Thoms., transverse section; 4 A, longitudinal section of the same, showing the normal structure of the genus. Lower Carboniferous, Gateside, Beith, Ayrshire.
- Fig. 5.* *Dibunophyllum Muirheadi*, Nich. & Thoms. (?), transverse section. Lower Carboniferous.
- Fig. 6.* *Dibunophyllum*, sp., interior view of the calice; 6 A, transverse section of the same. Lower Carboniferous.
- Fig. 7.* *Dibunophyllum*, sp., transverse section. Lower Carboniferous.

[To be continued.]

LIV.—On the Identity in Type of the Annelids and Vertebrates.
A preliminary Communication*. By C. SEMPER.

THE old view of Geoffroy St.-Hilaire and Ampère concerning the agreement in affinities of the Articulates and Vertebrates was, as is well known, completely supplanted by the type theory of Cuvier and Von Baer, which supposed a great difference in the structure of the two groups. And not without good reason; for if the inversion of an Articulate so that its ventrum was

* Translated from the 'Physikalisch-medicinische Verhandlungen zu Würzburg,' by P. Herbert Carpenter, B.A.

directed upwards, which was suggested by Ampère, Joh. Müller, and Rathke, and even earlier by Meckel, led to the recognition of a great agreement with the Vertebrates in the origin and position of many organs, those Articulates which were chosen for comparison (the Insects and Crustacea) were precisely the ones which were not well suited to furnish the proof of the correctness of the original view; for no one had succeeded in demonstrating the existence not only of the above-mentioned resemblances, but also of actual agreement in type of the Articulates and Vertebrates.

The case is now, I think, different; through the discovery of segmental organs in the embryos of the Plagiostomes and in many adult sharks*, I was led to suggest this process of inversion once more—but as applied to an Annelid†, by which was revealed a correspondence between Articulates and Vertebrates far more complete in detail than that obtained by the former direct comparison of Crustacea or of Insects with Vertebrates. Nevertheless there were some difficulties; and it is natural that others should lay stress upon them in order to demonstrate indirectly the unimportance of the extensive resemblances, first pointed out by me, in the typical structure of an Annelid and of a Vertebrate embryo.

The following preliminary communication is intended to

* See 'Annals and Magazine of Natural History,' ser. 4, vol. xv. p. 94.

† I should like to suggest that a slight *lapsus calami* occurred to our revered master Baer when he lately, in his notice of Dohrn's and my works, represented the facts incorrectly: it is not the former who was the first to compare the inverted worm-sections with transverse sections of a Vertebrate embryo, and the organs of both with one another respectively, but I; and this was not done by me incidentally, but completely and with the addition of figures. My first preliminary communication upon this subject appeared in July 1874, and the larger memoir ('Die Stammverwandtschaft' &c.) in October 1874; while Dohrn's work first appeared in February or March 1875.

It must be admitted that this investigator goes further than I in his hypothetical conclusions; thus he loses himself in specialities which cannot be proved and are completely devoid of substantial foundation; while I stop at the proof of the identity in relative position of almost all the organs of the Annelids and of the vertebrate embryos. But this I must claim as my property, to the acquisition of which no earlier expression of Dohrn could have led me; while it remains doubtful whether Dohrn would have taken an annelid as his starting point if he had not been acquainted with my work before publishing his own. It is true that he claims (*l. c.* p. iv) to have intimated, in the preface to the second part of his paper on the structure and development of the Arthropods, that "to him it was not so much the Ascidiæ as the Annelids which seemed to be the Invertebrates standing nearest to the Vertebrates." In the preface to the second part, however, there is no mention of this, and just as little in his other articles on the Crustacea. In the introduction to the third part (*Jenaische Zeitschr.* Band v. p. 278), where he first treats of

show that I have succeeded in the most surprising manner in demonstrating that all those difficulties either do not exist or else prove nothing, and at the same time in finding out such extraordinarily extensive resemblances, both in the type of the three classes of segmented animals and also in all their special relations, that he only, in my opinion, is justified in rejecting my views who believes himself able to arrive at morphological laws through physiological relations.

The opponents of my views do not agree in essential points. On the one hand Baer says:—(1) ventrum and dorsum are homologous in Vertebrates and Articulates; (2) therefore this is not the case with the ventral cord and spinal cord, for the latter has a dorsal and the former a ventral position; (3) the Articulates have no brain in the sense that the Vertebrates have, for their dorsal œsophageal ganglion is only the anterior end of their ventral ganglionic cord; and (4) the Articulates have only a singly symmetrical development, but the Vertebrates a doubly symmetrical one. On the other hand, Gegenbaur tacitly presupposes certain points, such as the distinction in type, to be proved; the arguments brought forward by him against my views are as follows:—(1) the position of the ventral cord (in agreement with Baer); (2) the dorsal position of the supraœsophageal ganglion, which is comparable to the brain and spinal cord of Vertebrates (at variance with Baer); (3) the asserted connexion of the sense-organs with the dorsal œsophageal ganglion in the Articulates; and (4) the dorsal origin of the latter out of a dorsally placed medullary plate.

I will begin with Gegenbaur's arguments. The sense-organs (eyes and ears) are very frequently connected with the ventral ganglia in Crustacea, Insects, and Annelids; the third argument of Gegenbaur is simply incorrect. The second, the

the old attempt to parallel the shell-gland of the *Daphniæ* with the segmental organs of the worms, he says, "from this it might possibly be attempted to derive the Arthropoda, or at least the Crustacea, from the worms."

Here, then, is no mention of the Vertebrates and Ascidiæ. If Dr. Dohrn would show me the place where he published the former of the two propositions quoted above before I did, I should be ready to give up to him the honour of having first suggested this idea, and to confess that I had completely overlooked his notification of it.

Among later observers, Leydig and Zaddach are the only ones whom I have to thank for support in the old line of investigation on which I have again recently entered; what, besides their work, has been mentioned by still living older investigators as to the affinities of the segmented animals can be of no use to me, as it contains only repetitions of earlier statements, was never followed up in a consistent manner, and was in great part wrong in its execution.

dorsal position of the supraœsophageal ganglion, is contained, according to our mode of treatment, in the first or fourth. Could it be proved that it originates dorsally and independently of the ventral cord, then its position would be dorsal. Now Gegenbaur asserts in the most decided way that this is proved; but this is only the case in his own imagination.

Not a single observation on the Articulates has been made which really satisfactorily demonstrates that it is formed on the dorsal side; while some, on the other hand, prove very exactly that it takes its origin from the ventral side. Bütschli has shown in the bee, and Ganin still more clearly in the larvæ of Ichneumonidæ, that the anterior end of the first rudiment of the ventral cord divides into two parts, which grow upwards round the œsophagus, and only unite dorsally at a later stage to form the so-called brain. No one mentions the appearance of a separated medullary plate of the dorsum in the Articulates; the frontal plates (*Scheitelplatten*) lie at first on the ventrum, and only gradually reach the dorsum. The assertion of various observers that these arise on the dorsum proves, from their own statements, that they have not understood the first developmental stages.

I can confirm the observations (only made, however, incidentally) of Bütschli and Ganin in the most decided way as regards the Naideæ, in which I have studied the formation of zooids uninterruptedly for six months, with the intention of clearing up the primary origin of the nervous system (ventral cord and brain). I have already gone far enough in this investigation to be able to bring forward the following points as firmly established.

1. The ventral cord originates neither exclusively in the ectoderm (Kowalevsky) nor in the mesoderm (Leuckart, Rathke), but both layers take part in its formation. Only the central azygos ganglion (*Clepsine*) or the azygos cellular cord under the nervous cord (*Lumbricus* &c.) originates directly in the ectoderm; and this is primitively quite unsegmented, precisely as in the osseous fishes. The two lateral ganglia, however, arise out of the protosegments of the mesoderm, and are therefore segmented from before backwards. The first-mentioned central ganglion alone corresponds to the spinal cord of Vertebrates, while the lateral ones correspond to their spinal ganglia.

In agreement with this, the lateral nerves leaving the ganglionic chain arise by two roots; they are true spinal nerves. Herrmann has clearly distinguished these two roots in the leech as superior and inferior.

2. The muscle-plate appears at first not in the neural (ven-

tral) median line, but in a line exactly corresponding to an axis which, in the form of an irregularly cellular cord, lies close beneath (resp. above) the rudiment of the central ganglion. This axis is comparable to the notochord. The muscle-plate bends outwards from it in a cardiac direction (towards the dorsum) round the heart and alimentary canal, and also in a neural (ventral) direction round the central nervous system.

This is the type of the Vertebrates. In *Nais*, just as in them, a cellular cord indicates an axis, from which the animal muscle-plates gradually envelop the alimentary canal on the one side, and on the other the central nervous system developed out of the ectoderm.

3. It is well known that every complete zooid of a chain of Nais is developed by the coalescence of a body part, which first appears, with a later-appearing cephalic part; the latter has usually only four (at most six), but the former from 9-24 segments. In both parts these segments appear according to the laws of annelid-segmentation; the first body-segment is invariably the oldest, and it coalesces with the fourth and youngest cephalic segment. This difference in the formation of cephalic and body-segments is here extremely sharply defined; it appears also in the larvæ of marine Annelids (*Terebella* according to Milne-Edwards), and reminds one of the analogous but less clearly marked condition in the Vertebrates and Arthropods. In both groups several new cephalic segments (which are much younger than many of the body-segments) interpolate themselves between the oldest body-segment and the oldest cephalic segment or segments; in both regions segmentation begins in front and ends behind; so that here, as in the Annelids, the youngest cephalic segment is next to the oldest body-segment.

4. In the cephalic part, the brain of the zooid does not originate in a dorsal medullary plate overlying the alimentary canal, but it is developed by a division of the anterior end of the ventral cord and the upward growth of the two halves of the œsophageal ring around the gullet. In this growth the two lateral ganglia chiefly participate, with, perhaps, a part of the central one (it was not possible to determine this with certainty in the specimens, requiring much difficult treatment, which I have yet examined), and finally also some secondary structures.

There appear, namely (even, as it seems, in the forms without eyes), either laterally or rather towards the ventral side, two sense-plates, which unite with the œsophageal ring before the latter has lost its cellular structure. Possibly (or even probably), therefore, three different cell-groups take part in the for-

mation of the dorsal œsophageal ganglion, viz. :—the central nervous system derived from the ectoderm of the ventral side, and dividing to form the œsophageal ring; the two lateral spinal ganglia growing round the gullet, and so constituting the greatest part of the œsophageal ring; and, thirdly, the two sense-plates growing upwards from both sides towards the œsophageal ring. There is no trace, however, of an azygos thickening of the ectoderm, situated in the median line of the dorsum, in which the so-called brain could originate; this is formed, as is seen, in the most marked contradiction to the authoritative assertion of Gegenbaur, by the coalescence of two primitively completely separated elements, derived from the ventrum. The distinction between the brain and ventral cord of the Articulates is therefore removed.

With the disappearance of this distinction and a reference to the facts, long known but completely ignored by Gegenbaur, that the sense-organs are not connected exclusively with the so-called brain of the Articulates, the arguments of the Heidelberg zoologist fall at once to the ground. The other suggestions that he brings forward against my view are due not to himself, but to Baer.

In Baer's opposition two arguments of different natures are combined. The one, the "evolutio bigemina," which is only typical for the Vertebrates, is purely morphological; the other, the distinction of ventrum and dorsum, is purely physiological, or almost completely so, dependent, namely, upon the relations of the united organism to the ground bearing it, or to the nutriment it seeks.

The purely morphological argument is refuted by the facts stated above; "evolutio bigemina" is also typical for the Annelids. In these also there are two parts of the animal muscular layer one above the other, and separated by an axis as in the Vertebrates; and as in these latter, so in the former, the one surrounds the alimentary canal, and the other the central nervous system. In the Arthropods this type *appears* to be obliterated. I say expressly *appears*; for up to this time the mode of growth of the muscle-plates has never been determined by transverse sections; and so it is quite possible that their development takes place in the same way as in the Annelids.

Further, should any one succeed in demonstrating that, in this group also, two primary blastodermic layers take part in the formation of the ganglionic chain, which is quite possible, the proof of "evolutio bigemina" in the Arthropods would then be furnished, and the desired correspondence with the Vertebrates established.

But even then, of course, only the identity in type of the three segmented classes would be proved, and not, as was formerly supposed, the near relationship of the Arthropods and Vertebrates, which would stand rather in the position of cousinship to one another, while the Annelids would have to be considered as their common ancestors. For only in these last does one find all the relations in the structure of the blastodermic layers as well as in their gradual segmentation, by the more or less partial transformation of which the typical single segments of the Vertebrates and of the Arthropods are to be explained.

If, therefore, only the relative positions of the organs are taken into consideration, the correspondence in type between the three segmented classes is to be regarded as proved. The result is otherwise, however, if one employs the purely physiological consideration of the position with regard to the earth's surface in order, as Baer has again recently done, to demonstrate the identity of ventrum or dorsum in all bilaterally symmetrical animals. Then, of course, there appears an absolute distinction between Articulates and Vertebrates; what in the latter is turned upwards, lies in the former on the ventrum; and a similar direct inversion appears in all the organs, although "evolutio bigemina" is typical in both cases.

But how is the identity of the ventrum* in the Articulates and the Vertebrates demonstrated? I have sought in vain to find a proof of it in Baer's latest work. It could only be established in one of two ways—either by proving that the same organs lie on the ventral side in both groups of animals, which is in this case impossible, or by showing that (perhaps in consequence of the influence of gravity upon the developing

* I should like in this place to be allowed to make a second small correction in Baer's reproduction of my remarks. Baer says that I had commenced my reasoning with the proposition that "dorsum and ventrum are not morphological ideas" in order to smooth my way. This is not quite accurate; for in the complete work, which appeared in October 1874, I introduced this in the course of the discussion of the other arguments against my views, and I did it purposely in order to avoid the appearance of wishing to smooth my way by a dogma; and, further, I did not put the proposition forward as a dogma, but attempted to prove it by the use of various arguments. It may be doubted whether this attempt has succeeded; but no one is justified in ascribing to me an intention of establishing a foundation for discussion which cannot be found in the wording of my paper.

I must confess that this misinterpretation of my words (which, I repeat, is in no way justified) has pained me.; or has Baer possibly not read my 'Stammverwandschaft'? Besides, Baer has completely misunderstood me when he supposes that I wished to deny the existence of a marked morphological distinction between dorsum and ventrum in the same animal or in the same group.

embryo) the ventral side is always directed downwards, and that here therefore dorsum and ventrum are due to mechanical causes, in the same way as the upper and under sides of the leaves of plants.

It is not necessary, however, to commence an investigation in this direction; for a little reflection shows that though in eggs which have been laid, as in the case of the frog and birds, the ventral side in the germinal disk is frequently directed downwards, it must in just as many cases (namely in ovoviviparous animals) undergo constant changes of position; nevertheless no deformities arise, and the type of structure remains unaltered. We cannot therefore speak of a cause acting mechanically which in the different symmetrical animals would always bring the same side downwards. Lastly, it follows from the fact that many animals primitively typically symmetrical, like ourselves and the flat fish, do not have the ventrum directed downwards, that the cause which determines the one or the other side as the ventral side is not dependent upon formative laws acting upon the embryo. The type of development in the various animal forms is independent of the direct influence of their position relatively to the surface of the earth; and it appears to be only the position of the mouth which physiologically determines the ventral side.

I can see, therefore, nothing in the theorem that the ventrum is the same morphological region in all animals, but an unproved and incorrect dogma. Of course, however, this does not necessarily imply what Baer appears to have inferred from my views, that there can be no morphological difference between the ventrum and dorsum in the Vertebrates or in the Articulates; on the contrary, I have accepted this difference just as much as Baer himself. But the existing simple distinction between the two regions does not yet prove that the ventrum is identical in Vertebrates and Articulates; on the contrary, the morphological distinction of the ventrum (or dorsum) in the two classes is proved to me by the perfect identity in the types of their development (*evolutio bigemina*), and by the almost complete correspondence in the relative positions of nearly all the organs in the two groups to one another (but not in their positions in space).

Baer has of course made use of some morphological arguments, in order to support the proposition that the Articulates have their nervous system on the ventrum of the Vertebrates, and that it is therefore comparable to the sympathetic system of the latter group. He refers first of all to the position of the extremities in the Arthropods; in them, as in the Vertebrates, these are curved towards the ventral side. For this

argument it must be presupposed that the extremities of the Crustacea &c. are homologous with those of the Vertebrates. But this is by no means the case. On the contrary, the Annelids have dorsal appendages which stand in the same relation to their dorsum as the extremities do to the ventrum in the Vertebrates; the dorsum of the former and the ventrum of the latter, however, are, according to my view, identical. In this case, therefore, one would have to compare the extremities of the Vertebrates to the dorsal feet, and the appendages of the Arthropods to the ventral feet of the Annelids.

Baer says further that the ventral side of the Annulates is indicated as such by the ventral position of the anus and genital openings. This, however, is only partially correct. In the segmented Nemertines and in some Annelids the genital apertures are dorsal; in the Nematodes and Myzostomidæ the efferent ducts of the sexual organs unite, as in the Vertebrates, with the rectum; if they lie on the ventral side, they undergo an unusual change in position. This variability in the position of the genital openings shows that it is quite valueless, because it is so extremely uncertain. Further, in many Annelids (the leeches for example) the anus is situated not ventrally but dorsally, and beyond it extends a prolongation of the body (viz. the posterior sucker of the leech), which, in its typical structure and in its origin, may be fairly compared to the tail of the Vertebrates; and one can then designate the posterior ganglion of the leech as caudal ganglion.

The only just argument brought forward by Baer is the ventral position of the mouth in all the Annulates. But it is a question whether the difference of its position in Annelids and Vertebrates may not be satisfactorily explained. Dohrn has made an attempt in this direction which is worth notice, although others may be put by the side of his, for which it is not necessary to enter into such bold speculations as Dohrn is of course obliged to do.

He rightly lays stress on the fact that the unusually late appearance of the Vertebrate mouth is a very remarkable circumstance. In distinction to this is the fact that the mouth appears extremely early in all Annelids, in the free-swimming larvæ of the marine Annelids even earlier than the "Keimstreif." That part of this last, through the segmentation of which the cephalic portion of the worm arises, necessarily finds an obstacle in the already developed gullet, and so curves upwards around it in two divisions. The existence of the gullet as a mechanical obstacle is the essential cause of the formation of the œsophageal ring.

In the Vertebrates, on the other hand, the cephalic portion

of the nervous system is developed extremely early, long before the appearance of the gullet; it finds no obstacle to its growth forwards and above the rudimentary intestine, but space enough to develop, extend, and establish itself. When, then, later the mouth comes to be formed, it cannot break through at the same point as in the Annelids; for the cephalic part of the nervous system here offers far too much resistance, partly through its own nature and partly owing to the rapid development of the embryonic skeleton around it. It is possible that, as Dohrn suggests, the *sinus rhomboideus* indicates the place where such a breaking-through should have occurred, and possible also that the new mouth, now appearing upon the opposite side, is the result of a transformation of the first gill-cleft. These are hypotheses which can scarcely ever be really tested. It is sufficient that Dohrn and I agree that the mouth of the Vertebrates occupies a different position from that of the Annulates. Whether, as I believe, it is a fresh formation on the dorsum of the latter, because the primitive point of perforation is rendered impassable owing to the great development of the brain, or whether it arises directly through the transformation of organs already existing in this position, is of no consequence for the questions immediately before us.

The sole really morphological and effective argument, therefore, which Baer can adduce in support of his opinion, is the position of the mouth, which, however, is not difficult to explain in the manner first suggested by Dohrn. Further, if one reflects that in the type of the Radiates the position of the mouth, as determined by the relation of the animal to the surface supporting it, may be extremely variable, it will scarcely be difficult to conceive it as situated in the one case on the dorsum and in the other on the ventrum.

If one does this, and then inverts the Annelid, a budding *Nais* for example, so that its physiological dorsum lies downwards, there appears an almost absolute identity in the origin and position of the individual organs of the Vertebrates and Annelids. I will here enumerate these points once more, although almost two years ago, and before any one else, I brought some of them prominently forward.

1. The central nervous system is developed unsegmentally from the ectoderm.
2. The spinal ganglia appearing from before backwards, and developed out of the protosegments of the mesoderm, unite with it.
3. The ventral cord in the body of all Articulates has spinal nerves with two roots, as in the Vertebrates.
4. The dorsal œsophageal ganglion of the Articulates does

not arise on the dorsum ; a morphological distinction between it and the ventral cord does not exist.

5. In Annelids, Arthropods, and Vertebrates, cephalic may be distinguished from body-segments ; in all cases the youngest cephalic segment is next the oldest body-segment.

6. In Annelids (Arthropods ?), as in Vertebrates, the type of the collective organization is indicated by " *evolutio bigemina* " (Von Baer).

7. Beneath the nervous system of the Annelids lies a cellular cord (*chorda dorsalis* ?), indicating the axis from which the two muscle-tubes extend round the alimentary canal and central nervous system respectively.

8. Beneath this cellular cord and above the alimentary canal in the Annulates, there lies a vessel in which valves are entirely wanting, and in which the blood flows from before backwards, just as in the aorta of the Vertebrates.

9. The so-called dorsal vessel of the Annelids corresponds to the Vertebrate heart ; it lies beneath the alimentary canal ; and the blood in it flows from behind forwards. It is the sole vessel which contains valves, and never loses its contractility ; and it is always a venous heart, which last is the embryonic type of heart in the Vertebrates.

10. The external gills of the Annelids and Arthropods receive their venous blood, like those of the Vertebrates, direct from the heart.

11. The segmental organs of the Annelids appear on the neural side, close beneath the axial cord and nervous system, exactly as with the segmental organs of the Vertebrates. (Häckel's section of the embryo of an earthworm is entirely incorrect.)

While, therefore, the hypothesis that ventrum and dorsum are morphologically similar (homologous) regions in the Vertebrates and Articulates has only the single morphological fact of the ventral position of the mouth to support it, the view that dorsum and ventrum are not similar in these animals is based upon a whole series of the most important morphological considerations.

Quite apart from the correspondence resulting from this view, in the vascular system, in the urogenital system, and in the typical parts of the nervous system, three arguments appear to me to be preeminently suited definitely to oppose the former hypothesis.

These are :—the proof that " *evolutio bigemina* " occurs also in the Annelids ; the evidence that no distinction exists between the brain and ventral cord in the Articulates ; and, lastly, the facts, already mentioned by others, that in Annelids, Arthro-

pois, and Vertebrates the cephalic and body parts of the animal are to be regarded as directly equivalent, because they originate in an absolutely similar manner.

This is not the place to draw the conclusions which naturally follow from the above considerations; for these I must refer the reader to my more complete work, which will appear in the next volume of the 'Arbeiten aus dem zoologisch-zootomischen Institut in Würzburg.'

Würzburg, January 20, 1876.

BIBLIOGRAPHICAL NOTICE.

Catalogue of the Fossil Reptilia of South Africa in the Collection of the British Museum. By RICHARD OWEN, C.B., F.R.S. 4to. London: Printed by Order of the Trustees, 1876.

IN this work the Author has completed another of the series of 'Descriptive and Illustrated Catalogues' by which, as in the case of Hunter's 'Physiological Series in the Museum of the College of Surgeons,' he has made available to students and applicable to the advancement of science collections in our Public Museums.

The subject of the present Catalogue, in quarto, illustrated by 70 plates, is a series of fossils from South Africa, now arranged and exhibited in the Geological Department of the British Museum.

It appears that comparatively few of these evidences of the cold-blooded air-breathing Class could be brought within the limits of previously characterized Orders; and they have consequently led to the definition of new ones.

The order *Theriodontia* is characterized as follows:—"Dentition of the carnivorous type; incisors defined by position, and divided from molars by a large lanariform canine on each side of both upper and lower jaws, the lower canine crossing in front of the upper, as in Mammalia" (p. 15). Of this order twenty-two specimens are described, and referred to fourteen species representing ten genera, which are grouped, according to characters of the external nostril, into the families *Binarialia*, *Mononarialia*, and *Tectinarialia*. The type genera of this order are *Lycosaurus*, *Tigrisuchus*, *Cynochampsia*, *Nythosaurus*, *Scaloposaurus*, *Procolophon*, and *Gorgonops*.

The order *Anomodontia* is characterized by:—"Teeth wanting or limited to a single pair, having the form and proportion of tusks, or several and small, but limited to the bony palate and to the inner part of the mandibular alveolar border. The first two families, defined by dental characters, also yield the following ordinal ones, viz.:—a 'foramen parietale'; two external nostrils; tympanic pedicle fixed; vertebræ biconcave; anterior trunk-ribs with a bifurcate proximal end; sacrum of more than two vertebræ; ischio-pubic symphysis continuous" (p. 29).

The order is divided into three families—I. "*Bidentalía*"; II. "*Cryptodontia*"; and III. "*Endothiodontia*."

The first family includes two genera, *Dicynodon* and *Ptychognathus*. The second family includes the genera *Oudenodon*, *Theriognathus*, and *Kistecephalus*. The third family is represented by the truly singular genus *Endothiodon*, in one species of which, viz. *Endothiodon bathystoma*, the author points out certain marks of affinity to the European Triassic genus *Placodus*, and intimates that further knowledge of the skeleton of *Endothiodon* may lead to its removal from the *Anomodontia*, to the advantage of the more natural character of that order.

As the order is defined in the Catalogue, it includes thirty-four species, represented by sixty-five specimens, some of which indicate reptiles of considerable bulk.

In the order *Dinosauria* a "Section" is represented by twenty-nine fossils referred to the genera *Tapinocephalus* and *Pareiasaurus*, characterized by the peculiar modification of the vertebræ described by the author in the 'Quarterly Journal of the Geological Society,' vol. xxxii. p. 43, pls. iv. & v., suggesting the term "*Tretospondylia*" applied by him to this Section of great herbivorous reptiles.

To the order *Labyrinthodontia* are referred the genera *Petrophryne* and *Saurosternon*, Huxley, to which latter fossil the name *Batrachosaurus* (bespoke by Fitzinger) had been given by its discoverer Mr. A. G. Bain.

The following is an extract from the Preface, in which the Author, with other topics, discusses the probable geological age of the South-African formations from which these new and singular reptilian fossils have been derived.

"From the observations of Andrew Geddes Bain* and his fellow explorers † of the geology of the Cape, we learn that, before the continent of Africa, as it now is, existed, the animals which have afforded the subjects of the present Catalogue lived, died, and propagated their kinds, through untold generations, in and near a vast body of fresh water occupying an extensive tract now elevated into mountain-ranges, attaining, *e. g.* in the Drakensberg range, an altitude of upwards of 11,000 feet. In the preexisting lakes or estuaries these dragons (*Reptilia*) frequented the banks and waters; and many of their carcasses sank and rotted in its sediments. Some notion may be formed of the duration of this life-scene by the ascertained vertical thickness of the fossiliferous lacustrine deposits in the following richly productive localities:—Stormberg beds, 1800

* * 'Geological Transactions,' second ser., vol. vii. 4to, 1845-1856, p. 53; and 'Geology of South Africa,' a lecture delivered by A. G. Bain, Esq., at the General Institute, Graham's Town ('Eastern-Province Monthly Magazine,' vol. i. p. 396).

† Joseph Millard Orpen, Esq., Government Surveyor of the Cape of Good Hope; Charles E. H. Orpen, M.D.; Dr. Atherstone. See also 'Section of the Zuurberg,' by R. N. Rubidge, Esq., M.B. ('Eastern-Province Monthly Magazine,' vol. i. p. 187)."

feet ; Beaufort beds, 1700 feet ; Koonap beds, 1500 feet ; Karoo shale, or Upper Ecca beds, 1200 feet.

“Actual Africa, in latitudes north of the Cape, still shows fresh-water lakes surpassing in extent those of other continents ; but the chief lake-basin of the ancient continent, part of which is represented by these reptiliferous deposits at the Cape of Good Hope, much exceeded in extent Tanganyika, or any of the inland freshwater seas which have been discovered by recent explorers.

“The attempt to conceive or give intelligible utterance to the sense of past time since the reptiles of South Africa existed in the now upraised lacustrine or estuarine area becomes oppressive ; the terms in which we reckon up phases of the world’s history in connexion with human existence are wholly inadequate to convey a clear or comprehensible idea thereof. We are driven, in the endeavour to realize a conception of prehistoric time, to resort to an artifice akin to that to which the astronomer has been compelled in order to conceive for himself, and convey to others, the relations of space which his instruments and calculus have discovered.

“The multiplication of millions of miles leaves as vague an idea of remoteness of our planet from the nearest fixed star as the multiplication of millions of years expresses the conviction of the geologist as to the periods needed for the deposit of the thousands of remaining vertical feet of stratified sediment composing even a small subdivision of any of his great natural groups or systems of formations.

“The ascertained velocity of light yielded the astronomer a more simple, more graspable expression of comparative distances. Light traverses the diameter of the earth’s orbit in a quarter of an hour ; it moves at a velocity of 193,000 miles in a second of time. From the nearest fixed star, a *Centauri*, a ray of light takes three years to reach the earth ; from Sirius sixteen years. A nebula, near or bright enough to enable the photographer to secure a recognizable image of it, exerts for the purpose a form of force, or sends its ray of light, which probably takes six hundred years in reaching and affecting the instrument and the optic nerve of the human artist. Hence the convenience of defining cosmical spaces or distances in the terms of ‘light-years.’

“So with the geologist : having approximately estimated the period required for the formation of a constituent of the quaternary, tertiary, or other period, he substitutes, for numerical aggregates of historical years, the expression that such or such an organism existed and became extinct in such or such a formation—prior, *e. g.*, to the Liassic period, as in the case of the Dicynodont reptiles. The name of the formation gives to him an idea of the distance of time since these and other subjects of the present Catalogue lived, more intelligible than could any row of figures summing up estimates founded on observations of the rates of deposit, of wear, of elevation, or of depression of the several strata of the earth’s crust.

“What the geologist requires in order to receive, in these terms,

the solution of his question as to the period of existence of the South-African reptiles, is the evidence of the age of the formations in which their remains became fossilized. The grounds on which geology founds its conclusion of such age in relation to the 'Karoo series' of South Africa, as of the contemporary Panchét beds of India, will be found in the works cited below*. Every specimen described in the present Catalogue, of which the locality has been determined, has come from the divisions of that series known as the 'Beaufort' and 'Stormberg beds.' The latter are the later. But amongst the rich abundance of fossil vegetation in these lacustrine deposits not one example of a cycadeous plant, or other indication of a liassic or oolitic age, has accompanied the vertebrate fossils. The remains of *Glossopteris* are of a species (*Gl. Browneana*) which has never been met with, like the Cycads, in a formation of oolitic age, but is associated in India and Australia, as in South Africa, with palæozoic evidences.

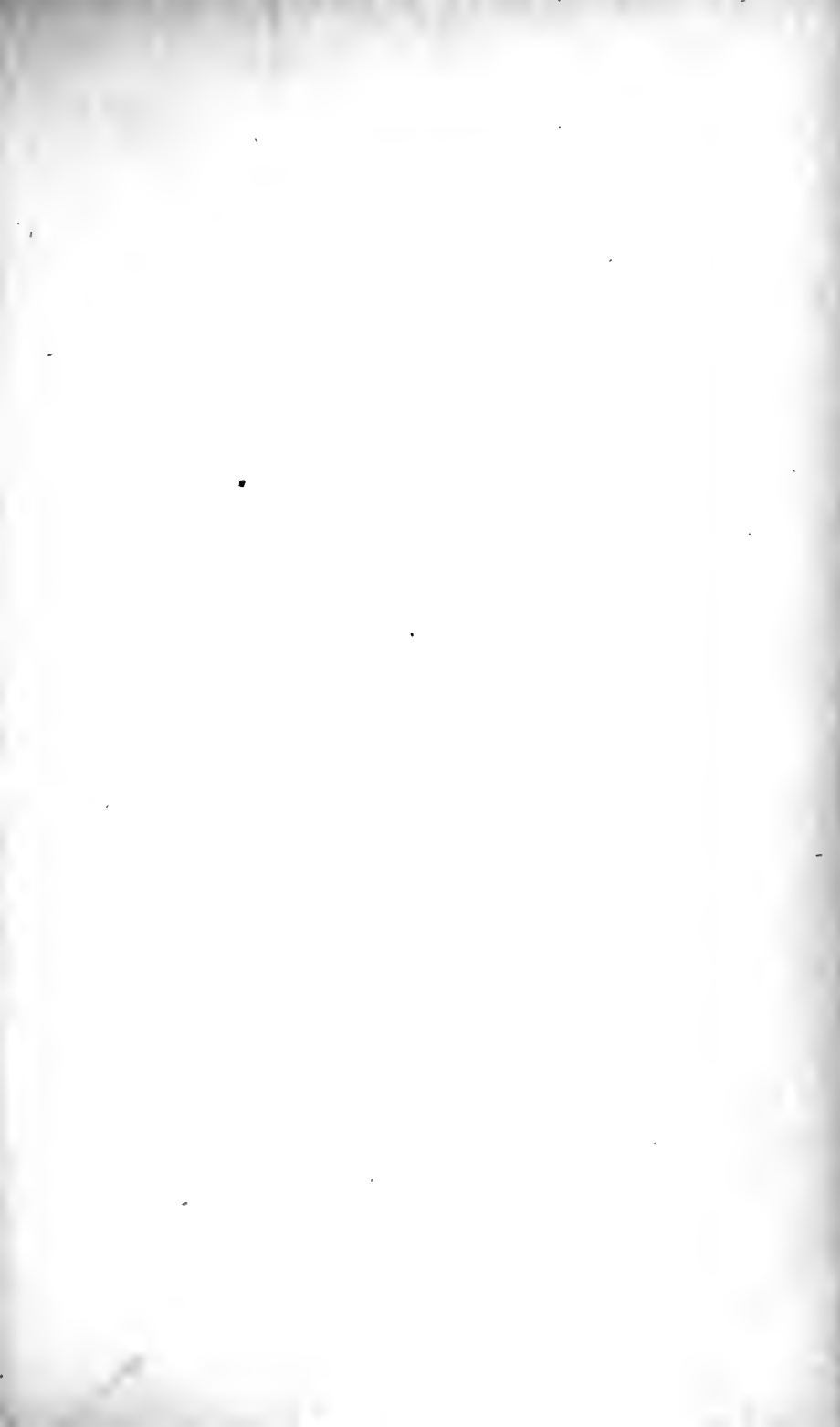
"The question lies between the triassic and the upper carboniferous periods; but the more generally adopted reference of the Beaufort beds and, especially, the Stormberg beds to a triassic age has been provisionally assigned in the notices of the localities in this Catalogue.

"The determination of the batrachian double condyle in the *Petrophryne* (S. A. 118) from the reddish sandstone of the Tafelberg in the Queenstown district proved its Labyrinthodont affinities, which were indicated by other cranial structures, as a similar demonstration in the *Brachiops* † had previously determined the presence of a Labyrinthodont reptile in the Mángali formations of the Kamthi group in India. Fragmentary evidences, most probably Labyrinthodont, and indubitable fossils of a Dicynodont, concur, with the plant fossils, to show the geological correspondence of the Panchét and Kamthi groups in India with the Beaufort beds in South Africa.

"Among the considerations which weigh towards the palæozoic age is the arrest of vertebral development, or retention of embryonal characters, in the centrum of these South-African Reptilia, a cha-

* "Bain and Atherstone, *ut supra*. Sutherland, Dr. P. C., 'Notes on the Geology of Natal, South Africa,' Quarterly Journal of the Geological Society, vol. xi. p. 465. Rubidge, Dr. R. N., 'On some Points in the Geology of South Africa,' Quart. Journ. Geol. Soc. vol. xv. p. 195. Stow, C. W., Esq., and Huxley, Prof., 'On some Fossils from South Africa,' *ib.* vol. xv. pp. 193, 555, 642. Tate, R., Esq., 'On some Secondary Fossils from South Africa,' Quart. Journ. Geol. Soc. vol. xxiii. p. 139. Griesbach, Charles Ludolf, Esq., 'On the Geology of Natal,' Quart. Journ. Geol. Soc. vol. xxvii. p. 53. Oldham, Thos., LL.D. &c., 'Memoirs of the Geological Survey of India,' 4to. Huxley, Prof., 'On Vertebrate Fossils from the Panchét Rocks, in the above 'Memoirs,' 4to, 1865. Blanford, H. F., Esq., 'On the Age and Correlations of the Plant-bearing Series of India,' Quart. Journ. Geol. Soc. vol. xxxi. p. 519.

† "Owen, Prof., 'Description of a Cranium of a Labyrinthodont Reptile from Mángali, Central India,' Quart. Journ. Geol. Soc. vol. xi. p. 37."



TABULAR VIEW OF THE FOSSILIFEROUS STRATA OF THE EARTH.



QUATERNARY or PSYCHOZOIC	Turbary. Shell Marl. Old-valley Drift. Bricks-Earth. Glacial Drift. Norwich and Red { Craig. } Coralline	MAN. by Remains. by Weapons. MAMMALS under present geographical distribution. Equus.
TERTIARY or NEOZOIC	Eocene. Miocene. Pliocene. Pleistocene.	Orders of Placentalia. Mars. Orders of Mars. Proboscidea. Rodentia. Carnivora.
SECONDARY or MESOZOIC	Maestricht. Upper Chalk. Lower Chalk. Upper Greensand and Gault. Lower Greensand. Weald Clay. Hastings Sand. Purbeck Beds. Portlandian and Kimmeridgian. Oxfordian. Kellvinn. Forest Marble. Bath-Stone. Stonesfield Slate. Lower Oolite. Liass. Bone Bed. Keuper. Muschelkalk. Bunter.	(Cyboid) Fishes. Ctenoid } Procelion Crocodiles. Toothed Birds and Pterodactyles. Iguanodon. Splanchothere, and other pouched Mammals. Phosaurus, Omosaurus. AVES, by Bones and Feathers. MARSUPIALS: Amphithere &c. Ichthyopterygia. Cephalopods (2-gilled). Tretospondylia. Theriodontia. } S. Afr. REPTILIA. Anomodontia. } Labyrinthodontia.
PRIMARY or PALÆOZOIC	Marl and Sand. Magnesian Limestone. Red Sandstone. Coal-Measures. Mountain Limestone. Carboniferous Slate. U. Old Red Sandstone. Cathness Flags. L. Old Red Sandstone. Ludlow. Wenlock. Llandovery and Caradoc. Llandello. Lingula Flags. Cambrian.	Devonian. Permian. Carboniferous. Silurian. AMPHIBIA, Ganocephala. Pisces { ganoid. } placoganoid. } placoid. Fishes. Annelides. Bryozoa. Trilobites. Brachiopods. Trilobites. Fucoids. Zoophytes.

racter which is exceptional in liasso-jurassic Reptilia; and that exception, exemplified in *Ichthyosaurus*, is adaptive, as in fishes, in relation to an aquatic medium of life and locomotion. In those South-African Reptilia which, from their jaws and dentition, were herbivorous, and, from what is known of their limbs, more terrestrial than aquatic, the proportion of the primitive notochord retained in their vertebral column, indicated by the term *Tretospondylia* (Nos. S. A. 1-31), offers a closer analogy to the condition of that column in the early air-breathing Vertebrates of the Carboniferous series than to any Dinosaur of the Mesozoic formations.

"A specimen of fossil fish (*Hypterus Bainii*, Ow.), transmitted with reptilian remains from the Beaufort beds at 'Alice,' near Fort Beaufort, belongs to a heterocercal genus near akin to *Amblypterus*, with close relations to other Ganoids of the Carboniferous formations.

"The answer, then, to the question of the geologist as to the age of the South-African Reptilia, at the present phase of evidence, is, that they are not later in time than the Trias, and probably lived in the Palæozoic period.

"Those, however, to whom such reply is in any degree intelligible form but a small proportion of the numbers visiting the British Museum who may give an intelligent glance at these singular fossils, and more or less comprehend the facts and deductions by which creatures so long extinct have been restored, so far, at least, as to enable the naturalist to assign to them their place and affinities in the zoological system. By such visitors the question naturally asked is, 'When did these dragons live? and how long ago is it since they died out?'

"To assist the comprehension of the grounds of a reply a 'Tabular View of the Fossiliferous Strata,' in the order of superposition, is subjoined (see opposite).

"Among the most recent of these strata (viz. the turbary deposits, or accumulations of peat, still in course of formation) there are found evidences of Man, with remains of red-deer, roebuck, wild boar, the small indigenous ox (*Bos longifrons*), &c.; but the conditions under which the great vertical extent of these deposits have been accumulated in certain localities yield ground for an estimate of a considerable lapse of historical time.

"When such beds of peat have been dug out, they are seen, in many localities, *e. g.* in Ireland, the Isle of Man, and adjacent coast of England, to have rested on a deposit of white marl, of a fine tenacious consistency, and forming a good manure for oat- and potato-crops, due, in part, to remains of successive generations of freshwater mollusks which flourished in the ancient lakes of which the marl formed the bed. In this marl are found remains of the reindeer, the *Megaceros*, the hairy northern elephant (*E. primigenius*), and of other large extinct beasts, which roamed from Northern Europe over a land extending into the Atlantic, parts of which continent now remain in an insulated state, as 'Great Britain,' 'Ireland,' the 'Isle of Man.'

"Since the deposits of 'shell-marl,' and of the corresponding

lacustrine or freshwater formations of 'brick-earth,' both the geographical and climatal conditions of those parts of Europe have changed.

"The legend of the loss of Earl Godwin's lands—the evidence of the monuments of the old monks transferred to Chichester Cathedral when the sea began to gain upon their Abbey, with the indication given by 'Selsey Bill' of the whereabouts of the submerged lands of the Saxon Earl on which the Abbey stood (about halfway, now, between Bracklesham and the east end of the Isle of Wight)—the submerged forest exposed some twenty feet below the actual sea-level in excavating the docks at Jarrow Slake,—these and many other examples of slow and gradual change, such as still affects the Norfolk coast, operated to the remotest bounds of recorded time and long antecedent to history or legend. They indicate part of those changes in the disposition of sea and land which, being concomitant with analogous changes of the American coast affecting currents and causing 'gulf-streams,' put an end to the glacial climate which previously prevailed in our latitudes.

"The evidences of the human species as we descend in the Quaternary series are mainly reduced to rude implements of stone; and all who have, without prepossession, intelligently studied these evidences and the conditions of their discovery, whether in caves or drifts, are at one in defining them as 'prehistoric.' Beyond the Quaternary series reliable evidences of Man are not known to the writer.

"During the Pliocene division of tertiary time, in which lived many mammals the species of which have now passed away, we infer, from the geographical correspondence of their distribution with that of their existing allies, that the main features of the actual distribution of land and sea, in regard to the larger continents, had been attained.

"In the Miocene and Eocene periods other geographical conditions prevailed, with other climates. Correspondence in localized distribution of recent and fossil species can no longer be predicated. But significant evidences of the origin of existing species are found. The miocene *Hipparion*, with the pair of hooflets dangling behind the main hoof in each foot, has made intelligible to anatomy the veterinarian's 'splint-bones' concealed beneath the skin of the fore and hind feet of the pliocene and modern Equines. The eocene *Palæotherium* shows the hooflets of the three-toed miocene horse in more normal and functional proportions. A similar progressive specialization is traceable from an artiodactyle type of quadruped, as represented, *e. g.*, by the eocene *Anoplotherium*, to the useful cloven-hoofed ruminants of the human period.

"The biological, geological, geographical, and climatological phenomena of the tertiary divisions of time baffle all endeavours to conceive the number of annual revolutions of the globe during which these changes and advances in organic life were in progress.

To so test or define the periods of formation of the grander and more numerous subdivisions of Secondary or Mesozoic series becomes

a vain effort of the limited faculties of a finite nature. Yet nearly all these periods have come and gone since the reptilian animals played their parts in the triassic and permian worlds.

“It is hard to realize the surpassing interest with which the evidences of such ancient life are first received, scrutinized, and compared, and by which is lightened the labour of gaining ideas of the frames, the limbs, the weapons, and ways of life of these long-since perished animals. Unlike the poet, and dealing with denser elements, the geologist nevertheless, but with eyes fixed and gaze intent, ‘bodies forth the forms of things unknown,’ ‘turns them to shapes,’ and, in the transitory continents which successively come into and fade away from his field of vision, gives to them ‘a local habitation and a name.’”

MISCELLANEOUS.

Note on the Embryogeny of the Tunicata of the Group Luciæ.

By M. A. GIARD.

I HAVE repeatedly insisted* upon the necessity that exists for separating clearly the compound Ascidia of the group Didemnidæ from other forms belonging to a very different type, of which I have made the family Diplosomidæ. Besides important anatomical and embryogenical differences, the presence of numerous calcareous spicules in the tunic of the Didemnidæ is a practical character which enables them to be easily distinguished from the Diplosomidæ, in which these spicules are replaced by pigment-granules.

This new family includes:—1, the genus *Diplosoma*, MacDonald; 2, the genus *Pseudodidemnum*, containing a great number of species, specially *Didemnum gelatinosum*, M.-Edw., *Leptoclinum gelatinosum*, M.-Edw. (*Polyclinum*, Lister), the *Lissoclina* of Verrill, &c.; 3, the genus *Astellium*, including many new species, one of which, no doubt, answers to *Leptoclinum punctatum*, Forbes.

The Ascidian so well investigated by Kowalevsky under the name of *Didemnum styliferum* † appears to be intermediate between the genera *Diplosoma* and *Astellium*.

The species that I have taken as the type of the latter genus, *Astellium spongiforme*, first found on the coast of Brittany, is also common at Saint-Vaast-la-Hougue in Normandy and on the shores of the Boulonnais. I have this summer undertaken some fresh investigations upon the curious embryogeny of this Ascidian; the results at which I have arrived, brought together with those of the magnificent work of Kowalevsky on the embryogeny of *Pyrosoma* ‡, seem to me to throw an unexpected light upon the relations of the Diplosomidæ with the other Tunicata.

* Archives de Zoologie, tomes i. & ii. 1872 and 1873.

† Schultze's 'Archiv für mikr. Anat.' Bd. x. 1874.

‡ Schultze's 'Archiv,' Bd. xi. 1875.

I reserve for a more detailed memoir the investigation of the formation, segmentation, &c. of the single ovum, and I shall confine myself at present to calling attention to some points of the organization of the hatched tadpole-like larva. The large vesicle which I regarded as the first rudiment of the common cloaca has certainly this physiological signification; but its morphological importance is greater than I had supposed.

This part, in fact, possesses the value of an individual; that is to say, it is the homologue of the Cyathozoid of the embryo of *Pyrosoma*. The arrangement of the other Ascidiæ relatively to this vesicle is exactly the same as that of the young Ascidioids of *Pyrosoma* relatively to the Cyathozoid. To be convinced of this it is only necessary to compare Kowalevsky's fig. 54, pl. xli. with the figure given by me for *Astellium*, in my 'Recherches sur les Synascidies' (pl. xxvi. fig. 6). To render this comparison perfect we must reverse the figure of the *Pyrosoma*, and turn it 45° from right to left round a longitudinal axis. The presence of a very abundant white pigment renders the continuous observation of the embryos of the Diplosomidæ very difficult, and prevented my perceiving this remarkable agreement.

The differences of structure which exist in the adult state between the branchiæ of *Astellium* and *Pyrosoma* are in relation to the different modes of existence of these animals. Moreover the embryos of an allied group, the Botryllidæ, have a branchia which astonishingly resembles that of *Pyrosoma*.

We may therefore regard the Diplosomidæ as representing the fixed state of a type of which *Pyrosoma* is the swimming or pelagic form. Consequently the group Luciæ of Savigny may be divided into two families, Pyrosomidæ and Diplosomidæ, presenting reciprocally the same relations as the Siphonophora and the Hydriformes among the Acalephan Cœlenterata.

A last fact which is important to indicate is, that in the peculiarities of the development of the Luciæ (defined as we have just seen) we find a new application of the law enunciated by us as the consequence of our embryogenic investigations on the group Molgulidæ. The Pyrosomidæ, which live free, present an abridged and condensed development, a partial segmentation, and an anurous embryo destitute of organs of sense; while the sedentary Diplosomidæ in the adult state have a dilated metamorphosis and a urodelous embryo, furnished with a well-developed visual and auditory apparatus. I may add that the tadpole-like larva of *Astellium spongiforme* possesses a caudal appendage, the musculature of which is very complex, while its membranous part is traversed by horny filaments, like those described by us in the simple Ascidiæ of the group *Cynthia* and in the Synascidiæ of the genera *Botryllus* and *Botrylloides*.

Lastly, in *Astellium*, as in *Ascidia scabra*, Müller, and *A. gelatinosa*, Risso, the tunic of cellulose is formed independently of the embryo, during (and even before) the segmentation of the vitellus. However, this process is less distinct than in the Ascidiæ in which we have observed it.—*Comptes Rendus*, December 13, 1875, pp. 1214-1216.

On Hückel's Theory (Allœogenesis) of the Genetic Connexion between the Geryonidæ and Æginidæ. By ALEXANDER AGASSIZ.

In the Proceedings of the Elliot Society for 1857 M'Crady gave a very interesting account of the commensalism of the young brood of a *Cunina* and of *Turritopsis*. No notice was taken of this remarkable mode of development, M'Crady's observations having been discredited by the later publication (1865) of a magnificently illustrated memoir on the "Rüsselquallen" by Hückel. The startling hypothesis of the genetic connexion between the Geryonidæ and Æginidæ contained in this memoir, and called by Hückel allœogenesis, has been ever since a stumblingblock to all theories of genetic relationship among Medusæ.

Two short papers recently published—the one by Schulze (Mitt. naturw. Ver. f. Steiermark, 1875, p. 125), and the other by Uljanin (Ann. & Mag. Nat. Hist. March 1876, p. 215), have, however, proved conclusively that Hückel's theory, like many other of his vagaries, had no foundation of truth. It was based not merely on an incorrect interpretation of facts, but the facts themselves existed only in his imagination.

As, perhaps, with the exception of his monograph of the Radiolaria, no other memoir has contributed more than the one above quoted to give Hückel the position he holds among zoologists, we may be allowed to remind the Hückelian school of naturalists that this same genetic connexion has furnished the text for many a sermon from their high priest. Infallible himself, he has been unsparing in his condemnation of the ignorance and shallowness of his opponents. Proved now to be in the wrong, we expect therefore justice without mercy from this stern scientific critic, and look forward in the next number of the 'Jenaische Zeitschrift' for a thorough castigation of Hückel by Hückel, showing up the absurdity of allœogenesis and all that hangs thereby.—*Silliman's American Journal*, May 1876.

On the Embryogeny of the Ephemera, especially that of Palingenia virgo, Oliv. By M. N. JOLY.

With the exception of the memoir by Luigi Calori "Sulla generazione vivipara della *Chloë diptera* (*E. hemera diptera*, Linn.)"*, there is, so far as I know, no work on the embryogeny of the *Ephemera*†. One might even say that all the acts concerned in the reproduction of these insects are still enveloped in a mysterious veil. Their copulation has been differently described by the authors who have treated of it. Swammerdam even denies that it ever takes place, and thinks that the ova are fecundated by the male liquid

* See 'Nuovi Annali delle Scienze Naturali,' ser. 2, tome ix. Bologna, 1848.

† The author seems to have no knowledge of Sir John Lubbock's paper "On the Development of *Chloëon dimidiatum*," in the Transactions of the Linnean Society, vols. xxiv. and xxv.—ED.]

after the fashion of those of fishes*. This is a manifest error, as the eggs of *Palingenia virgo*, collected by us immediately after their deposition on the piles of the quays of the Garonne, underwent development in little artificial lakes.

Réaumur asserts that he was several times witness to the copulation of *Palingenia virgo*; but the few words he says about it prove that he did not sufficiently observe it. De Geer is more explicit; but his description is so vague as to leave doubts in the reader's mind. Lastly, M. Pictet, the author of a splendid monograph of the Ephemeridæ, is completely silent with regard to the important act in question, probably because he never witnessed it. We have been no more fortunate than the learned Genevese Professor; and Calori was not more successful.

More favoured than his predecessors, Eaton has described, as an eye-witness, the aerial amours of the insects under consideration. According to him the male seizes the female with his abdominal forceps, compels her to yield to his desires, and fecundates the ova in the ordinary manner.

When examined separately, the eggs resemble small semitransparent grains of sand of a yellowish white colour and of an ovoid form, with the smaller extremity surmounted by a sort of hood, of a brown colour and spongy consistence, formed of tubes or cells arranged concentrically, in the midst of which we have thought we could perceive the micropyle. The diameter of the egg is scarcely $\frac{1}{4}$ millim. The shell is rather hard, and resists the decomposing action of the water for a long time, even after hatching. The vitellus consists, as usual, of a multitude of granules and oily drops, destined partly for the formation of the organs, and partly for the nutrition of the young individual.

It is always towards the large end of the egg that its development commences; it is there that the vitelline globules become converted at first into a finely granular blastoderm. In this region the egg becomes more transparent; and from the fifth to the sixth day of incubation we vaguely discern the part that will become the head. This detaches itself in the form of a crescent upon the dark ground of the vitellus; then a few days afterwards the abdomen appears at the opposite pole of the egg, its segmentation always much preceding that of the thorax, and always commencing at its setigerous extremity. The caudal setæ themselves appear early.

At first we see neither eyes, mouth, nor antennæ in the blastodermic mass which represents the head; but as soon as the eyes have appeared in the form of black spots composed of fine granules of that colour, or even a little earlier, we see rising from the lateral parts of the head tubercles or appendages representing the mandibles and the maxillæ. The labrum and labium appear much later.

The antennæ at first resemble thick conical rods, obscurely three-

* Swammerdam expresses himself as follows on this point:—"Tum igitur Faniella, more piscium, sua excutit ovula, quæ deinde a mascula, qui itidem prius ex aquis evolat, et postmodum teneram adhuc pelliculam in terra exiit, spermate vel lactibus effusis fecundabitur" (Biblia Naturæ, tome i. p. 235: Leyden, 1737).

or four-jointed, with the free extremity directed towards the caudal portion.

The legs make their appearance under an analogous form, and fold down against the thorax in proportion as they enlarge. Their articulations are at first very indistinct, but soon become more marked; and we then distinguish all the parts which ordinarily compose these appendages.

The abdomen, which increases more and more in length, gradually shows the nine segments with which it is furnished at the time of hatching; but it is folded in the form of a bow in front of the thorax and cephalic mass, which it finally masks in part.

The caudal setæ, as already stated, originate early upon the last abdominal segment; but like the other appendages (antennæ, mandibles, maxillæ, legs) they are at first destitute of any segmentation, and, what is more, of all villosity.

During the whole time that the animal remains in the egg we do not see any internal organ completely formed in it; the intestine itself is only indicated by a mass of oily drops and vitelline granules occupying the axis of the body, and more or less opaque except towards the caudal extremity, which is perfectly transparent. It is almost unnecessary to say that the vitellus becomes less and less abundant in proportion as the body and its appendages are developed. As in all other insects, it adheres to the dorsal region, which is always the last to be formed.

It is to be noted that for a very long time (about two months and a half) all the appendages and, especially, the cephalic mass have so little consistency as to be *diffluent*, after the fashion of sarcode, if the embryo is extracted from the egg and immersed in water. By degrees, however, the organs become consolidated, and towards the end of the sixth month, or in the first days of the seventh, the embryo bursts its envelope and exclusion takes place.

At this moment the young larva of *Palingenia virgo* is at most 1 millim. in length. It is still destitute of some apparatus which, at the first sight, would appear to be indispensable for life, and the late appearance of which may well surprise us. Thus at first it possesses no visible nervous or muscular system, no circulatory apparatus, no complete digestive tube, and no special organs of respiration. Its mouth is not so well armed and its legs less villous than in the adult larva. Its antennæ and caudal setæ possess neither the number of joints nor the villosity which they will afterwards acquire; in a word, compared with what it will be a little before its nymphosis, it may be said to be a very incomplete animal.

We have elsewhere described in detail the singular metamorphoses that the false branchiæ of *Palingenia virgo* undergo. They appear at first in the form of tubular cæca suspended from the posterior angles of the first six segments of the abdomen; then, with increasing complication, they become lamellar, at first simply denticulated behind, but afterwards furnished with tubular fringes on the margins; then they present definitively the appearance of a double lanceolate leaf, traversed by a large trachean trunk with fine branchlets.

As soon as the false branchiæ appear (that is to say, eight or ten days after hatching), the blood-corpuscles may be seen oscillating in the dorsal vessel, then vaguely indicated. Eight days later the circulation is well established, and is effected in the manner indicated in the well-known and often-cited memoirs of Carus and Verlorej.

The buccal and locomotive organs undergo analogous changes, although less strongly marked than those of the branchiæ, always excepting the mandibles, which become more robust and more villous, and acquire a form rather different from that of the mandibular hooklets of the larva when only a few days old.

When it has attained the age of six months, and a length of from 7 to 8 millims., which corresponds to that age, the larva of *Palingenia virgo* is no longer subject to changes of any importance, until the time of nymphosis; but those which it has already undergone authorize us in saying that it presents a new and striking example of *hypermetamorphosis*, analogous to those which we have made known in the larvæ of the *Œstridæ* (*Œstrus equi*). Von Siebold has indicated similar phenomena in the Strepsiptera, and Fabre, of Avignon, in *Meloë*.

We have fully ascertained the precise duration of the incubation of the egg of *Palingenia virgo*. By care, patience, and perseverance, after frequent checks, I have succeeded in ascertaining that the time necessary for the hatching of the egg is six months at least, and seven months at the most. None of the naturalists who have preceded me were able, I believe, to arrive at this result. Swammerdam himself therefore would no longer have the right to repeat now-a-days what he said when he wrote his admirable memoir on the *Ephemera*—namely, that the period of the incubation of their eggs is very difficult to say, and known of God alone, who gave them form and life*.

Lastly, from the observations that we have made during many consecutive years (from 1862 to 1874), and the principal results of which are contained in the note which we have the honour to lay before the Academy, the illustrious author of the 'Biblia Naturæ' would be no more authorized to maintain that the larvæ of the *Ephemera* at their escape from the egg do not differ from the adult larvæ either in form or organization:—"A vermibus adultioribus nec figura, nec fabrica discrepant."—*Comptes Rendus*, May 1, 1876, p. 1030.

Protection of Herbaria and Entomological Collections from Insects by means of Sulphide of Carbon. By M. J. B. SCHNETZLER.

M. Schnetzler of Lausanne states that the collection of Swiss flowering plants belonging to the Academy of Lausanne having been attacked by *Anobium paniceum*, he was led to try the effect of sulphide of carbon in destroying those insects and their larvæ. He had a wooden box made large enough to contain five fasciculi of the herbarium, each composed of about 200 plants. Four ounces of sulphide

* "Dictu sane quam difficillimum est, nec nisi soli Deo notum, iis qui formam vitamque dedit" (Biblia Naturæ, tome i. p. 236).

of carbon were poured into the five fasciculi; the box was tightly closed, and the whole left for a month (January 15th to February 15th). All the insects were destroyed and no injury was done to the specimens or to the papers on which they were fastened. A little later in the season a fortnight was found to be sufficient. The expense of the operation is very small; and M. Schnetzler recommends that the boxes should be placed under a shed, as in case of the escape of any vapour from them there might be danger of explosion. The same process may be employed for collections of insects.—*Comptes Rendus*, April 10, 1876, p. 863.

Silica of Grasses and other Plants carried up as Diatoms or other Siliceous Grains, and not in Solution or as Soluble Silicates. By Prof. P. B. WILSON.

My attention was called, some time since, in the examination of the ash of plants obtained by slow incineration in a platinum crucible, to the fact that when the ash is treated with dilute acid, and evaporated to dryness on the water-bath, it does not pass into the gelatinous condition prior to complete decomposition of the *hydrated* mass, as is the case with the silicates soluble in acid, or those decomposed with sodium and potassium carbonates. If, however, the ash, prior to the treatment with acid, is subjected to a high temperature, a combination of silicic acid with the alkalies, the alkaline earths, and the earths takes place, if all are present; then the silica separates in the gelatinous form, and presents all of the chemical reactions of silicic acid obtained from the natural silicates. The silica obtained from ash by either of the processes indicated, on close examination, was observed to be entirely free from any combination, showing that it had been assimilated in the free state.

To demonstrate this theory, my friend G. I. Popplein, Esq., of this city, suggested the application of infusorial earth of the Richmond formation, found in large quantities on the western shore of the Chesapeake bay, to land sown in wheat. I have obtained straw from wheat so grown, and have found, after it has been treated with nitric acid and the siliceous remains placed on the field of the microscope, that it consisted wholly of the siliceous shields of Diatomaceæ, the same as found in the infusorial earth, excepting that the larger disks in their perfect form were absent (*Actinocyclus Ehrenbergii* and *Actinoptychus undulatus*). My conclusion is that they (and there probably may be other forms) are too large to enter the root-capillaries. During the coming summer I will attempt, if possible, to make micrometer measurements of both.

The discovery of Diatomaceæ in their original form in this wheat-straw precludes the possibility of the infusorial earth having undergone any chemical change in the soil, either by forming chemical combination with the alkalies or the earths, or by suffering physical disintegration from any catalytic action of any salts present in the soil.

In the particles of silica placed upon the glass slide, when they were completely separated from each other, the outlines of the individual diatoms were sharply and distinctly defined. On the other hand, when the physical action of ebullition with nitric acid was not sufficient for the complete separation of the particles of the epidermal shield, there was observed a marvellous interlacing of the various forms, showing that they were conveyed by the sap-cells directly to the section of the plant where they were destined to complete its structure. I have examined several specimens of straw, taken at random in the market: the silica in each specimen consisted of plates, very thin and truncated at the corners.

The result of these investigations shows the necessity of finely divided silica in the soil, so minute as to be capable of passing with facility through the sap-cells; secondly, that simple or compound silicates are useless as fertilizing agents, either natural or artificially prepared. We have no valid reason for forming any theory that vegetation can, through any known chemical law, separate the elements or their compounds from combinations so positive in their character.

In this case we have a practical result, capable of being verified at any stage of growth of a plant, produced by the application of silica to the soil in the form of certain well-defined microscopic organisms; for, finding these in the ash to the exclusion of other particles of silica, they seem to be more acceptable for the plant-structure. Free silica is hence the only condition in which it can enter the plant.

I look upon this discovery as leading agricultural investigations in a new direction; and it must eventually change many of the views expressed and accepted by scientists.

Every precaution was used in having all the material thoroughly cleansed, with a view both to accuracy and to removing suspicions that these microscopic forms were the result of dust-showers.—*Silliman's American Journal*, May 1876.

Washington University, Medical Department.
Baltimore, Md., February 1876.

*On Fish of the Ceratodus-group existing in the River Fitzroy,
South Australia.* By M. PAUL GERVAIS.

M. Paul Gervais announces that he has received from M. Francis de Castelnau, French Consul at Melbourne, an intimation of the existence in the river Fitzroy of a new form of fish allied to *Ceratodus*. It presents the principal characters of the species from the river Burnett, to which Messrs. Kreff and Günther have given the name of *Ceratodus Forsteri*, but differs from them sufficiently to lead M. de Castelnau to regard it as forming a distinct genus. He gives the name of *Neoceratodus* to this genus, and calls the species *N. Blanchardi*.—*Comptes Rendus*, May 1, 1876, p. 1034.

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END OF THE SEVENTEENTH VOLUME.

Fig. 1.



Fig. 2a.

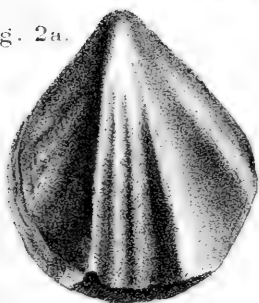


Fig. 2b.

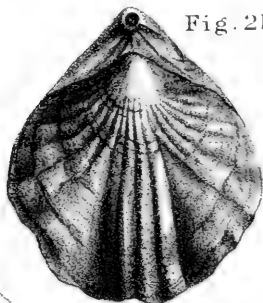
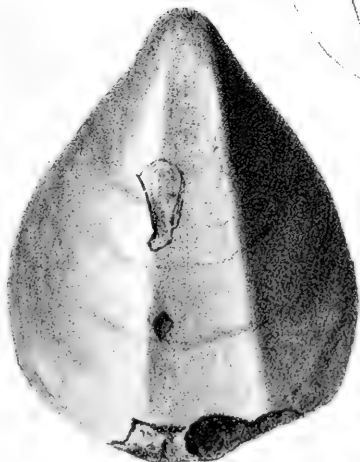


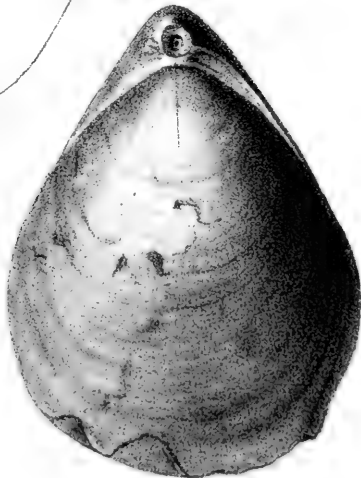
Fig. 3c.



d



b



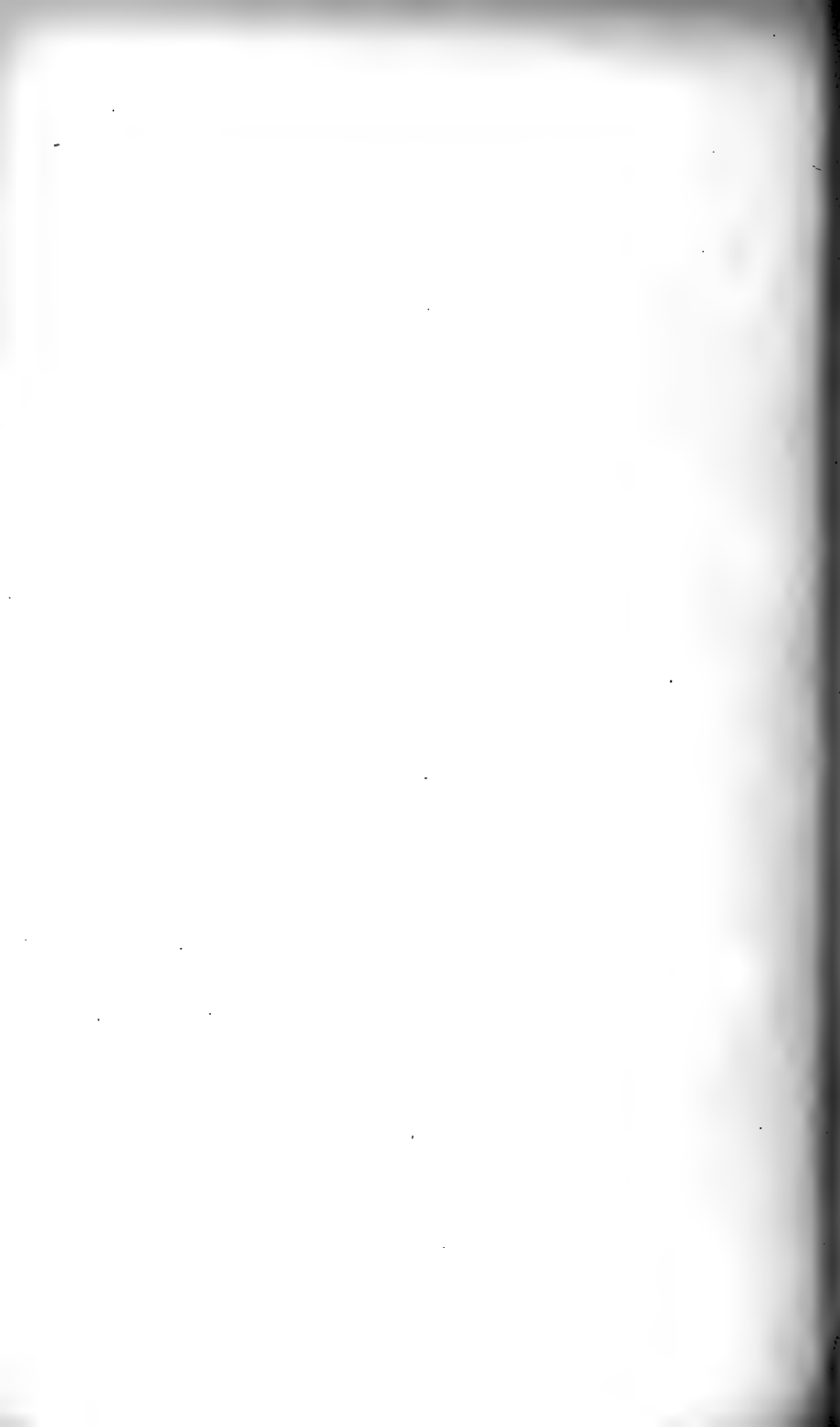


Fig. 4.

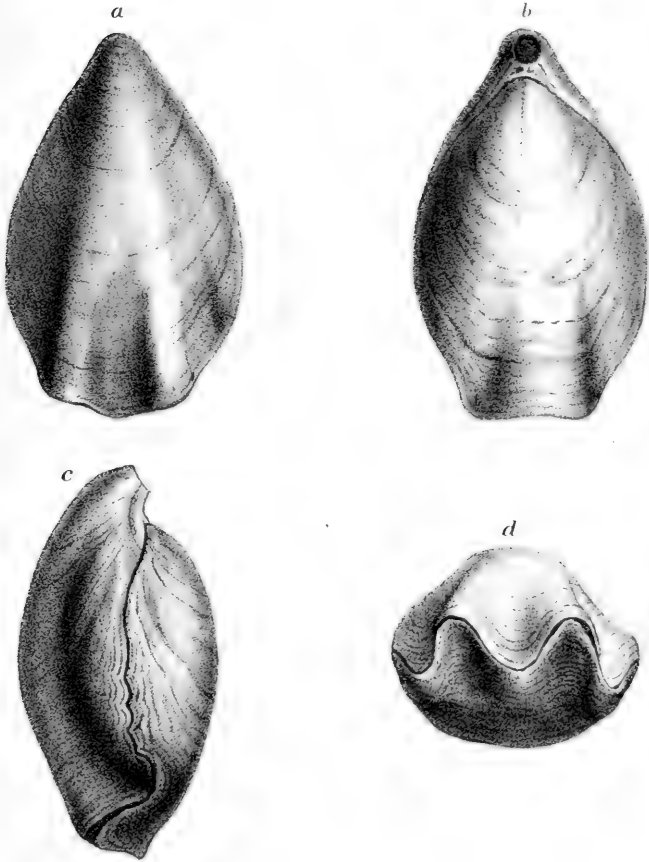


Fig. 5.

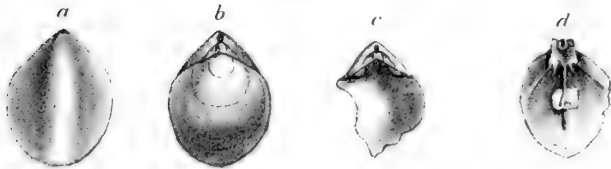










Fig 3

Fig. 2^a

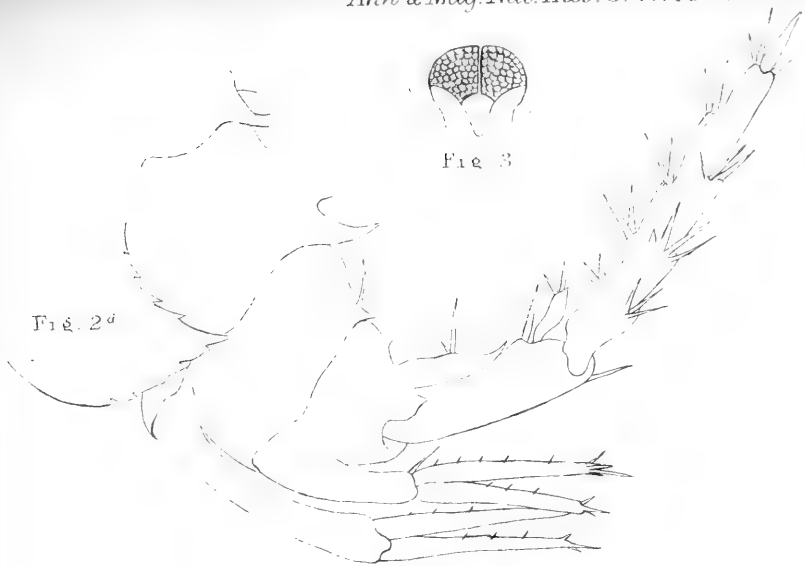


Fig. 1^a



Fig 2



Fig 2^a

Fig 2^b



Fig 2^c



Fig. 6

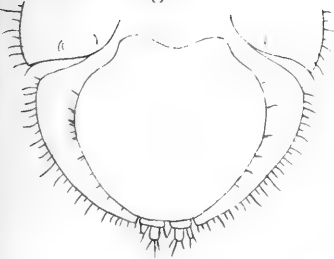


Fig. 5^b

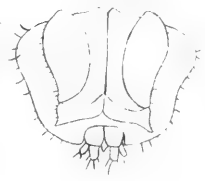


Fig. 7.



Fig. 5

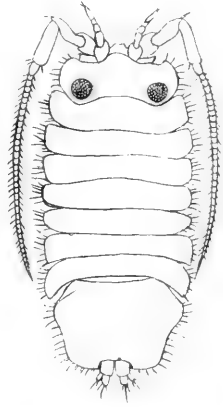


Fig. 5^a

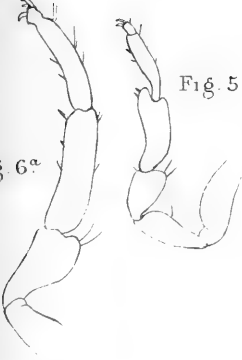


Fig. 1^b

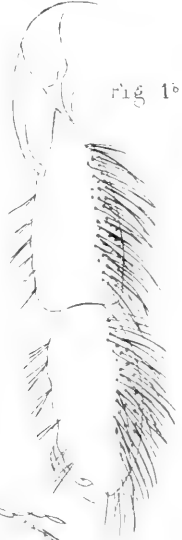


Fig. 1.

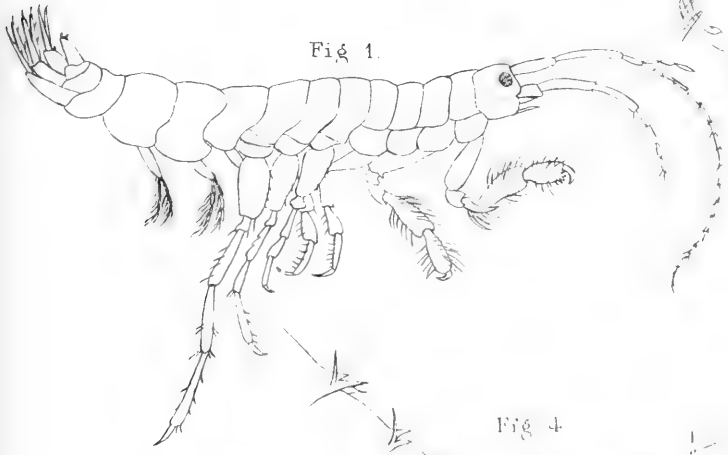
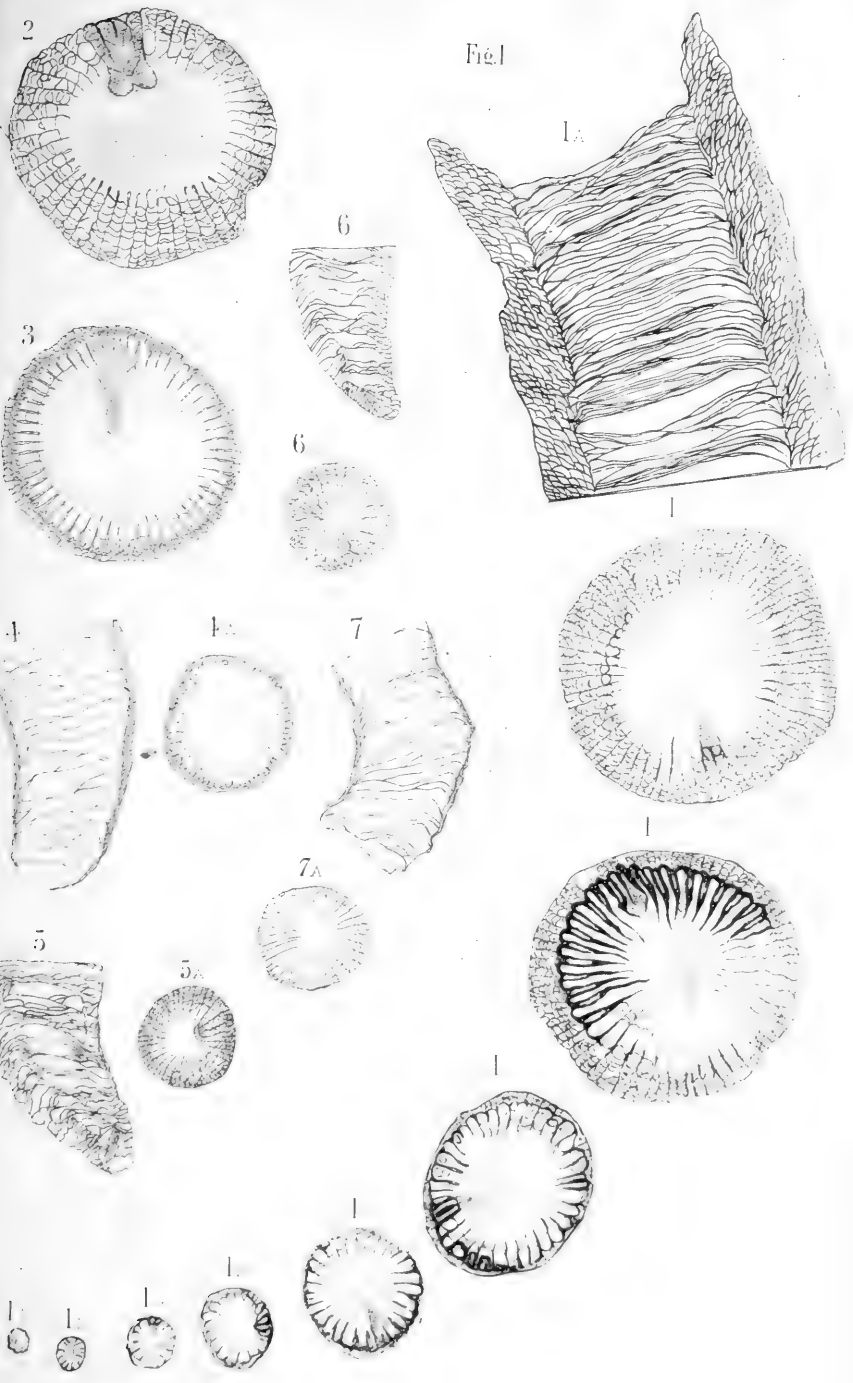


Fig. 4





Fiel

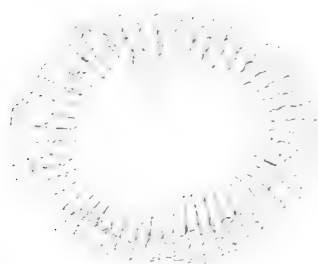




2



3



4



Fig. 1.



6a



6



5



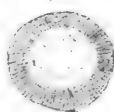
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7a



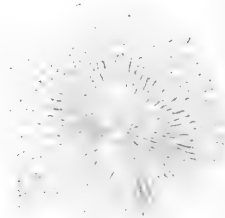
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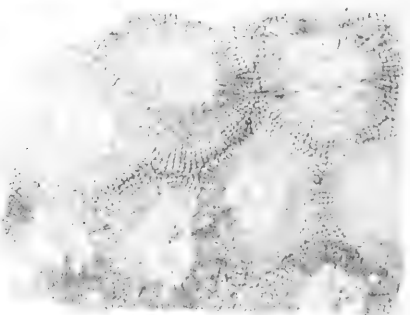
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8



9



7



9



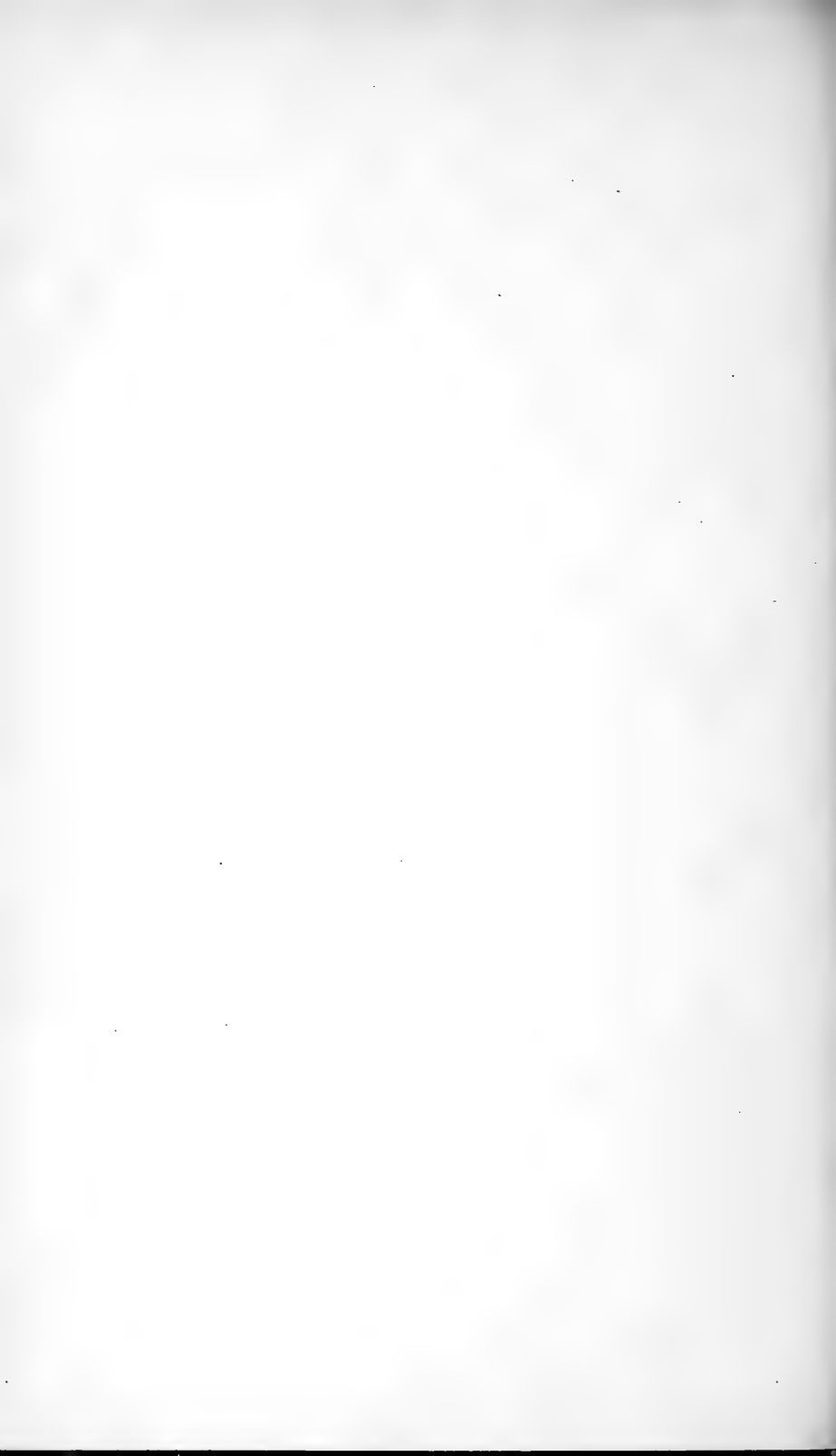
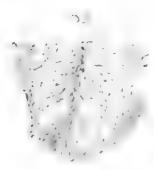
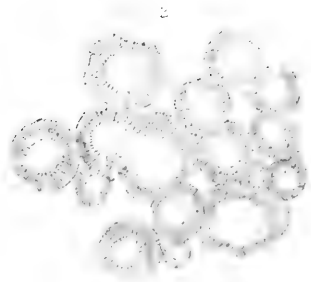
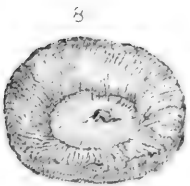
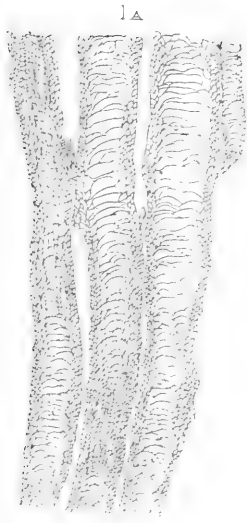
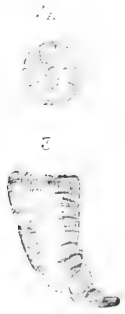
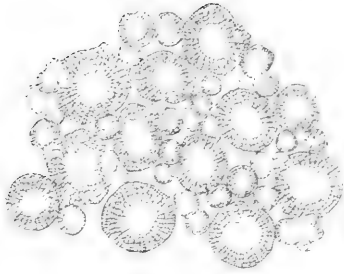


Fig 1



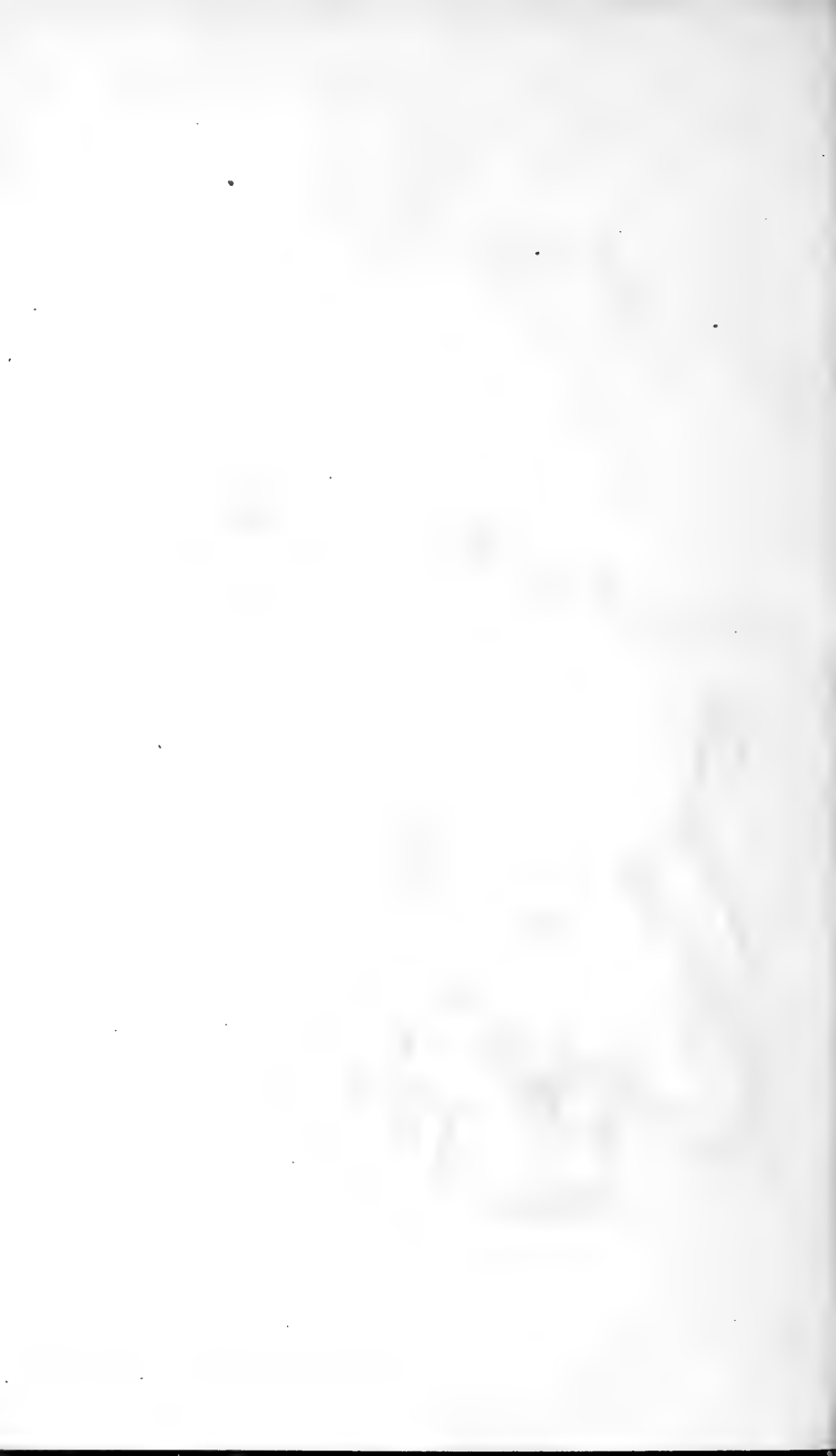


Fig. 1.

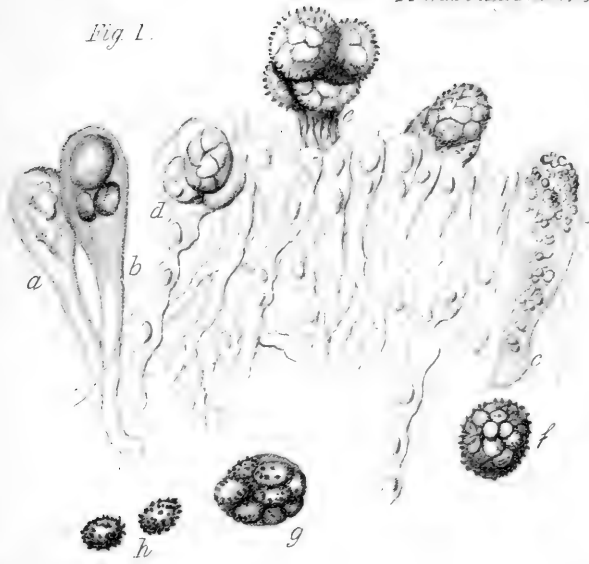


Fig. 2.

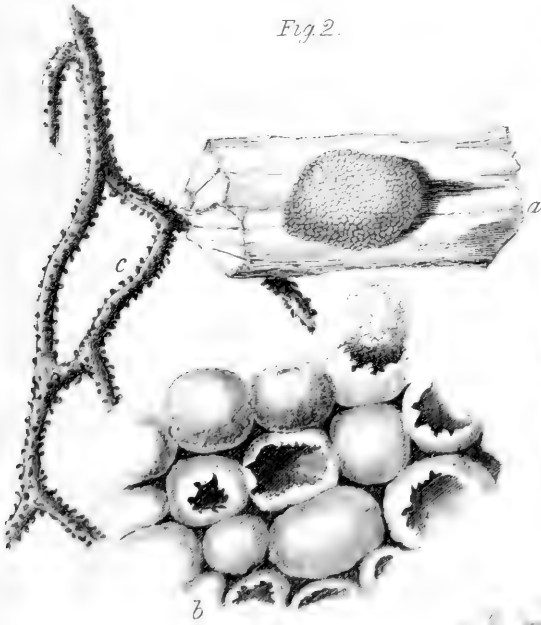


Fig. 3.





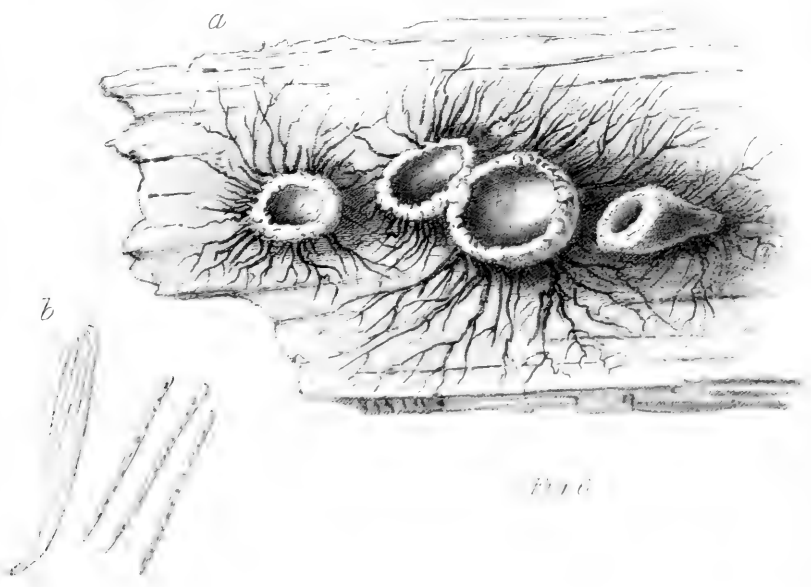
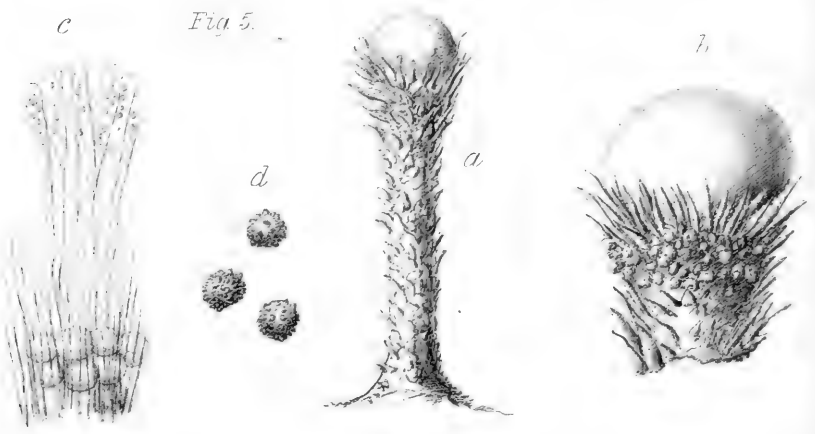




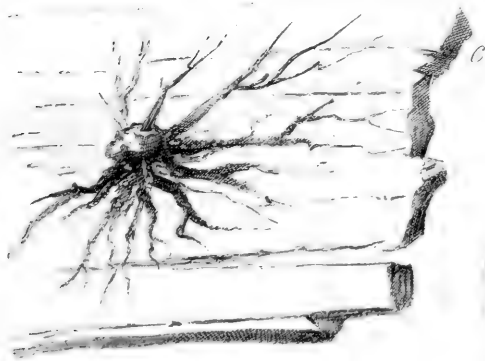
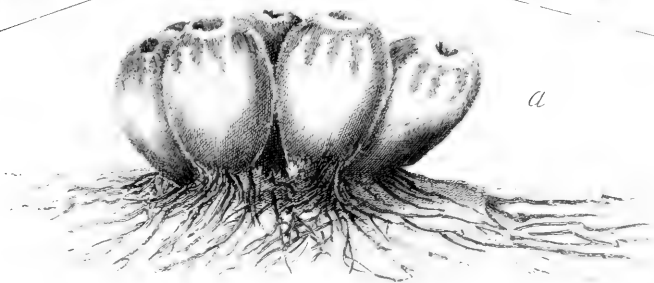
Fig. 1.



a

b

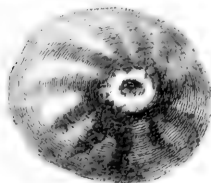
a



c

b

Fig. 2.

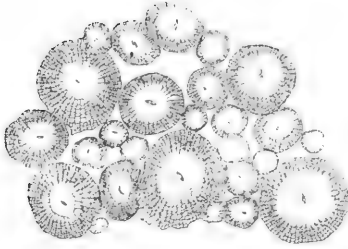


d





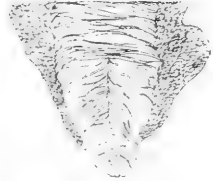
Fig 1



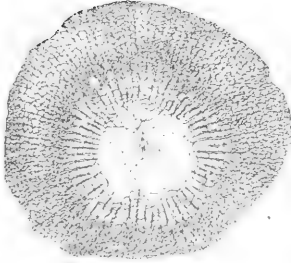
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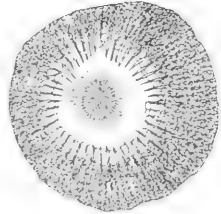
2A



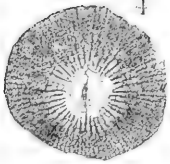
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5



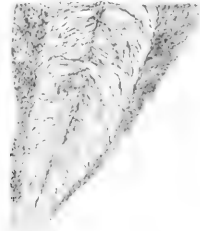
4



2B



6A



6

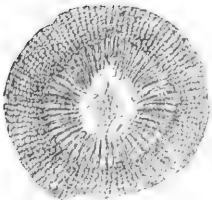


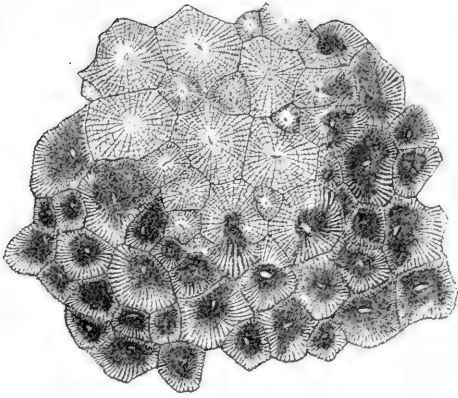


Fig 1

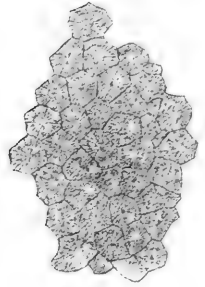




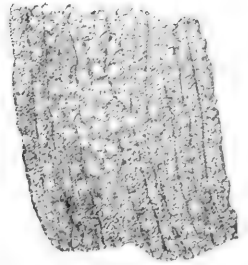
Figl.



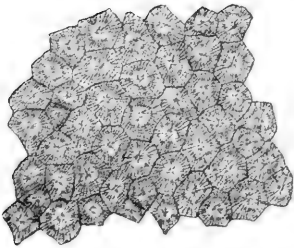
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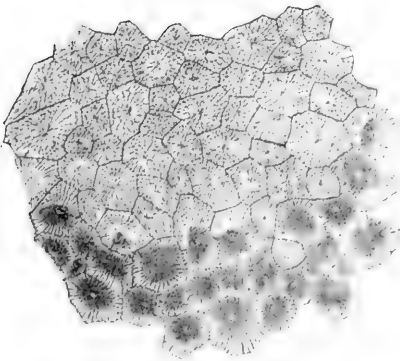
2A



3



4



2B

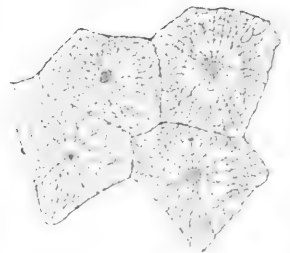
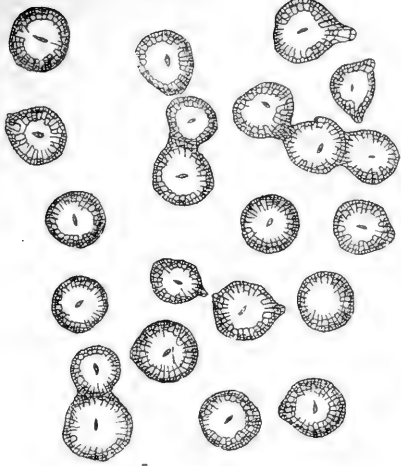
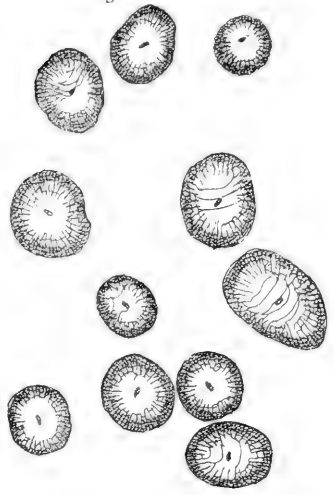




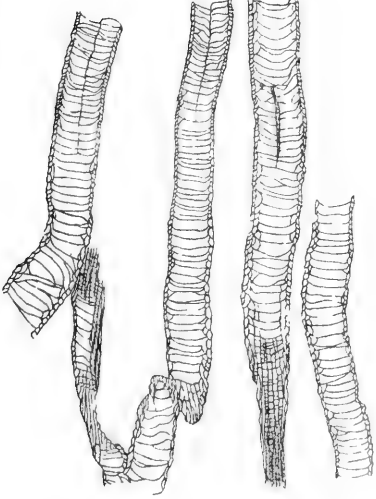
Fig 1



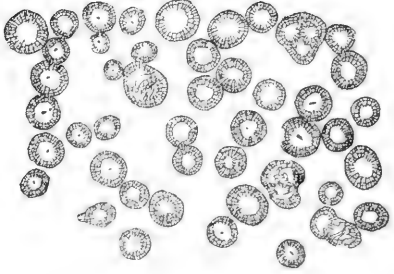
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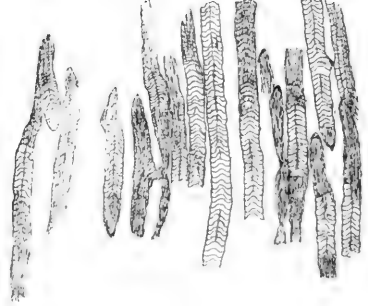
1A



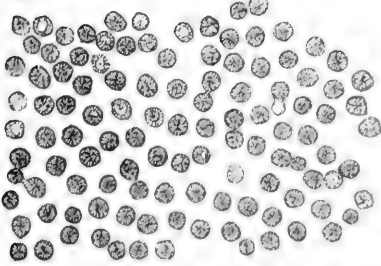
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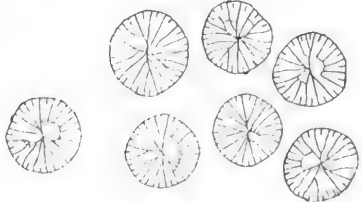
4A



4



4B



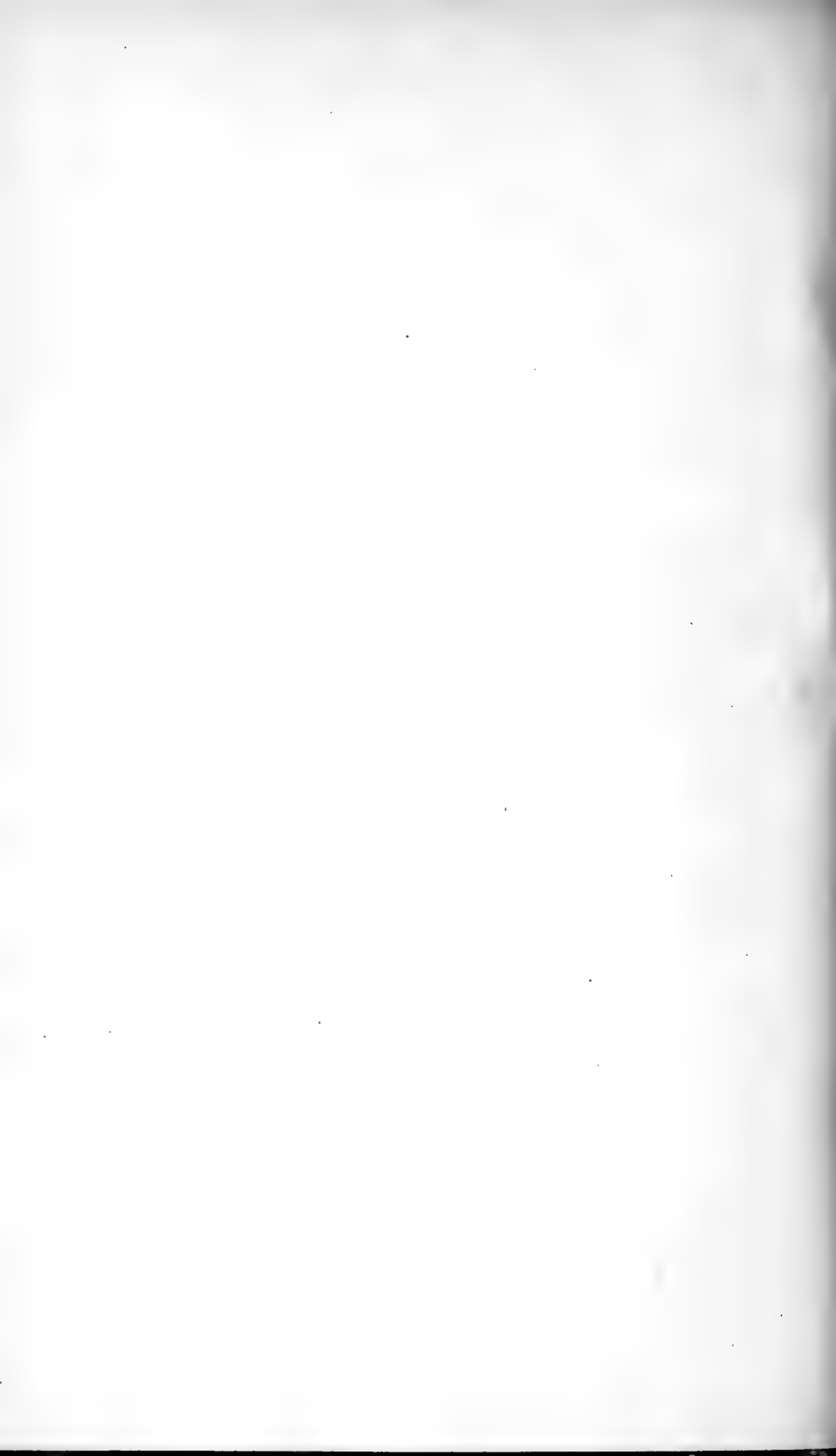
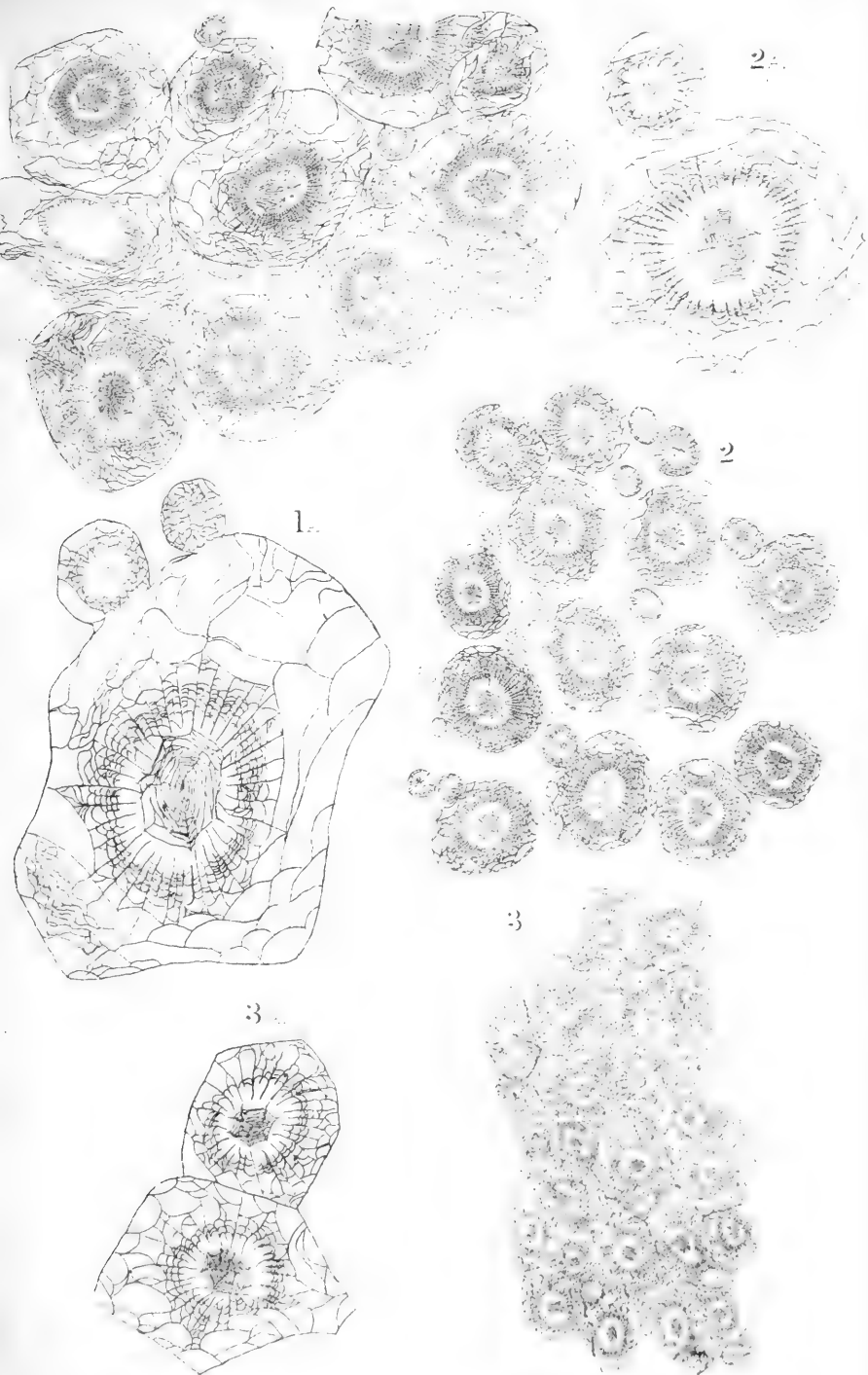
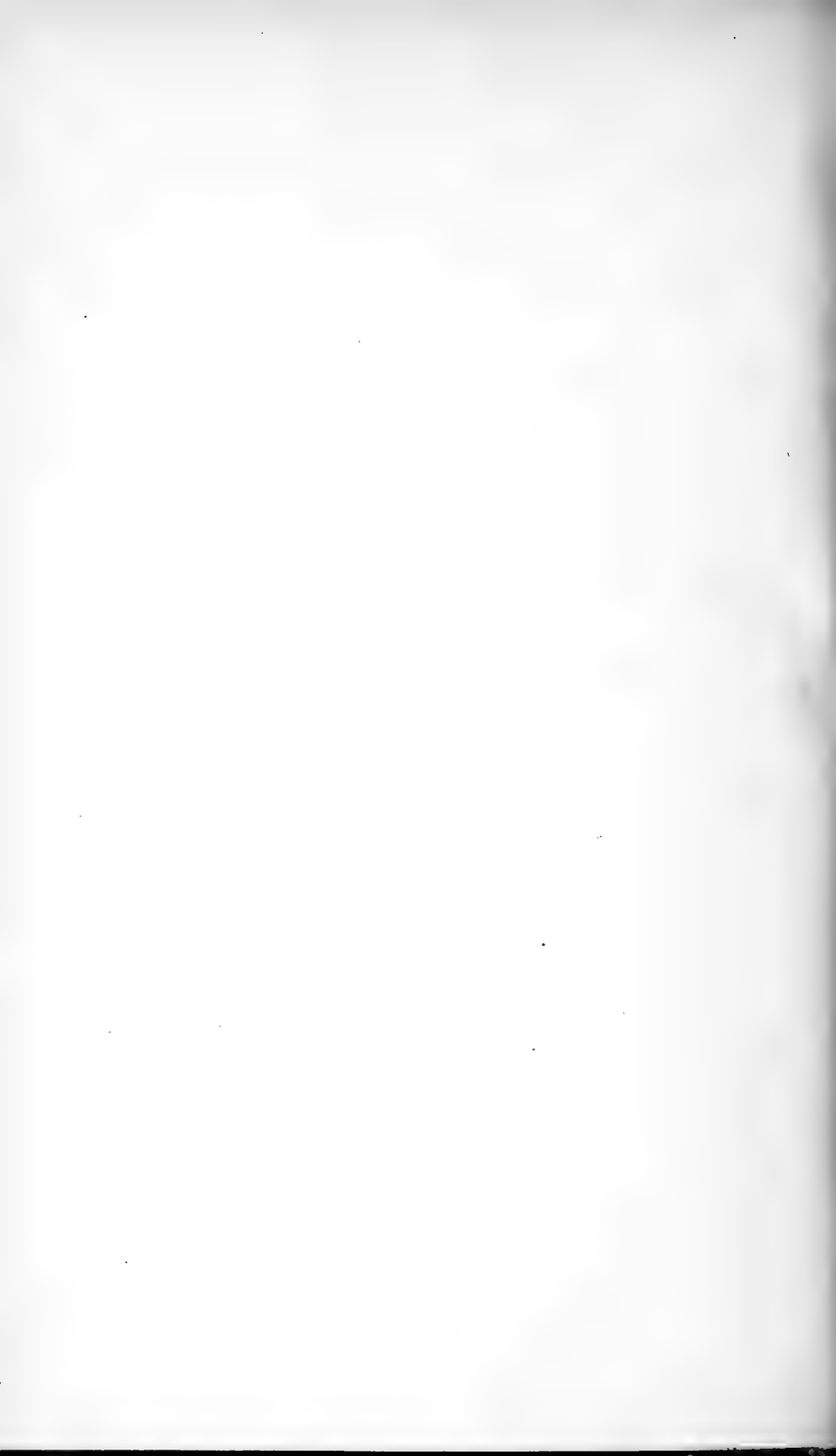
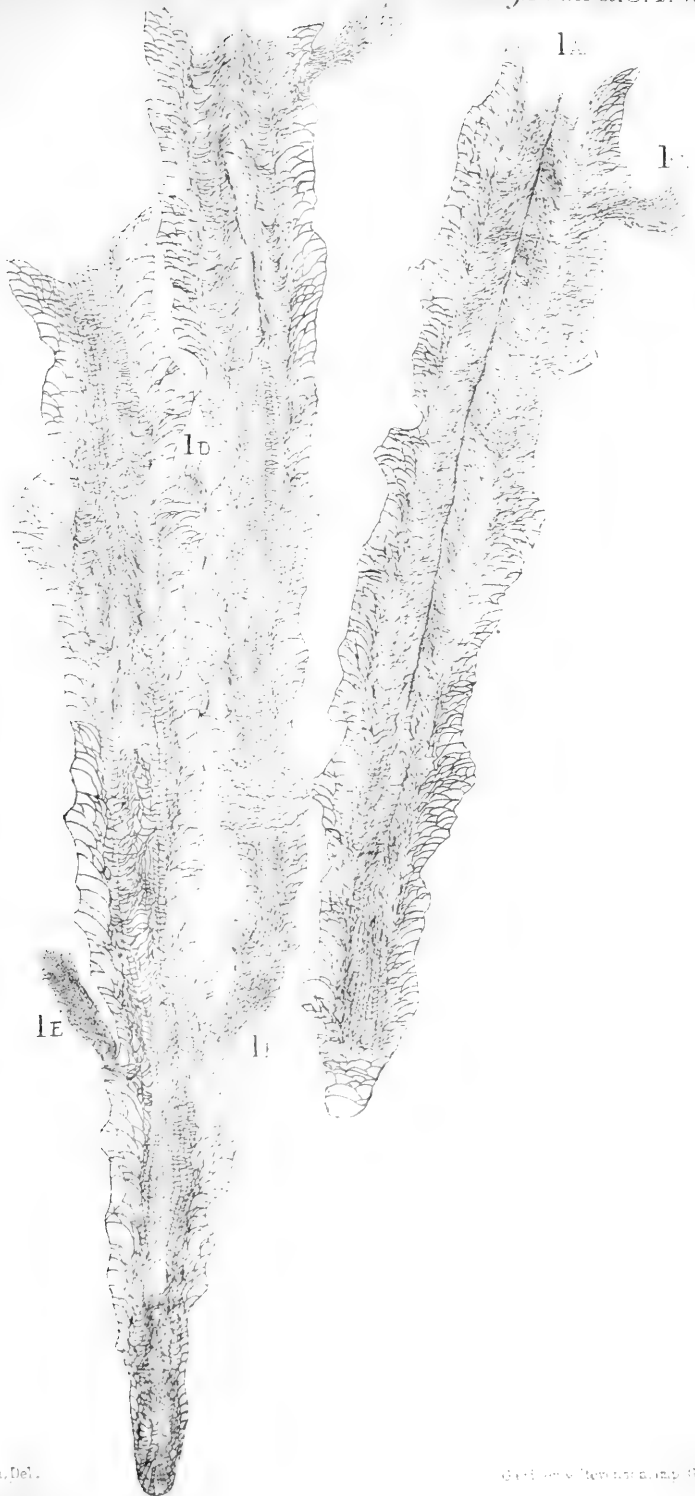


Fig 1

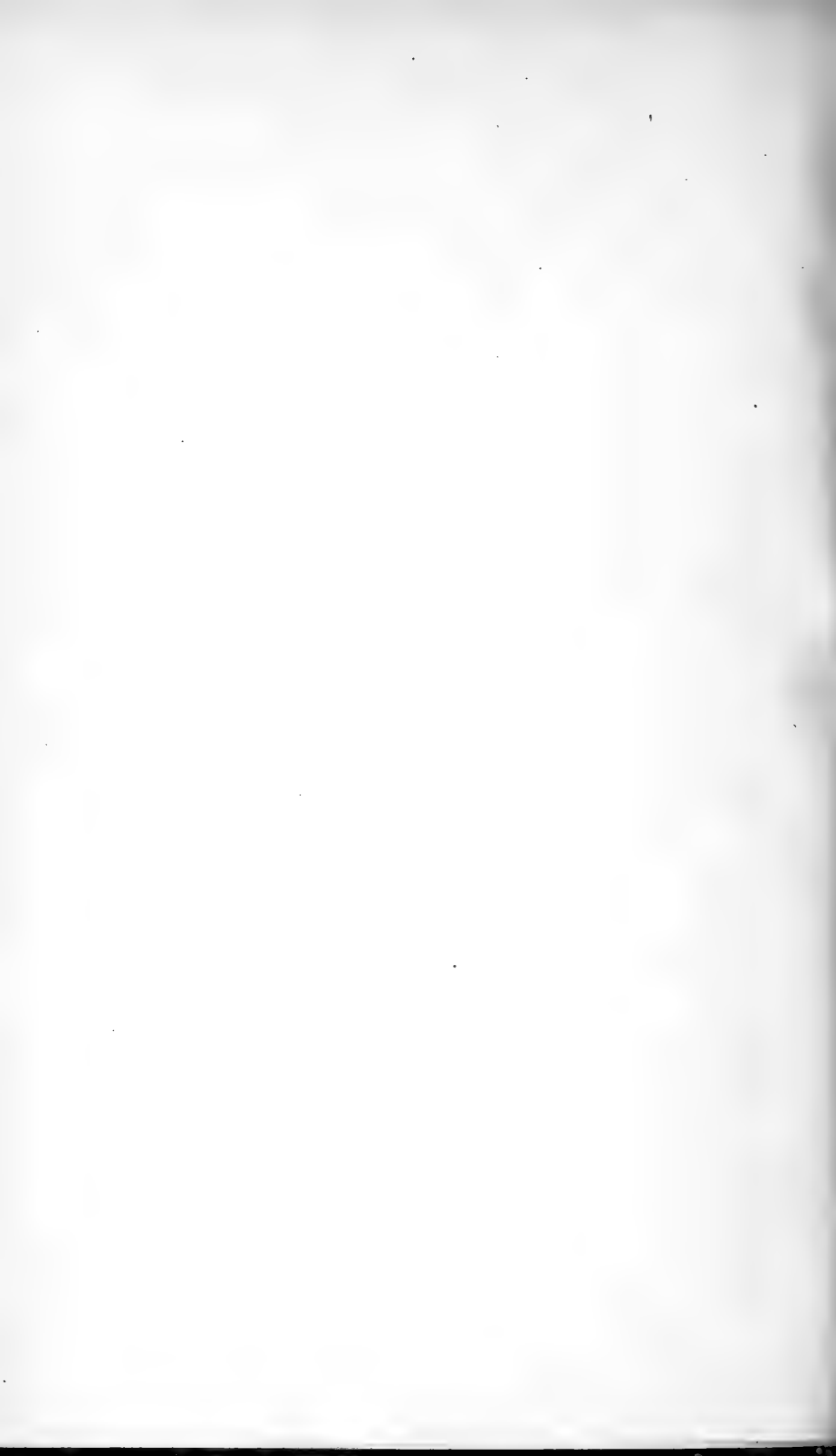


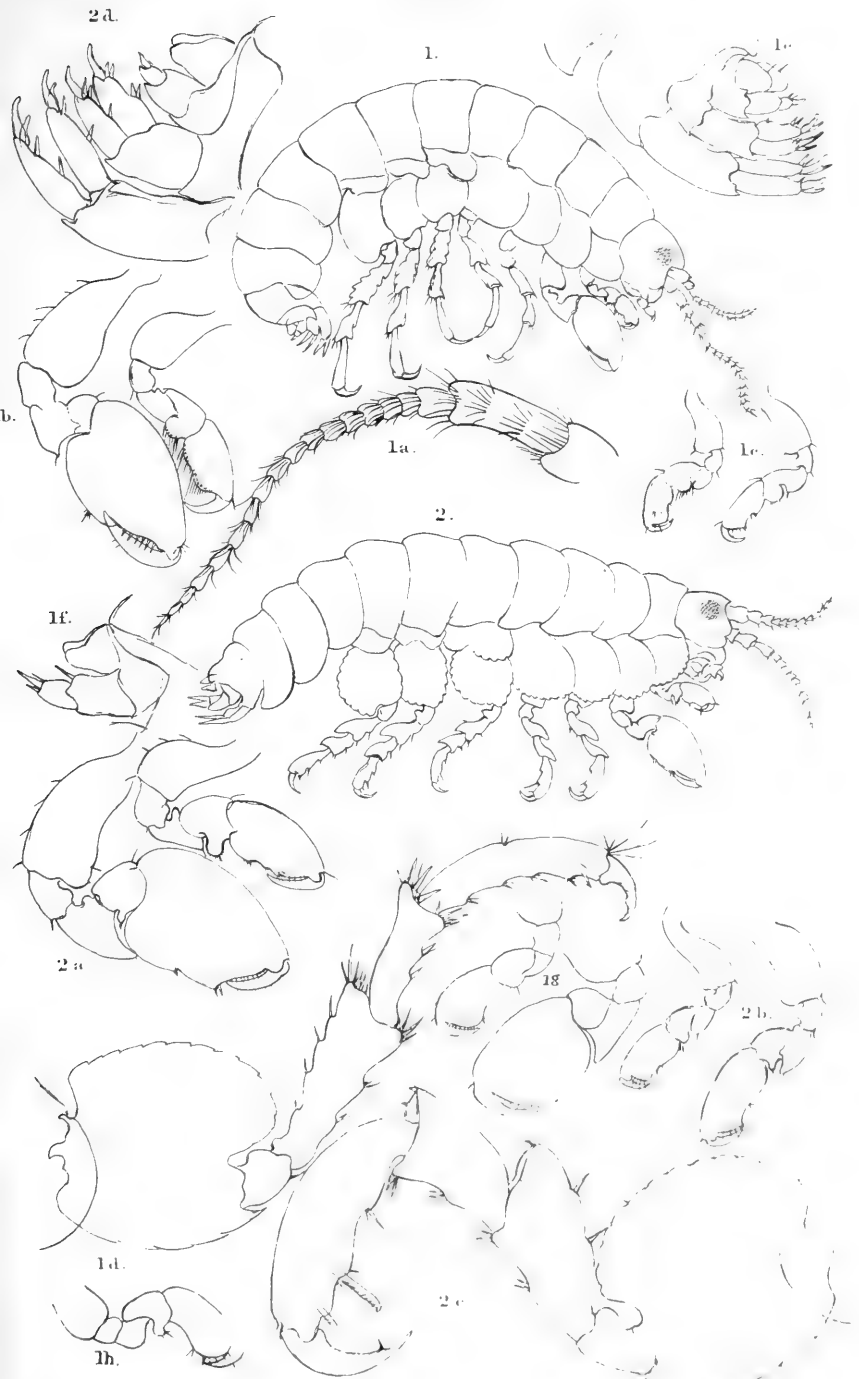




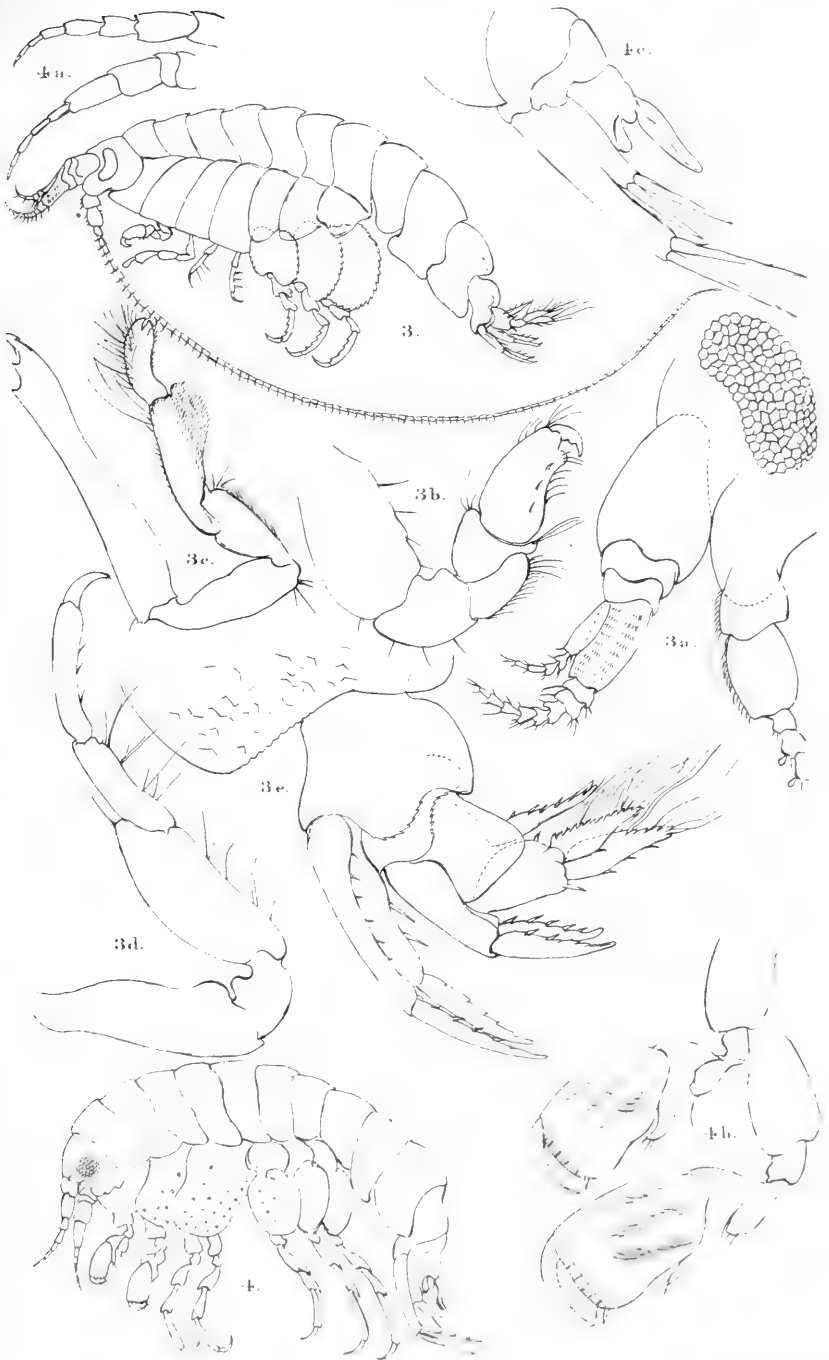
1E

1D

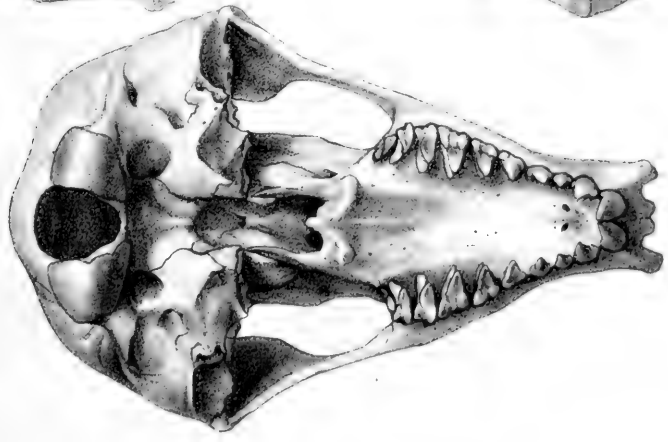
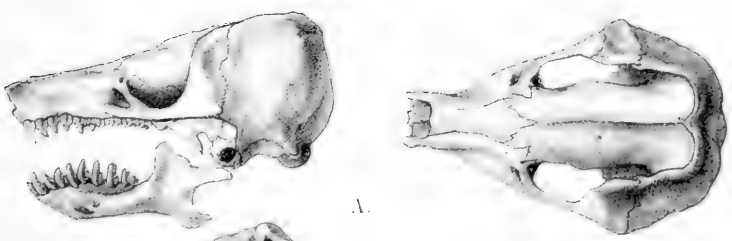
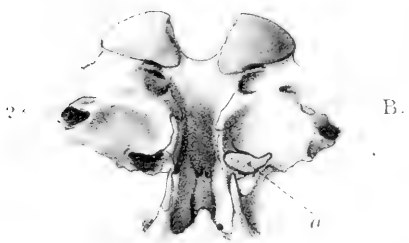
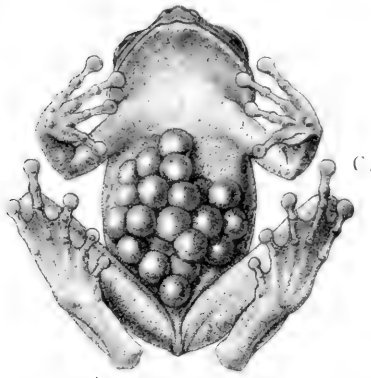












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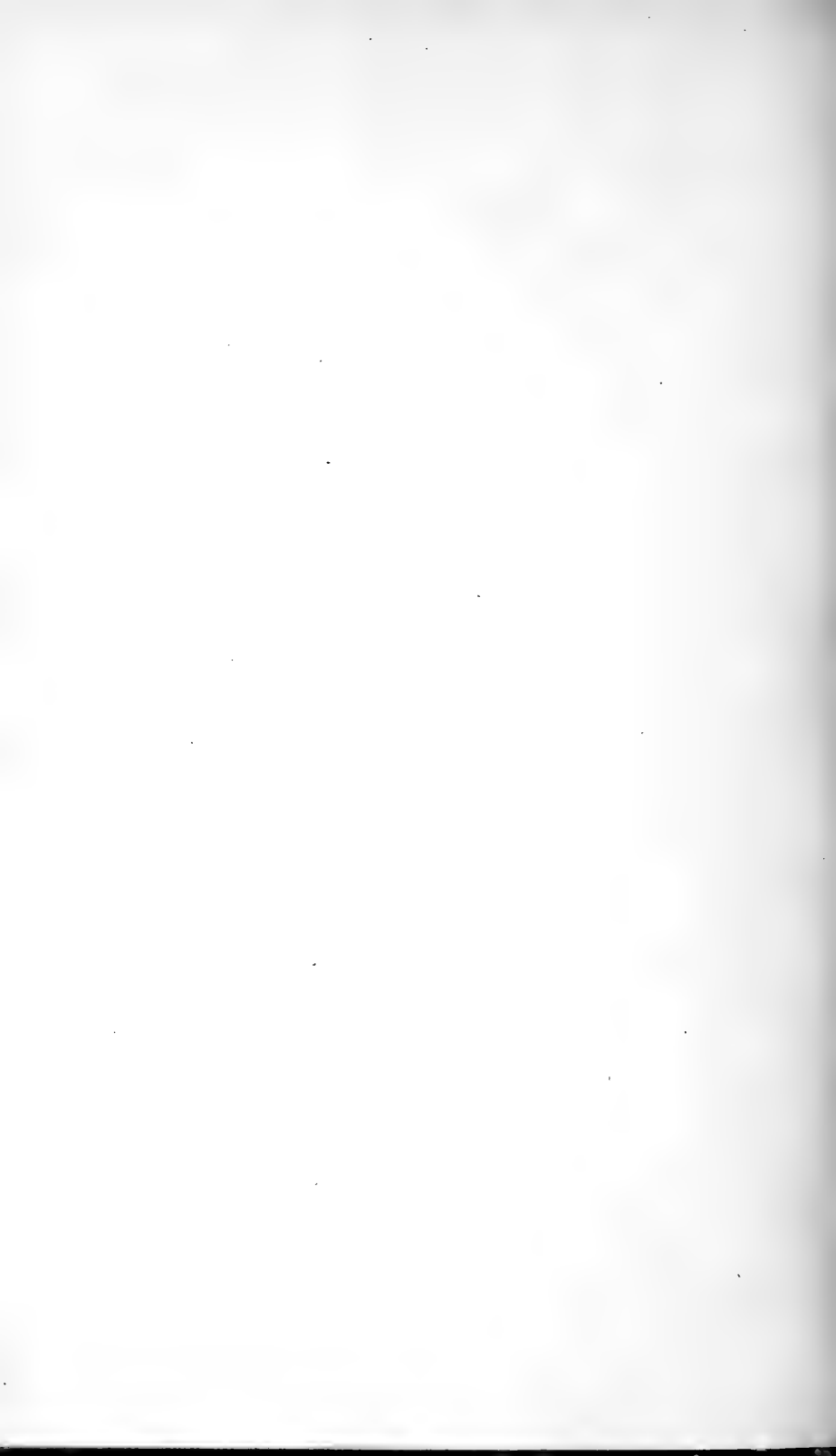
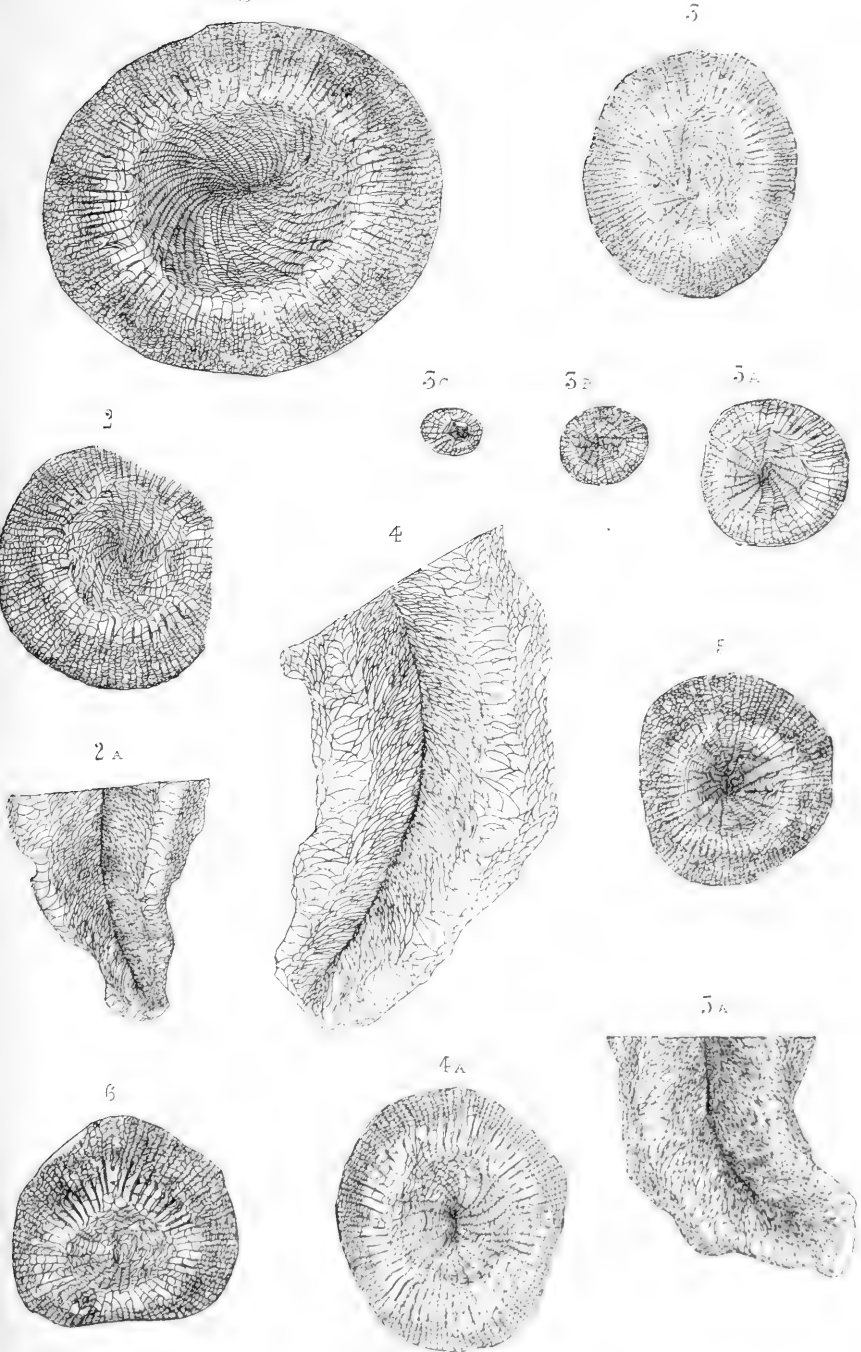


Fig 1



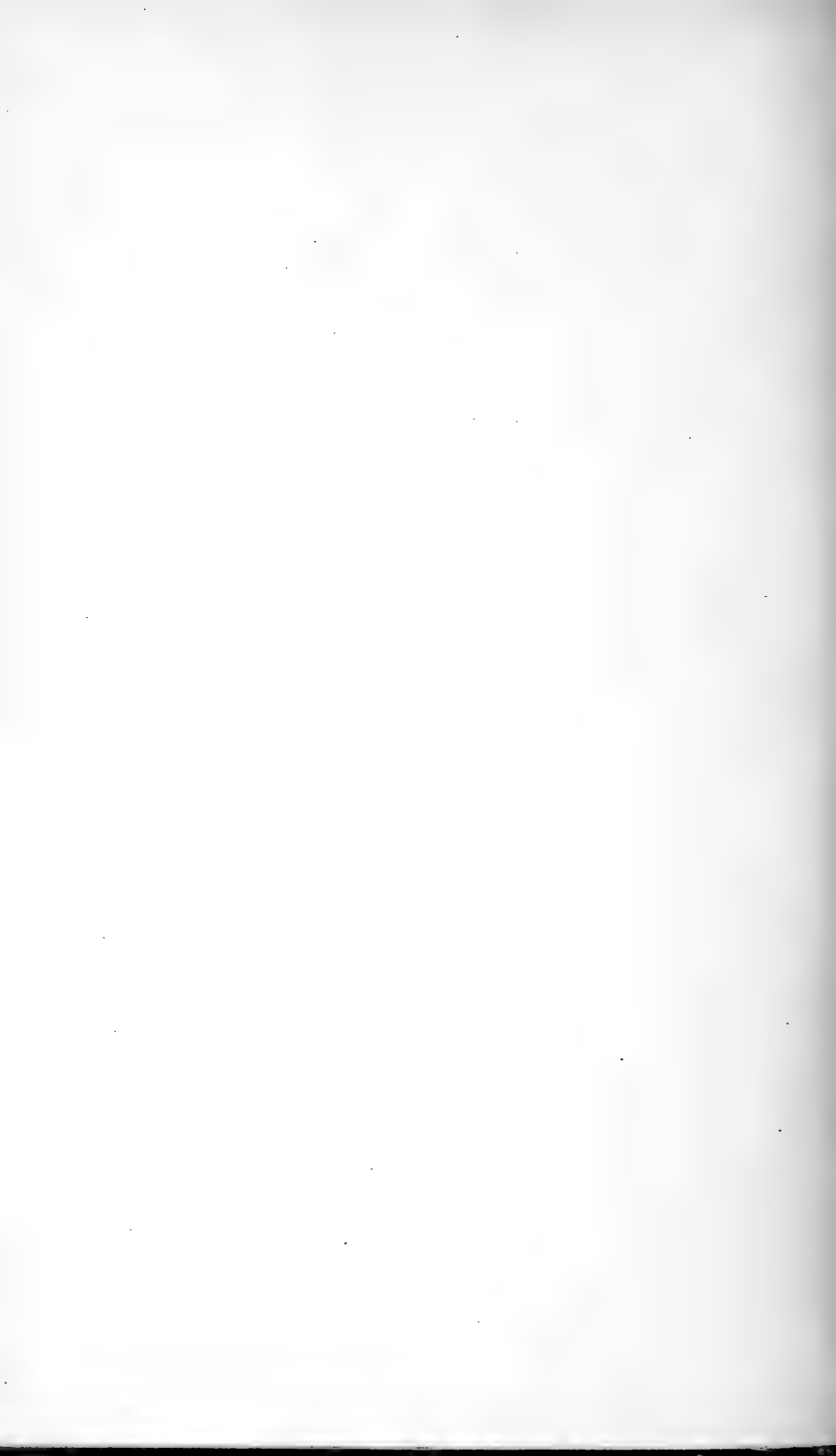
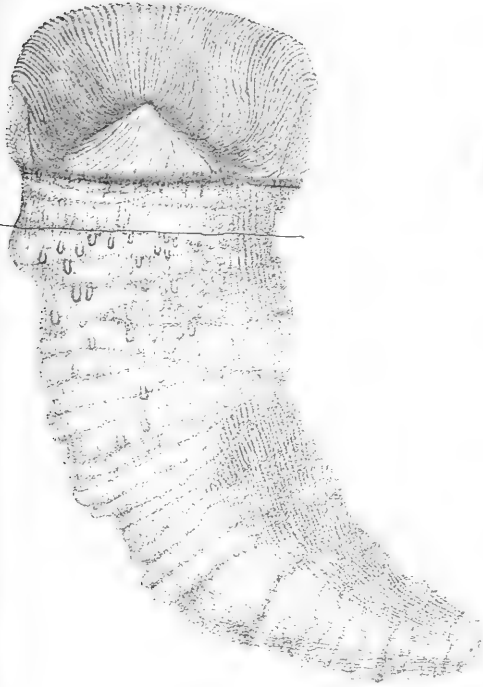
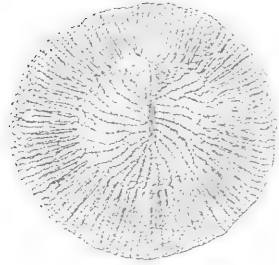


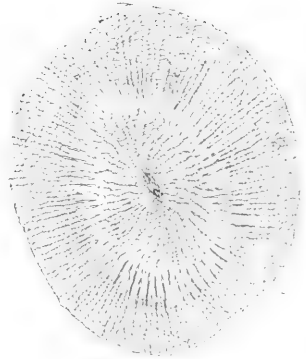
Fig 1



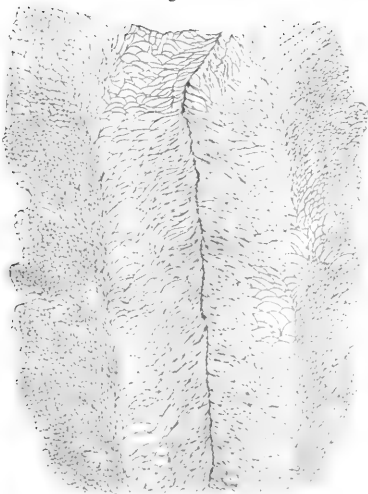
1A



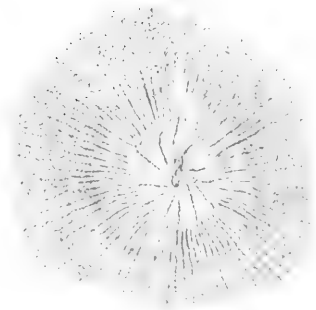
2



3



3A



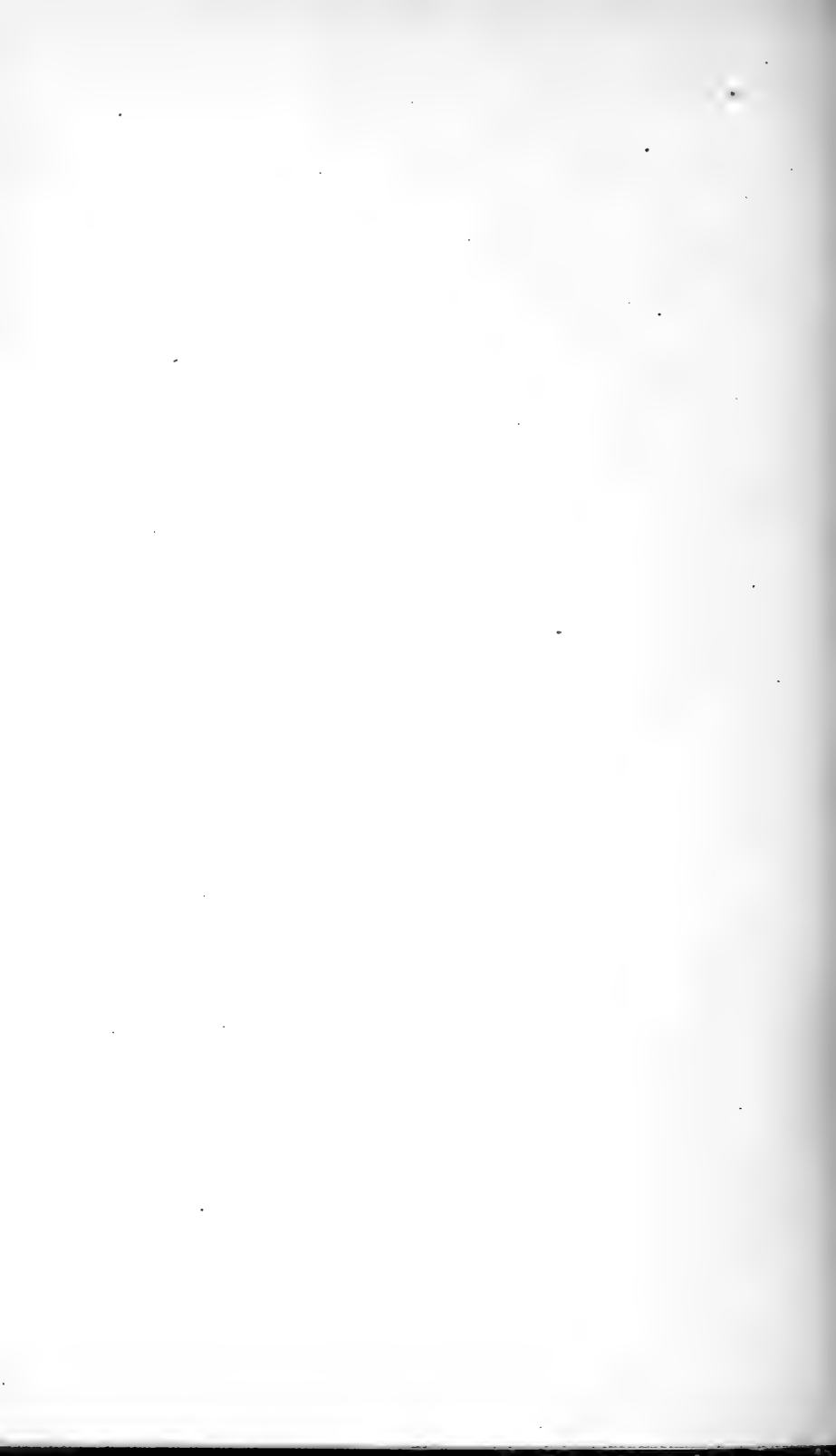


Fig. 1

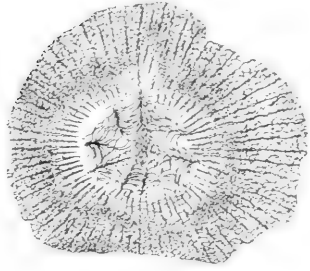


Fig. 2

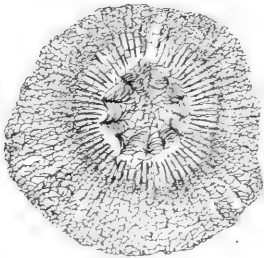
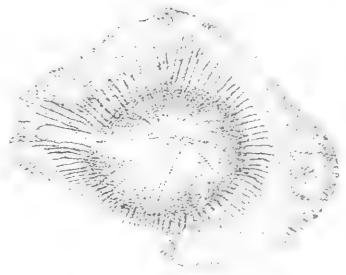


Fig. 3

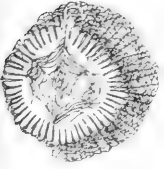


Fig. 4

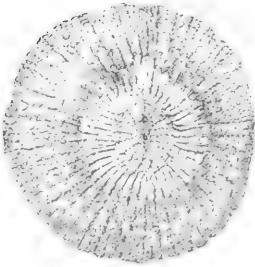
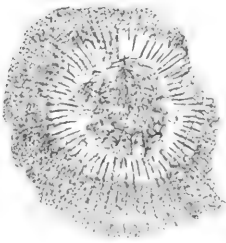
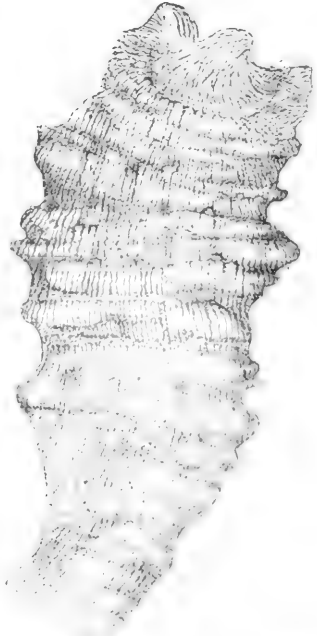


Fig. 5





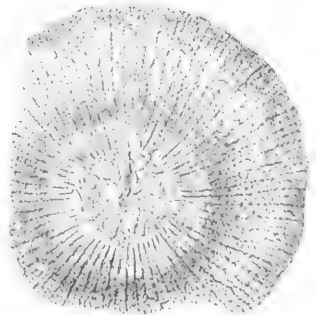
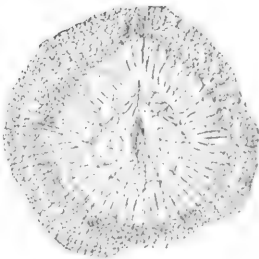
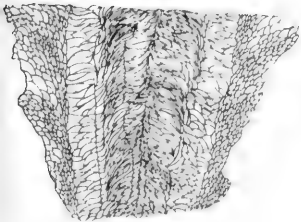
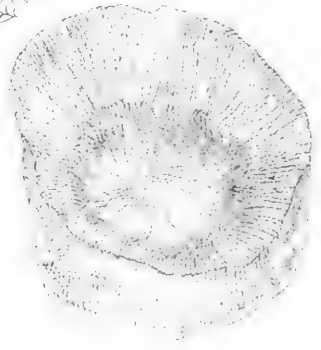
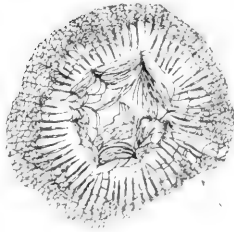
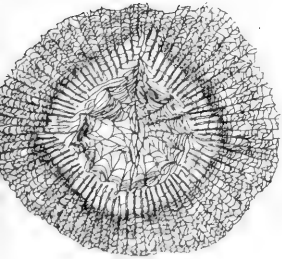
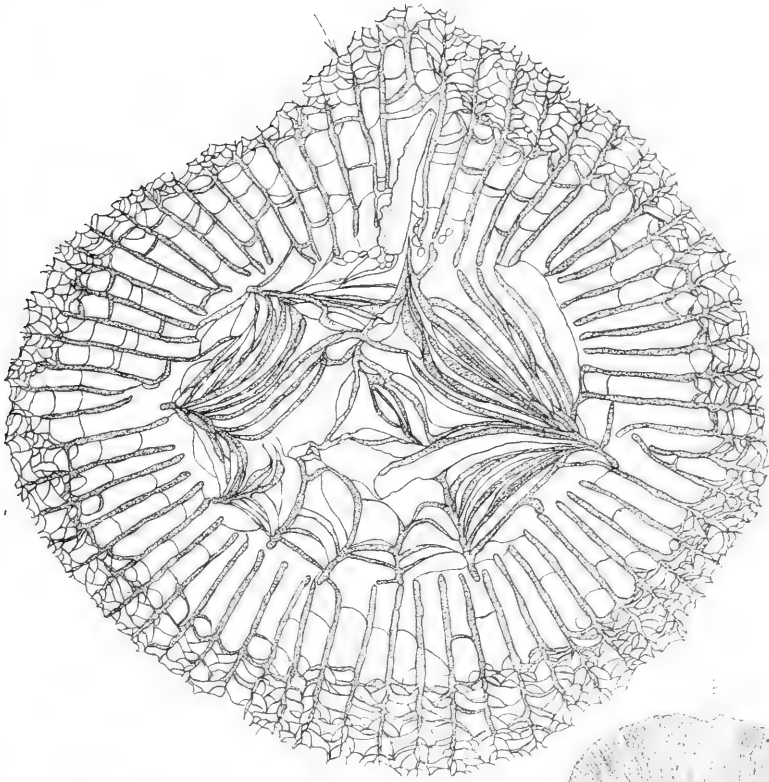
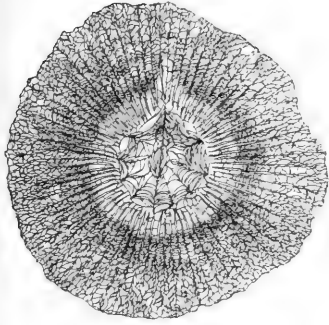
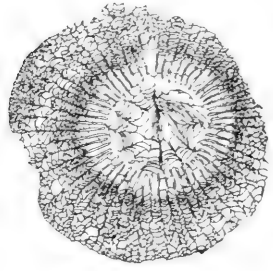




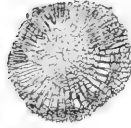
Fig 1



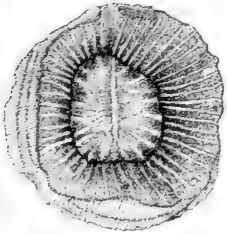
4



2



3



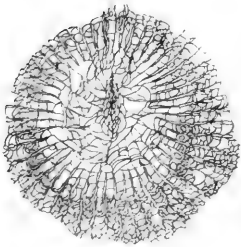
3A



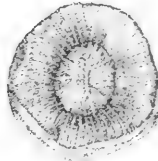
4A



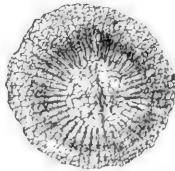
3A



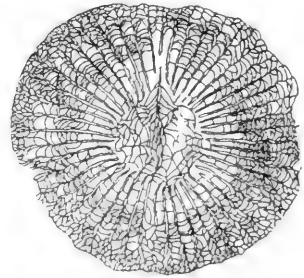
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