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I

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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RICHARD TAYLOR, F.L.S., F.G.S.

VOL. XVII.—SECOND SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMAN, BROWN, GREEN, AND LONGMANS; SIMPKIN, MARSHALL, AND CO.; PIPER AND CO.; BAILLIÈRE, REGENT STREET, AND PARIS: LIZARS, AND MACLACHLAN AND STEWART, EDINBURGH: HODGES AND SMITH, DUBLIN: AND ASHER, BERLIN.

1856.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

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

N. Parthenii Giannettasii Ecl. 1.

No. 97. JANUARY 1856.

I.—*On the Conjugation of* Cocconeis, Cymbella *and* Amphora; *together with some Remarks on* Amphiphora alata (?), Kg. By H. J. Carter, Esq., Assistant Surgeon H.C.S., Bombay.

[With a Plate.]

THE discovery of the mode of reproduction in the Diatomeæ through spores, though inferred by Kützing, is really due to Mr. Thwaites. The former, seeing some of the cells in *Meloseira* dilated like those of *Œdogonium,* considered it sufficient to declare that this was one way in which the Diatomeæ were propagated*; but Mr. Thwaites recognized the process fully in *Eunotia turgida* in May 1847†, and then first described and figured it most satisfactorily. He afterwards detected it in *Fragilaria pectinalis, Gomphonema minutissimum, G.* n. s. ?, *Cocconema lanceolatum* and *Cistula,* and in *Epithemia gibba*‡; and subsequently in *Meloseira varians* and *Borreri, Aulacoseira crenulata, Cyclotella*? *Kützingiana, Orthoseira Dickieii, Schizonema eximium, subco-*

* *Ap.* Meneghini "On the Animal Nature of Diatomeæ," &c., 1845. Eng. Trans. by C. Johnson, p. 369. Ray Society's Publications, 1853.

† Ann. and Mag. Nat. Hist. vol. xx. p. 9. pl. 4.

‡ *Idem*, p. 343. pl. 22.

hærens, vulgare and *neglectum*; and lastly in *Dickieia Danseii* *. Since that, no one seems to have added any more instances of this process of reproduction in the Diatomeæ, until Dr. J. W. Griffith noticed it in a species of "*Navicula* †;" and lately I have seen it in *Cocconeis Pediculus* (Kg.), *Cymbella Pediculus* (Kg.), and *Amphora ovalis* (Kg.), mihi, under such circumstances as to enable me to offer the following descriptions and figures of it respectively, in each of these genera.

Cocconeis Pediculus (Kg.). On the 4th of September, I perceived a brown incrustation extending over the sides of a basin in which *Nitella*, infested with *Fragilaria* and *Cocconeis*, had been kept for upwards of three months; and on examination with the microscope, it proved to be the latter, of different sizes, undergoing conjugation and deduplication.

The spore is formed by two of the smaller frustules, one of which is less in size than the other (Pl. I. fig. 1). These, after having become approximated, secrete a mucus which holds them together, while the lining mucus-membranes or primordial utricles respectively burst open the valves of their frustules (fig. 2), and approaching each other unite to form the spore (fig. 3); the latter then assumes a spherical form and the endochromes become mixed (fig. 4), after which the spherical form becomes elongated and finally elliptical (fig. 6); when, the endochrome also becoming scattered in more or less detached portions over the circumference, a single line appears, dividing the spore longitudinally into two somewhat unequal parts (fig. 7); two other lines then present themselves, one on each side the first (fig. 8); and the latter, passing into a groove, soon effects a deduplication of the spore, which then becomes divided into two sporangial frustules and thus the process is completed (fig. 9). Very soon after the spore has become spherical, the valves of the small conjugating frustule are thrown off, so that it is only now and then that they are seen; while the valves of the large one remain attached to it until deduplication commences. The large conjugating frustule bears to the sporangial frustule (fig. 11) the proportion of $\frac{1}{1733}$ to $\frac{1}{373}$ of an inch; at least these are their respective measurements.

Cymbella Pediculus (Kg.). On the 17th of August, after having had a matted portion of *Cladophora, Spirogyra* and *Oscillatoria* together in a basin for a few days, a number of *Cymbellæ* of different sizes left the filaments and came to the sides of the vessel, where they conjugated.

* Ann. and Mag. Nat. Hist. vol. i. p. 161. pls. 11 & 12, 1848.

† *Idem*, vol. xvi. p. 92. August 1855.

The spore is formed by two of the smaller frustules, one of which is less in size than the other (fig. 13). These, after having become approximated, first secrete around themselves a mucus in which they are thus imbedded. The commencement of the sporangial frustules is then indicated by two elliptical masses of endochrome appearing in the midst of this, parallel to and between the conjugating frustules (fig. 14); at least this is the earliest part of the process which I have observed. The sporangial frustules in which the endochromes are enclosed respectively, then become elongated (fig. 15); the transverse lines appear, the endochromes become scattered over their new habitations (fig. 17), and at length the frustules are formed (figs. 18, 19). By this time the mucus-investment and the valves of the conjugating frustules, which separate during the process, are thrown off, and the new frustules are thus liberated. The large conjugating frustule bears to the sporangial frustule (fig. 20) the proportion of $\frac{1}{630}$ to $\frac{1}{383}$ of an inch; at least, these are their respective measurements.

Amphora ovalis (Kg.), mihi. On the 31st of July, after a mass of that interesting form of *Spirogyra*, whose cells after division conjugate with each other, had spored and sunk to the bottom of the basin, with an *Oscillatoria* which was also present, several species of Diatomeæ multiplied upon the sides of the basin, among which were many frustules of *Amphora* of different sizes undergoing deduplication and conjugation.

The spore is formed by two of the smaller frustules, one of which is less in size than the other (fig. 21). These, after approximation (fig. 22), become invested in mucus, and, presently, exhibit their endochromes in two globular masses between them (fig. 23); elongation of the sporangial frustules which enclose these respectively takes place, transversely to the long diameter of the conjugating frustules (fig. 24); the former then assume a bent form towards each other, and the endochromes becoming irregularly scattered through them, they attain their utmost development (figs. 24–27). Meanwhile the valves of the conjugating frustules become separated, and two remain at the ends of the sporangial frustules, while the other two appear about their middle, one on each side (fig. 27). The mucus then becoming dissolved, the valves of the conjugating frustules are thrown off, and the sporangial frustules are thus set free. The large conjugating frustule bears to the sporangial frustule (fig. 28) the proportion of $\frac{1}{1733}$ to $\frac{1}{630}$ of an inch; at least, these are their respective measurements.

Observations.—Nothing can be more obvious in these processes, than that one point gained by the conjugating of the small frustules is the restoration of the largest size of the species; but perhaps not the most important point. In what way the small frustules are produced I am ignorant. Braun states that the effect of cell-division in the Diatomeæ is to reduce the size of the frustules *. This is evident enough in the cells of the *Spirogyræ*; and Meneghini has pointed out how it must be the case from the conico-truncate form of *Cocconeis*, where the plane of division is parallel to the base of the frustule †. But Braun deduces his opinion from what occurs in *Glœocapsa*, where "the size of the cells diminishes with the increasing magnitude of the family stock (*phytodon* ‡)," that is to say, that the last generations of cells are smallest.

That quantity should be required for restoring the size of the species, would appear from what takes place in the form of *Spirogyra* already noticed, where the original cell, after having been divided into four equal parts, ends in reuniting the contents of each contiguous two of these to form two new spores. Still more striking is the conjugation of two filaments of another species, where the cells of one happen to be divided into only two, and those of the other into four parts each. Here, although the conjugation is commenced as usual by active tubulation, the latter proves abortive; for the protoplasm of the large cells soon withdraws itself from the tube, and wraps its contents up into an elliptical spore of the normal size of the species; while the contents of every other small cell in the opposite filament (the intervening ones not sporing at all) also wrap themselves up into small globular spores respectively, but not without a strong attempt at first to mix with those of their opposite neighbour;—inasmuch as, in one instance, the tubulation of the small cell with the large one appeared to have been entirely formed by the former, whose contents had even passed a little way into the latter, but finding the spore formed in the large cell, were about to return to their own, or to remain where they were when I saw them in this position.

The rationale of this would at first appear to be, that the contents of the large cell found themselves sufficient in quantity to form the proper-sized spore,—which is the normal process in *Zygnema mirabile* (Hass.) §, while those of the small cell in the other filament found themselves in the opposite condition, and after making an attempt to mix with their opposite neighbour withdrew themselves, from finding no response, into their own

* "Rejuvenescence in Nature." Eng. Trans., by A. Henfrey: Botan. and Phys. Memoirs, published by the Ray Society, 1853. Foot-note, p. 132.

† *Loc. cit.* p. 406. ‡ *Loc. cit.* Foot-note, p. 131.

§ Hassall's British Freshwater Algæ, p. 156. pl. 25.

cell, and there wrapped themselves up into a small globular form*.

Again, in the conjugations above described, one frustule is always smaller than the other, as if only a certain quantity of cell-contents were required to make up the portion necessary for the reproduction of the new sporangia; and this is commonly the case also in the conjugation of *Spirogyra*, viz. that one cell is smaller than the other; while in *Cladophora*, the whole of the contents of a cell move towards one end of it, where they are condensed into the elliptical form of spore proper to this genus, without any cell-division or conjugation of separate compartments.

Hence it becomes questionable, whether the division of the cell has anything to do with the formation of the spore; while again it cannot be determined that the formation of the spore is the process ordained for the *perpetuation* of the species, until it be known in what this process essentially consists, or whether sporing is the only means of reproduction.

On comparing the spore-formations above mentioned with those described by Mr. Thwaites in the Diatomeæ, it will be observed, that *Cocconeis* agrees chiefly with *Fragilaria pectinalis*, whose single sporangium, developed from two small frustules, "is at first cylindrical, soon assumes a flattened, somewhat quadrangular form, and in many, but not in all cases, undergoes fissiparous division before it has put on the exact appearance of a frustule of the *Fragilaria* †."

The processes again in *Cymbella Pediculus* and *Amphora ovalis* respectively, agree with those of *Cocconema lanceolatum* ‡ and *Eunotia turgida* §. In the latter, the way in which the process commences is detailed by Mr. Thwaites, but nothing is said about it in the former; and although it is easy to conceive how the sporangial frustules in *Amphora ovalis* should be formed like those of *Eunotia turgida*, yet it is not so easy to conceive how the processes commence in *Cocconema* and *Cymbella*, where the sporangial frustules lie parallel with instead of across the conjugating ones; unless we assume that another act takes place, in which either the conjugating or the sporangial frustules turn round to obtain this position.

* Should these small spores develope a filament, the latter would probably be below the normal size of the species; though the original size might be gained by the whole of the contents of a single cell of this development, with or without those of the cell of another filament, passing into one new spore. In this way among the Zygnemaceæ, as well as among the Diatomeæ, species may be added to this family and subclass respectively which after all are mere varieties.

† *Loc. cit.* vol. xx. p. 334.

‡ *Loc. cit.* vol. xx. pl. 22 C. fig. 3, &c. § *Idem*, pl. 4.

Now it so happens that in one of the earliest states that was presented to me of the conjugation of *Amphora*, the endochromes were joined together in the form of the figure 8 (fig. 32), and I could not help coming to the conclusion that the endochromes of both frustules passed into one sporangium at first, instead of directly into two, as in *Eunotia*, and then became divided afterwards; or, that this was an accidental occurrence. If this is the normal process in both *Cocconema* and *Amphora*, then it is easy to conceive how the sporangial frustules become opposite each other in both instances, viz. by the division of the united endochromes taking place either parallel or transversely to the longitudinal axes of the conjugating frustules. We have something analogous to this in *Meloseira* and *Aulacoseira*, where the axis of elongation of the sporangium is parallel with the filament in the former, and at right angles to it in the latter; with the line of division of course the reverse in each *, that is, with the filament in *Aulacoseira*, and across it in *Meloseira*; corresponding in the former to *Amphora* and in the latter to *Cymbella*. Facts however are wanting to prove this conjecture.

I need hardly call attention to the difference in the size and forms of the conjugating and sporangial frustules which are represented in the Plate, or again remind the reader of what Mr. Thwaites has stated, viz. that the sporangial frustules, though very different from the conjugating ones at first, eventually assume a form very similar to them; this is effected by fissiparation, and equally applies to the endochrome as to the frustule. It is well seen in figs. 23–31. The relative size of the forms represented in the Plate has been preserved as much as possible, and each figure is taken from nature, with the exception of No. 2, which to supply a deficient link has been constructed upon No. 3 and other observations.

Amphiphora alata (?), Kg. Pl. I. fig. 33.

There are at least two species of this genus abounding in the back-waters of the island of Bombay, and as they do not appear to have been studied much in their living state, and have constantly come under my observation, I propose offering the following remarks on that one, which, if not identical with, is very nearly allied to the *A. alata* of Kützing †.

Frustule.—Oblong, truncate; primary surfaces closely approximated, lateral surfaces produced laterally and so compressed as to form a thin edge, which, being constricted in the centre,

* Thwaites, *loc. cit.* vol. i. p. 161. pl. 11. A 2, B 2.

† Species Algarum, p. 93. I regret that I have not his figures to determine this satisfactorily.

represents two alate, hyaline appendages on each side, thus giving the frustule the form of an hour-glass flattened. Valves forming the primary surfaces thick, oblong, truncate, sometimes striated (plicated?) longitudinally, closely approximated throughout, suddenly compressed and narrowed at each end, supporting on their sides the alate appendages mentioned. *Endochrome*: flat, double lozenge-shaped, connected; consisting of a single (?) layer, continuous, presenting a transparent area in the centre in which is the nucleus, and from which a few delicate branched threads radiate towards the sides of the frustule; chiefly confined to the central valves, but occasionally extending for a short distance into the hyaline appendages.

Movements.—Like those of Diatomeæ in general, but with a peculiar contortion, which brings one half of the frustule into right angles with the other. Deduplication, through the broad or primary surfaces. Size $\frac{1}{1200}$ to $\frac{1}{270}$ of an inch long.

Hab. The brackish water in that part of the main drain of Bombay which mixes with the sea at every tide; abounding in silty clots of *Oscillatoria* which float on the surface.

Observations.—A clot containing several hundred specimens of this species was placed in a small wide-mouthed bottle in the middle of December, where they continued to deduplicate up to the middle of the following June, by the vessel having been replenished from time to time with fresh water. Long before the last of these frustules were seen the whole of the other organisms had perished, and the remaining contents of the bottle, which might have been supposed to contain a number of them empty, on being examined, were found to contain none; hence it may be inferred that the frustules are not siliceous or coherent. The most striking feature about this species is its contortion (fig. 34), which from the thinness and flexibility of the alate expansions is effected to such a degree, that the narrow lateral edges, respectively, in one half, are brought almost into right angles with the primary or broad surface of the other; a phase which this Diatomean is continually assuming, and which, at first, is very difficult to understand. For some time I mistook it for an *Amphora* with one half of the frustule split open, and the edges turned back. The central valves are frequently marked with longitudinal lines (folds?), and fine lines may occasionally be seen cutting each other at acute angles across them; while a linear appearance also presents itself sometimes in the alate appendages parallel to their borders Fig. 37 shows all this; and sometimes their hyaline transparency is interrupted by white specks.

This species differs from the navicular forms in the general and greater flatness of its frustule, in the greater expansion of its alate appendages, and in the form of the endochrome, which, instead of being separated into two portions united through the intervention of the nucleus and its capsule, as in the navicular forms, and in *Naviculæ* generally, appears to consist of a single, continuous, thin layer like that of *Cocconeis Pediculus*. The lateral surfaces are not lanceolate ("*anguste lanceolata*"), as Kützing's description would seem to imply, and as they appear to be; for when it is remembered that they are mere margins formed in the way mentioned, it is evident that this cannot be the case; but that it is the margins of the central valves which present the lanceolate figure (fig. 35), more particularly in the navicular forms; while in the species under description they are suddenly compressed at the extremities, and laterally present the form of a bottle at each end (fig. 36). Hence I am inclined to doubt the identity of this with Kützing's *Amphiphora alata*.

Besides the two bright-looking tubercles (holes *) at each extremity of the frustule which mark the union of the lateral edges with the corners of the central valves, there are two other tubercles or holes, one on each side in the angle of constriction (fig. 36), and therefore corresponding in position to the hole or mark in the centre of the lateral surfaces of the *Naviculæ* †.

Deduplication takes place through the centre of the flat surfaces, and the new individuals, besides remaining together until they are fully formed, sometimes separate before this takes place, and then present the wing-like appendages on one side only. In fig. 38, where deduplication is nearly completed, the central valves respectively will as a matter of course be found to be much narrower than the one represented in fig. 32, where deduplication has not yet commenced.

EXPLANATION OF PLATE I.

N.B. The black shade in all the figures is intended to represent the endochrome.

Fig. 1. *Cocconeis Pediculus* (Kg.). The two conjugating frustules relatively magnified. The largest $\frac{1}{1733}$ of an inch long.

Fig. 2. Opening of the frustules and approximation of the primordial utricles with their contained endochromes. (Conjectural figure.)

Fig. 3. Union of the two utricles to form the sporangium.

Fig. 4. Spherical form of the sporangium.

Fig. 5. Elongation of ditto, and disappearance of the valves of the small frustule.

Fig. 6. Elliptical form of ditto, with the thin valve of the large frustule in front.

Fig. 7. Ditto, with the line of deduplication and the valves of both frustules still adherent.

* Kützing and Meneghini.

† Meneghini, *l. c.* p. 422.

Fig. 8. The line of deduplication becoming sulcated and two other lines appearing one on each side.
Fig. 9. Deduplication effected.
Fig. 10. Lateral view of sporangial frustule.
Fig. 11. Inferior view of sporangial frustule without endochrome, $\frac{1}{575}$ of an inch long.
Fig. 12. Oblique view of sporangial frustule after second or third deduplication. Lower individual.
Fig. 13. *Cymbella Pediculus* (Kg.). Conjugating frustules relatively magnified. The largest $\frac{1}{650}$ of an inch long.
Fig. 14. Union of ditto in secreted mucus; endochromes elliptical, parallel with frustules.
Fig. 15. First appearance of sporangial frustules.
Fig. 16. Transverse section showing the relative position of conjugating and sporangial frustules at this period.
Fig. 17. More advanced stage.
Fig. 18. Ditto, where the valves of the conjugating frustules have become divided. In this, as well as in figs. 15 & 17, one sporangial frustule is hid behind the other, as explained by fig. 16.
Fig. 19. Fully-formed sporangial frustules.
Fig. 20. Sporangial frustule after liberation from the sporangial mucus, &c., $\frac{1}{385}$ of an inch long.
Fig. 21. *Amphora ovalis* (Kg.), mihi. Conjugating frustules relatively magnified. The larger $\frac{1}{1733}$ of an inch long.
Fig. 22. Conjugating frustules approximated.
Fig. 23. Ditto disunited, but held together by mucus, in which is seen their endochrome divided into two spherical masses.
Fig. 24. Sporangial frustules appearing, and elongating transversely to the conjugating frustules.
Fig. 25. Ditto in a more advanced state, valves of conjugating frustules separating.
Fig. 26. Ditto with ditto, more separated.
Fig. 27. Sporangial frustules formed; two valves of the conjugating frustules remaining in the centre, and one at each end.
Fig. 28. Sporangial frustule liberated, $\frac{1}{650}$ of an inch long.
Fig. 29. Ditto undergoing deduplication.
Fig. 30. Ditto after having undergone one or two deduplications, and again about to deduplicate.
Fig. 31. Conjugating frustule about to deduplicate; here inserted for comparison with fig. 30.
Fig. 32. Supposed preliminary state to fig. 28; endochrome fissiparating.
Fig. 33. *Amphiphora alata* (?) (Kg.): shows the broad side of the frustule, the form of the central cavity, and the shape of the endochrome, with terminal and lateral foramina.
Fig. 34. Ditto under contortion.
Fig. 35. Oblique view without the endochrome, showing the two component parts of the frustule.
Fig. 36. Lateral view without endochrome, showing lateral aperture.
Fig. 37. Different forms of lineolation occasionally seen on the surface.
Fig. 38. Deduplication; complete separation of the individuals not effected.

II.—*Description of a new Species of* Clausilia *from the neighbourhood of Cheltenham.* By A. Schmidt.

To the Editors of the Annals of Natural History.

Gentlemen, 23 Chesham Place, Dec. 12, 1855.

The following translation of a notice which I have just received in Latin from the well-known German malacologist, Dr. Schmidt of Aschersleben, the collaborateur of Pfeiffer, Rossmässler, and Menke, will, I think, not be unacceptable to the readers of your Journal. At all events, it may direct the attention of British conchologists to an interesting subject of inquiry, and enable us to decide whether the species in question is henceforth to be considered as British or not.

I am, Gentlemen,
Your obedient servant,
Wm. J. Hamilton.

Amongst the shells which I have received from the neighbourhood of the town of Cheltenham, I have found *Clausilia Mortilleti*, Dumont. As this shell was published by the author only about two years ago (Bulletin de la Société d'Histoire Naturelle de Savoie, 1853, p. 78, according to Charpentier), I do not know whether it has yet been noticed by English malacologists. The author's specimens, found in the district of Valenciennes (Quénoy near Valenciennes, Département du Nord), at Lyons, at Löwenburg near Bonn, at Schieder near Pyrmont, and at Wölfelsfall in Silesia, have been forwarded to me, as well as the unique specimen from Cheltenham. It is not therefore probable that this species is on the whole confined to a narrow district, or that it should live in the single locality alone which we have mentioned in England. In order that we may as soon as possible know more about its distribution, I offer the following description of it to the notice of English naturalists.

Clausilia Mortilleti, Dumont.

T. subrimata, ventroso-fusiformis, confertim costulato-striata, corneofusca, sericea; anfr. 10–11, convexiusculi, ultimus basi distincte carinatus; apertura rhomboideo-pyriformis; lamella infera profunda, sæpe antice ramosa, supera producta cum spirali juncta; lunella arcuata; plica palatalis 1 supera, subcolumellaris vix emersa; spatium interlamellare plerumque plicatulum; peristoma continuum, breviter solutum.

Long. 14, diam. 4 millim. Apert. $3\frac{1}{2}$ long., $2\frac{1}{3}$ lata.

This species is easily distinguished from all those forms which are so closely allied both to *Cl. ventricosa,* Drap., and *Cl. lineolata,* Heldr., and *Cl. plicatula,* Drap., by the circumstance that the striæ at the back of the throat (cervix) are rather more distant from each other than the striæ of the penultimate whorl. It is distinguished from *Cl. ventricosa* both by its smaller size and the interlamellar plaits (for the true *Cl. ventricosa* never has them); from *Cl. lineolata,* Heldr. (*basiliensis,* Fitzinger), and the other forms allied to *Cl. plicatula,* both by a distinctly marked keel bounded on each side by grooves, and by the absence of the palatal callosity. Nor does it ever possess the rudiment of a lower palatal fold so peculiar to *Cl. lineolata.* We shall enter more fully into this subject in the iconographic monograph which we have undertaken to write on the *Clausiliæ* allied to *ventricosa, plicatula, rugosa,* and *parvula.*

Adolf Schmidt.

Aschersleben, Oct. 1855.

III.—*Memoir on the Indian species of Shrews.* By Edward Blyth, Esq.* *With Notes by* Robert F. Tomes, Esq.

As an incentive to the investigation of some of the most imperfectly known of Indian Mammalia, and not the most inviting of groups to amateur students, we shall here endeavour to bring together, and to reduce or digest into intelligible form and order, the scattered materials available for a monograph on the Indian Shrews.

It may lead to the discovery of additional real species, and probably to the diminution of the number of present supposed species; besides conducing to the further elucidation of those at present known and recognized, and especially to a better knowledge of the extent of their geographical distribution.

In general the Shrews of tropical and subtropical countries are distinguished by their comparatively large size, and slaty hue of every shade from pale grey to black, with rufous tips to the fur more or less developed, though in some scarcely noticeable †; the ear-conch is conspicuously visible above the fur; the tail thick, tapering, and furnished with scattered long hairs, which certain species also exhibit on the body; and the teeth are wholly white ‡, and of the following type of structure.

The superior front teeth or *quasi-incisors* (vide J. A. S. xx. 164)

* From the Journal of the Asiatic Society of Bengal.

† In at least some species, the rufous tips appear to increase with age; and, to a considerable extent, the colour of these animals is darker according to the increase of altitude inhabited by a species.

‡ While preparing this memoir, we discovered a remarkable exception in the instance of *Sorex melanodon*, n. s.

are large and strongly hooked, and much longer than their posterior spur; while the inferior have rarely so much as a trace of a serrated upper edge: of four upper premolars anterior to the *carnassier*, the first is large, the second and third are much smaller, the fourth is diminutive, and the third exceeds the second. This group of Shrews is familiarly exemplified by the common large Musk Shrews of Asia and Africa, and constitutes the restricted SOREX, L. (v. *Pachyura*, De Selys Longchamps*).

The Indian species are as follows:—

1. S. CÆRULESCENS, Shaw; *S. pilorides*, Shaw; *S. giganteus*, Is. Geoffroy; *S. murinus*, L., apud Gray: figured in Hardwicke's Ill. Ind. Zool. as *S. myosurus*, Pallas; whence probably *S. myosurus*, apud Walker, in Calc. Journ. Nat. Hist. iii. 255. The common Musk Shrew, or (*vulgo*) 'Musk Rat,' of Bengal, &c. (but different from the 'Musk Rat' or *Muskquash*—FIBER ZIBETHICUS of North America, which is a rodent nearly affined to the Voles—ARVICOLA).

This animal is described by Mr. Hodgson in the Ann. & Mag. Nat. Hist. xv. 269 (1845); but the length of the tail (as given), $3\frac{1}{8}$ in., is possibly a misprint for $3\frac{5}{8}$ or $3\frac{7}{8}$ in., or more than half the length of the head and body, which is given as 6 in. Number of caudal vertebræ 24. Total length of skull of adult male, with front teeth *in situbus*, somewhat exceeding $1\frac{5}{8}$ in.; of female, somewhat under greatest breadth of skull of former, $\frac{11}{16}$ in.; of latter $\frac{5}{8}$ in. Colour uniform pale grey, slightly tinged with ferruginous, and more conspicuously on the lower parts; the naked parts flesh-coloured.

This is the common large Musk Shrew of Bengal, Nepal, and we believe the valley of Asám; becoming rare in Sylhet, and wholly disappearing in Arakan. In Nepal Mr. Hodgson styles

* Certain small species of temperate climates were detached by Wagler from the ordinary Shrews of those climates (with piceous-tipped teeth, &c.) by the name of CROCIDURA (v. *Suncus*, Ehrenberg, apud Gray), *e. g.* S. ARANEUS, S. LEUCODON, S. ETRUSCUS, &c.; but we are not aware that these are separable from the above, and certainly the various Pigmy Shrews of India are typical SORICES, except that some only of them want the odoriferous glands on the sides of the body.

N.B. In the 'Report on the Quadrupeds of Massachusetts,' published by the Government Commissioners of the Zoological and Botanical Survey of the State (1840), the extraordinary statement is made by Mr. E. Emmons, that "In the specimens of SOREX which have fallen under my observation, I have not been able to discover, even with the microscope, any nostrils, the termination (or extremity) of the nose being apparently an imperforate membrane." Upon reading this we examined several species (large and small) preserved in spirit, and easily detected a lateral valvular orifice, which, on pressure of the snout above, was shown to be perforate, by the fluid oozing through. Could Mr. Emmons have tried so simple an experiment?

it "the common House Shrew of the plains, and also of the hills up at least to 6000 feet." We have seen specimens from the neighbourhood of Agra; but whether it be the common Musk Shrew of South India is doubtful on present evidence, though Dr. Kelaart's description of the Cingalese animal corresponds. It certainly does not appear to inhabit the eastern coast of the Bay of Bengal, from Arakan to the Straits of Malacca. Dr. Horsfield gives as its habitat "India generally, and the eastern islands;" and he notes a specimen from Butan presented to the India-House collection by Major Pemberton. We suspect that its reputed existence in the Malay countries needs confirmation.

In addition to the names above cited, Dr. Gray in his Catalogue of the specimens of Mammalia in the British Museum (1843) refers the following name and synonyms to this species: S. MURINUS, L.; *S. myosurus*, Pallas; *S. indicus* et *S. capensis*, Geoffroy; *S. Sonneratii*, Is. Geoffroy; *S. crassicaudatus*, Lichtenstein; *S. nipalensis*, Hodgson, and *S. moschatus*, Robinson. The last two are merely MS. names; and indeed the zoological appellations in Mr. W. Robinson's 'Descriptive Account of Asam' are given pretty much at random, and would establish a most extraordinary community of species among the Mammalia of that country and of Europe! He gives, "Genus MYGALE. *Sorex moschatus*, Cuvier. The common Musk Rat." Now *Sorex moschatus*, L. (nec Cuvier), is the type of the genus MYGALE of Cuvier; altered to MYOGALEA, Fischer (*Myogale* apud Rüppell), because pre-occupied by Linnæus for a well-known genus of spiders; and MYOGALEA MOSCHATA is a Russian animal, generically differing from Mr. Robinson's Musk Shrew. Nevertheless his adoption of the term *moschatus* would seem to indicate the rankly-smelling S. CÆRULESCENS rather than S. MURINUS (v. *myosurus*), which is the only Shrew mentioned in Prof. Walker's list of the Mammalia of the same province.

S. INDICUS, Geoffroy, v. *S. Sonneratii*, Is. Geoffroy, is accepted as a distinct species from S. CÆRULESCENS in Dr. Horsfield's Catalogue of the specimens of Mammalia in the India-House Museum (1851); and a specimen is noted from the Dukhun, presented by Col. Sykes, and the following habitat given for the species—"Continent and islands of India." Col. Sykes terms it the *Chuchouder* of the Mahrattas; being the same name which is applied to S. CÆRULESCENS in Bengal, spelt *Choochundr* by Dr. Cantor (J. A. S. xv. 191); and the latter author gives "*Chinchorot* of the Malays of the Peninsula," as the name of the very distinct species referred by him and others to S. MURINUS, L.; which latter was originally described from Java. According to Col. Sykes these troublesome and disagreeable animals are very numerous in Dukhun, but much more so in Bombay. The sebaceous glands in an old male were observed to be very large, and the odour of musk from them almost insupportable; while in an adult female the glands were scarcely discernible, and the scent of musk very faint. [It is tolerably strong in the female of S. CÆRULESCENS; though more or less so, perhaps, with reference to sexual condition.] "The SOREX INDICUS and S. GIGANTEUS," it is added, "are regarded by Col. Sykes as specifically identical, he having killed them in the same room, and seen them frequently together." (P. Z. S. 1831, p. 99.) Prof. Schinz accordingly assigns S. GIGANTEUS, Geoff., Ann. du Mus. xv. pl. 4. f. 3, as a synonym of S. INDICUS; but the reference is erroneous, the 'Mémoires du Muséum,' tom. xv. (to which we have not access) being probably intended. S. GIGANTEUS, Is. Geoff., Voy. de Bélanger, refers to *S. cærulescens* of Bengal.

According to M. Isidore Geoffroy, the S. INDICUS (his *S. Sonneratii*) is a smaller animal than S. CÆRULESCENS (his *S. giganteus*), with tail forming always *a quarter* of the entire length. Length of head and body of adult a little under 4 in. (Fr.). Fur ashy, washed with russet-brown, and pale ashy below. Inhabits the Coromandel coast and also the Mauritius. If truly a distinct species from S. CÆRULESCENS, its natural habitat is probably W. India; but we have vainly sought for information of such an animal.

In Dr. Rüppell's printed Catalogue of the specimens of Mammalia in the Frankfort Museum (1842), examples referred to S. INDICUS, L. (Fr. Cuv. Mamm. ii. t. 28), are noted from Java, and also from Massoua and from Suez; and a supposed variety, termed by him S. INDICUS, var. *cinereo-ænea*, from Schoa; and he elsewhere suggests that these animals have probably been introduced by the shipping from S.E. Asia and its islands, and so found their way even to Schoa, where a different climate had effected the colouring of the fur. On ship-board they could of course subsist on *Blattæ*; but their presence (certainly that of the fœtid *S. cærulescens* of Bengal) would scarcely escape remark, the more especially as that of a single individual might seriously damage a whole cargo; besides the obvious necessity of both sexes being required to continue the race, a condition most likely to be fulfilled by the conveyal of a pregnant female with her future litter of some five or six. S. CRASSICAUDUS (nec *crassicaudatus*), Lichtenstein, refers to a Musk Shrew inhabiting Egypt, and stated to be common about Suez, which may therefore be presumed identical with Dr. Rüppell's S. INDICUS from Suez; and the description certainly seems to approximate that of S. CÆRULESCENS (length $5\frac{1}{2}$ in.; tail $2\frac{3}{4}$ in.): and S. CAPENSIS, Geoffroy, is termed S. FRANCINUS by Prof. Schinz, who gives Mauritius as its habitat (length 3″ 8‴; tail 1″ 9‴). The most notable identification is that of Dr. Rüppell's specimens from E. Africa and from Java, presuming the latter to be really from that island.

2. S. MURINUS, L.; *S. myosurus,* Pallas; *S. cærulescens,* var., Raffles; *S. Griffithii* (?), Horsfield; the common Malayan species originally described from Java, and by Dr. Cantor in J. A. S. xv. 191, and thus denominated by him after Prof. Schinz (Synopsis Mammalium), who states it to inhabit Java, Sumatra, Borneo, Celebes, Amboyna, *Japan, Bengal, Abyssinia,* and the *Cape of Good Hope.*

We have *italicized* the habitats which probably need verification: and the Society possesses specimens from the Arakan and Khásya Hills, which accord with Dr. Cantor's description, *l. c.*; but less so with M. Geoffroy St. Hilaire's figure in the Annales du Muséum d'Histoire Naturelle, tom. xvii. pl. 3. f. 2, which may nevertheless be intended to represent the same species. As compared with a mature female from Arakan, taken out of spirit, the ears in M. Geoffroy's figure are represented too small, and neither the snout nor tail is sufficiently elongated. Length of this Arakan female—head and body 5 in., and tail 3 in.; hind-foot (with claws) $\frac{7}{8}$ in. Unfortunately we have no Malayan specimen for actual comparison; but there is every reason to suspect that this species replaces S. CÆRULESCENS along the whole eastern coast of the Bay of Bengal, and thence through the hilly country northward to that skirting the valley of Asam. Dr. Horsfield mentions a Nepalese specimen presented to the India House by Mr. Hodgson; but this species is unnoticed in the latter gentleman's Catalogue of Nepalese animals, and especially in his descriptive notices of the Nepalese Shrews, Ann. & Mag. Nat. Hist. xv. 269.

With the exception of the small S. TENUIS, S. Müller, from Timor, it appears to be the only well-established species of Shrew throughout the great Oriental archipelago. In the Tenasserim provinces, the Rev. J. Mason states—"We have at least two species of Musk Shrew, both of which emit an offensive odour." (Qu. S. MURINUS and S. SERPENTARIUS?) In S. MURINUS, according to Dr. Cantor, "the smell of musk emitted by the adult animal, and which in the young is barely perceptible, is much less intense than in the Bengal Musk Shrew." S. SERPENTARIUS, according to Dr. Kelaart, has a powerfully offensive musky odour. S. MURINUS has longer ears than S. CÆRULES-

CENS; and Dr. Cantor describes it as—"Dark brownish-grey above, beneath light brownish-grey. Feet and tail flesh-coloured in the living animal, changing to cinereous after death. In the young the colour is more of a bluish-grey, slightly mixed with brown on the back." A stuffed specimen from the Khasya Hills has the fur longer and less dense than in S. CÆRULESCENS, the piles somewhat curly, and colour dark ashy at base, with rufous-brown tips, which give the prevailing hue. A most obviously distinct species from S. CÆRULESCENS.

We suspect that *S. Griffithii,* Horsfield, of that naturalist's Catalogue of the specimens of Mammalia in the Honourable Company's Museum, is no other than our presumed MURINUS from the Arakan and Khasya Hills, although described from Afghanistan, because we saw a fine skin from Cherra Punji in the possession of the late Mr. Griffith, which was forwarded to the India House by Mr. M'Clelland; and we have previously had occasion to remark, that specimens of reptiles procured by Mr. Griffith in Afghanistan and in the Khasya Hills, had manifestly become mixed and confounded; whence certain important mistakes concerning habitats*. *S. Griffithii* is described to be affined to S. MURINUS; "but differing essentially by the uniform deep blackish-brown tint, and the shortness, delicacy and softness of the fur. Colour deep blackish-brown throughout, with a slight rufous reflection in a certain light. Length of head and body, $5\frac{3}{4}$; tail, $2\frac{1}{2}$ in."—Horsfield's Catalogue.

[From a careful examination of the specimens of S. CÆRULESCENS and *S. indicus* mentioned by Dr. Horsfield in his Catalogue of the Mammalia in the Museum of the East India Company, I am quite persuaded that they are identical, the latter differing from the former in having the fur of the back somewhat more tinged with rufous, and the animal in its mounted state being rather smaller, but the head, teeth and feet are of similar dimensions. With respect to the comparative length of the tail, no safe conclusion can be formed from specimens from which the bone has been extracted, and the form reproduced according to the fancy of the stuffer.

The specimen of S. MURINUS above alluded to by Mr. Blyth differs only from the above-mentioned species in having the fur much longer, being nearly twice the length, amounting to 4‴, whilst the fur of S. CÆRULESCENS scarcely exceeds 2‴ in length. The colour also is somewhat darker and browner.

The dimensions of the three specimens in Dr. Horsfield's Catalogue are as follow :—

* Vide J. A. S. xxii. 413.

	S. cærulescens.	*S. indicus.*	*S. murinus.*
	$''$ $'''$	$''$ $'''$	$''$ $'''$
Head and body about...	6 6	......	......
Head	1 8	1 7	1 7½
Tail	2 10	2 2	2 6
Fore-arm	10	......	......
Fore-foot	5½	6½	......
Tarsus and toes	9	9¼	9

S. Griffithii is a perfectly distinct and well-marked species, remarkable for the *large size of its teeth,* which exceed those of every example of the great S. cærulescens I have yet seen. I cannot concur with Dr. Horsfield in considering the fur as either short, close or soft, but describe the species thus—Fur of medium length, deep blackish-grey, glossy and rather coarse; ears smaller and more hidden than in S. cærulescens. Front teeth very large. Head and body about 5″ 9‴. Head 1″ 7‴ or 8‴. Tail 2″ 5‴. Fore-arm 9‴. Fore-foot 6½‴. Tibia 11‴. Hind-foot 10½‴. Length of lower incisors 3⅓‴.—R. F. T.]

3. S. serpentarius, Is. Geoffroy; *S. kandianus,* Kelaart. Described in J. A. S. xxi. 350, from a skin sent by Dr. Kelaart, as "the large godown Shrew of Kandy," though scarcely corresponding with his indications, J. A. S. xx. 164, 185. A second skin of precisely the same species, and also an adolescent specimen entire in spirit, were subsequently forwarded from Mergui by Capt. Berdmore, as noticed in xxii. 412. In both adults the tail (vertebræ) measures $2\frac{1}{8}$ in.; and the head and body (allowing for some extension of the skin) about $4\frac{1}{2}$ in. "The Kandyan specimen is more rufescent than the others, but we can perceive no further difference whatever; indeed, to judge from the two Mergui examples, it would seem that this animal becomes more rufescent with age." Dr. Kelaart states that its odour is as offensive as that of the large Musk Shrew of Ceylon. The Coromandel coast and the Mauritius are given as its habitats. Colour duskyish grey, with dark rufous-brown tips to the fur, more or less developed according to age, and the under parts somewhat paler.

4. S. soccatus, Hodgson, Ann. & Mag. Nat. Hist. xv. 270. A Sikim specimen which we refer to this species bears considerable resemblance to the last, but is a good deal darker, with well-clad feet and tail, and the head and limbs are proportionally larger. Entire length of skull with front teeth *in situbus* $1\frac{5}{16}$ in.; breadth $\frac{9}{16}$ in. (nearly); entire range of upper teeth $\frac{5}{8}$ in.; ditto of S. serpentarius barely exceeding $\frac{1}{2}$ in. Tail (vertebræ) $2\frac{3}{16}$ in.; compressed towards tip, which is furnished with a pencil-tuft of stiffish hairs. Mr. Hodgson thus describes his

animal—"Size and proportions of S. NEMORIVAGUS, H. (nearly), but distinguished by its feet being clad with fur down to the nails, and by its depressed head and tumid bulging cheeks (mystaceal region). Ears large and exposed. Colour a uniform sordid or brownish slaty-blue, extending to the clad extremities. Snout to rump $3\frac{1}{2}$ in.; tail $2\frac{1}{8}$ in.; planta $\frac{13}{16}$ in. This animal was caught in a wood plentifully watered, but not near the water. It had no musky smell when brought to me dead." *Hab.* Nepal and Sikim.

[For further remarks on the synonymy of this species, see a note appended to the account of *Soriculus nigrescens*.—R. F. T.]

5. S. NEMORIVAGUS, Hodgson, Ann. & Mag. Nat. Hist. xv. 269. Differs from the ordinary type "by a stouter make, by ears smaller, and legs entirely nude, and by a longer and more tetragonal tail. Colour sooty-black, with a vague reddish smear; the nude parts fleshy-grey. Snout to rump $3\frac{5}{8}$ in.; tail 2 in.; planta $\frac{11}{16}$ in. Found only in woods and coppices." Nepal. According to Dr. Gray, an example presented to the British Museum by Mr. Hodgson, as of this species, "is probably only a half-grown specimen of S. MURINUS" (*i. e.* CÆRULESCENS)! * The foregoing description should indicate a very different animal, but which might be mistaken for the young of S. MURINUS (*verus*), and such probably is the supposed S. MURINUS from Nepal of Dr. Horsfield's Catalogue.

[See the note on this last-mentioned species.—R. F. T.]

6. S. HETERODON, nobis, n. s. Very similar to S. SOCCATUS in general appearance, but less dark-coloured, with shorter fur, and pale instead of blackish feet and tail underneath; the feet, too, are broader, especially the hind-feet, and they have a hairy patch below the heel. The skull, of the same length as in S. SOCCATUS, and with equally large teeth, is much more narrow, and the upper quasi-incisors are conspicuously less strongly hooked than in that and other typical SORICES. From Cherra Punji in the Khasya Hills.

7. S. NIGER, Elliot; described in Dr. Horsfield's Catalogue (1851). "Length of the head and body $3\frac{1}{2}$ in.; of tail $2\frac{1}{2}$ in. Tail equal in length to the entire animal, exclusive of the head, gradually tapering to a point. Snout greatly attenuated. Colour

* We made a description of the identical specimen before it was taken by Mr. Hodgson to England, viz.—"Of a shining rufescent-brown colour, merely weaker on the under parts. Length $3\frac{1}{2}$ in.; of tail $1\frac{7}{8}$ in.; fore-feet and claws $\frac{3}{8}$ in.; the claws alone $\frac{1}{8}$ in., and of a yellow colour, perhaps whitish in the fresh animal; hind-feet and claws $\frac{5}{8}$ in."

blackish-brown, with a rufescent shade to the upper parts; abdomen greyish. From Madras." (Qu. Madras Presidency?)

[S. NIGER, Elliot, appears like a miniature S. GRIFFITHII, but with a long and slender tail. To the description given by Dr. Horsfield, I may add, that the tail, although long and slender (thus differing from the larger examples of this section), has the scattered stiff hairs observable in the species with stout tails, such as S. CÆRULESCENS and S. GRIFFITHII. Fur deep blackish-grey, tipped with glossy-brown, as in the latter-mentioned species, in which, as in S. NIGER, the fur has somewhat of the same glistening appearance so remarkable in some of the aquatic species of Australian mammals, such as the *Ornithorhynchus* and *Hydromys*, and also the *Myogalea* of Europe; but at the roots the fur is not so dense as in these aquatic animals. Head and body 3″ 8‴, about; tail 2″ 6‴; fore-foot 6‴; planta 9‴. This note has been taken by the kind permission of Dr. Horsfield from the specimen described in his Catalogue of the Mammalia in the Museum of the East India Company.—R. F. TOMES.]

8. S. FERRUGINEUS, Kelaart, J. A. S. xx. 185; *S. montanus*, apud nos (misled by a label), *ibid.* 163, vide xxi. 350, note. *Hab.* Ceylon.

N.B. The dimensions of the specimen described in J. A. S. xx. 163, accord with those assigned by Dr. Kelaart to the next species; and he states that the two are nearly of the same size, and that the smell of the present species is very powerful.

9. S. MONTANUS, Kelaart (nec apud nos, J. A. S. xx. 163). "Length of head and body $3\frac{3}{4}$ in.; of tail $2\frac{1}{4}$ in.; of hind-foot $\frac{2}{3}$ in. Fur, above sooty-black, without any ferruginous smear; beneath lighter coloured; whiskers long, silvery-grey; lower part of legs and feet greyish, clothed with appressed hairs. Claws short, whitish. Ears large, round, naked; the outer margin lying on a level with the fur of the head and neck, and being thus concealed posteriorly." Mountains of Ceylon ("the blackest Shrew of the highest parts of the island." Kelaart).

N.B. Dr. Kelaart has lately forwarded an entire specimen in spirit of a *young* female Shrew found at Galle (!), though with the three pairs of inguinal teats well developed, which may prove to be the young of S. MONTANUS, but is perhaps distinct and new. If so, S. KELAARTI, nobis. Colour uniform blackish, above and below, slightly grizzled and glistening; the fur short and close, with scattered fine long hairs throughout (as described of S. MONTANUS). Length of head and body $2\frac{3}{4}$ in.; of tail $1\frac{1}{4}$ in.; and of hind-foot with claws $\frac{5}{8}$ in.

10. S. PYGMÆUS, Hodgson, Ann. & Mag. N. H. xv. 269; nec *S. pygmæus*, Pallas; if the small European species referred by Schinz, Rüppell, and others to the latter be correctly identified. S. PYGMÆUS, Pallas, apud Schinz, is placed by the latter zoologist among the species with brown-tipped teeth, and in the division of them which corresponds to CORSIRA, Gray; and the description—*cauda basi constricta; auriculis brevissimis*—will certainly not apply either to Mr. Hodgson's animal, or to various other minute Indian Shrews hitherto undistinguished from it; and therefore Mr. Hodgson's name for the present species may stand, as he states the structure of the animal to be typical*. The following is his description:—Snout to vent, less 2 in.; tail $1\frac{3}{16}$ in.; head $\frac{11}{16}$ in.; palma $\frac{1}{4}$ in.; planta $\frac{3}{8}$ in. Structure typical, save that no odorous glands were detected, nor had the animal any musky smell. Colour sooty-brown, paler below. Naked parts of a dusky fleshy hue. *Hab.* Nepal, where it "dwells in coppices and fields, and is rarely found in houses."

Of numerous species of minute SORICES from various localities, the only one which approaches to the above description is a species which we have just procured in Calcutta, curiously enough, while engaged in the investigation of this particular group. It may be termed

11. S. MELANODON, nobis, n. s.: from the remarkable colouring of its teeth, which are *piceous* and *white-tipped*; exhibiting thus the reverse coloration of those of CORSIRA, &c. Length of adult female $1\frac{7}{8}$ in.; tail $1\frac{1}{16}$ in.; hind-foot and claws $\frac{5}{16}$ in. Colour uniform fuscous, without any rufous tinge; scarcely paler below; the feet and tail subnude, save the usual scattered fine long hairs upon the latter, and with the ears and snout of a livid colour, paler below; claws white, and distinctly visible.

Procured by one of our Museum assistants in his own house, where he states that he has observed and can probably obtain others.

12. S. MICRONYX, nobis, n. s. Length of head and body $1\frac{5}{8}$ in.; tail somewhat exceeding $1\frac{1}{8}$ in.; hind-foot and claws $\frac{13}{32}$ in.; skull $\frac{1}{2}$ in. Teeth white. Claws with fine hairs impending them, and so minute as to be scarcely discernible without a lens. Fur of a paler and more chestnut-brown than any other of these minute species examined, and also more silvery below.

* Since writing the above, we have seen the figure of SOREX PYGMÆUS, Pallas and Laxman (*S. minutus*, L., *S. exilis*, Gmelin, and *S. minimus*, Geoff.), in the Act. Acad. Leop. vol. xiii. pt. 2. t. 25 (1827), and the species is widely different from all the pigmy Shrews here described, and is evidently a CORSIRA.

Feet and tail subnude, or thinly furred, showing the colour of the skin through; browner above, whitish (or perhaps flesh-coloured) below. Of two specimens in our Museum, one in spirit, the other now dried, the latter was obtained by the late Major Wroughton in Kemáon, the former by L. C. Stewart, Esq., of H.M. 61st Foot, at Landour, where, he informs us that he picked up many of them dead, on the surface of the snow, during the severe winter of 1850–51.

13. S. Perrotetii, Duvernoy, Guérin's Mag. de Zool. 1842, livr. 8. We can only refer to Prof. Schinz's description of this species, which is as follows:—"*S. notæo saturate fusco-nigricante, gastræo canescente, artubus pedibusque pilosis, auriculis magnis, conspicuis. Long. corporis* 1″ 4‴, *caudæ* 11‴." From the Nilgiris. We have a Darjiling female which approximates this description, and may prove to be of the same species. Head and body $1\frac{1}{2}$ in.; tail 1 in.; hind-foot and claws $\frac{11}{32}$ in. Skull somewhat exceeding $\frac{5}{8}$ in. Teeth white. Colour uniform brown, with a slight tinge of chestnut, and scarcely paler below. Feet and tail distinctly furred, besides the usual scattered long hairs on the latter. Claws whitish and conspicuous. Tail brown above, pale and perhaps flesh-coloured beneath; more probably, however, of a livid hue, and tapering evenly throughout. If new, S. Hodgsonii, nobis.

14. S. nudipes, nobis, n. s. Remarkable for its naked feet and very large ears; also for the odoriferous glands on the sides being strongly developed, whereas we can detect them in no other of these minute species. Length of female $1\frac{3}{4}$ in.; tail $1\frac{1}{16}$ in.; hind-foot $\frac{11}{32}$ in. Ears conspicuously larger than in the others; tail almost nude, save of the long scattered hairs; and the fore-feet and toes of the hind-feet are conspicuously naked, and apparently flesh-coloured. Fur uniform brown above (like the back of Corsira vulgaris), a little grizzled and glistening; the lower parts with a silvery gloss. Tail brown above, pale (probably flesh-coloured) below; somewhat thick and uniformly tapering. Specimen procured at Amhurst (Tenasserim provinces).

[Mr. Blyth has since received two from Pegu.—R. F. T.]

15. S. atratus, nobis, n. s. Of this we have only a headless specimen, which was found, impaled upon a thorn by some Shrike*, at Cherra Punji, in the Khásya Hills; but the species

* The same fact we have observed in England of *Lanius collurio* and *Corsira vulgaris*, these diminutive Shrews falling an easy prey to the "Butcher-birds;" while the larger members of the same genus are

is evidently distinct from all the preceding. It is remarkable for its very dark colour, extending over the feet and tail, which is even *blackish underneath*. Length of tail 1 in., and of hind-foot $\frac{1}{3}\frac{1}{2}$ in. Fur blackish-brown above, a little tinged rufescent, and with dark greyish underneath; the feet and tail conspicuously furred, besides the scattered long hairs upon the latter.

Here may be noticed, that the Society formerly possessed a specimen of one of these minute Shrews, which was found in a cellar in Madras, and was presented by Walter Elliot, Esq., Madras Civil Service. We formerly considered it identical with S. MICRONYX, so that it could scarcely be so with S. MELANODON of Bengal; it was, however, darker than S. MICRONYX; and more probably S. PERROTETII (*verus*), if not distinct from the whole of the foregoing. It is even probable that several more Indian species of these most diminutive of all Mammalia remain to be discriminated. Upon minute comparison of five specimens in our Museum, taken out of spirit and carefully dried for the occasion, we immediately detected four well-marked species, and presently afterwards obtained the S. MELANODON fresh. It may be further remarked, that we once found the nearly digested remains of an adult small white-toothed *Sorex*, rather larger than a common mouse, in the stomach of an *Elanus* which was shot on the banks of the Hugli, about fifty miles above Calcutta; but we have since in vain sought to procure the species.

[Since the publication of Mr. Blyth's memoir, he writes me word that he has procured another typical SOREX, of which the following is a description:—

S. FULIGINOSUS, Blyth, n. s. Length of an adult female taken from spirits, $5\frac{1}{2}$ in.; tail $2\frac{1}{4}$ in.; foot *plus* $\frac{5}{8}$ in.; skull 1 in., and $\frac{7}{16}$ in. in greatest diameter. Length of series of upper teeth $\frac{7}{16}$ in.; breadth of palate $\frac{1}{8}$ in. Soles bare to the heel; tail with seventeen vertebræ, and perhaps a minute eighteenth at the tip. The scattered long hairs on the tail small and fine. Fur dense, porrect, and somewhat velvety; dark slaty at base, the rest fuliginous-brown, with inconspicuous dull hoary tips; beneath scarcely (if at all) paler. A second specimen differs merely in being a trifle smaller. *Hab.* Schwe Gyen, Pegu.

Besides the foregoing species thus enumerated by Mr. Blyth, are two others, named S. SATURATIOR and S. LEUCOPS by Mr. Hodgson; they have been described by Dr. Horsfield in the

ferociously predatory upon any hapless birdlet they may chance to seize,—as is likewise the case with Moles, and doubtless other SORICIDÆ of adequate size and strength.

Number of the Annals for August of the present year. Both are from Nepal.

I shall now proceed to give a description of a Shrew from Mr. Cuming's collection, received by him from Ceylon, where it was captured by Mr. Thwaites.

Forms, those of a typical Sorex: teeth white, the lower ones rather less curved at their points than usual. Odoriferous glands considerably developed; ears rather large; tail nearly as long as the head and body, tapering uniformly throughout, appearing naked and finely annulated, but, on being examined with a lens, is seen to be furnished with extremely fine short hairs, besides the usual long ones, which in this species are very fine and thinly set, and not extending for more than one-third the length of the tail. Upper surface of the feet furnished with very small thinly set hairs, appearing almost naked without the assistance of a lens; soles of the feet perfectly naked. Fur rather long, being as much as 2‴, which is nearly equal to that of the large S. cærulescens; dark, close to the skin, but for the greater part of its length of a grizzled brown, of about the same hue as in Corsira vulgaris of Europe; beneath decidedly paler, with a yellowish cast and with a slight silvery gloss. All the naked parts dirty yellowish-brown; upper surface of the tail browner. Upper incisors (projecting from the gum) barely 1‴; lower ones $1\frac{1}{4}$‴. Length of head and body 2″ 4‴; head $10\frac{1}{2}$‴; tail 1″ 11‴; fore-foot and claws $3\frac{1}{2}$‴; hind-foot and claws 6‴. The above was taken from a male, evidently adult; and a female having the mammæ considerably developed, but with the teeth exhibiting some signs of youth, does not differ except in having the tail a little more slender, slightly quadrangular, and rather more hairy. Colour of the upper parts darker, and of a slaty hue, very slightly tinged with brown; below, grey with a silvery cast, without any tinge of yellow or rufous. Several others, obviously immature, resembled this female in colour, but were somewhat smaller. The only other species from Ceylon, in Mr. Cuming's collection, is the S. montanus of Kelaart.

As the species here described appears to differ very considerably from the other small species found in India, I shall propose calling it Sorex Horsfieldii, as a just tribute to that well-known naturalist.—R. F. T.]

Another form of white-toothed Shrew, with thick and tapering tail having scattered long hairs upon it, is exemplified by

Feroculus, Kelaart. Teeth small; the upper quasi-incisors shorter and less strongly hooked than in restricted Sorex, with the posterior spur large; the lower quasi-incisors serrated, showing two depressions, and therefore a row of three coronal points; four small upper premolars preceding the *carnassier*, the two medial being of equal size, the first rather large, and the fourth small. Feet remarkably large. The ear-conch scarcely visible above the fur.

16. F. MACROPUS. *Sorex feroculus*, Kelaart; *S. macropus*, nobis, J. A. S. xx. 163. Length about $6\frac{1}{2}$ in., of which the tail is $2\frac{1}{4}$ in; hind-foot with claws nearly $\frac{7}{8}$ in.; the fore-foot $\frac{1}{4}$ in. broad, with long and but slightly curved claws, that of the middle digit $\frac{1}{4}$ in. in length. Fur somewhat long and very soft, uniform blackish, very faintly tinged rufescent; the extreme tip of the tail naked and of a flesh-colour. Inhabits Ceylon.

Another white-toothed Indian Shrew exists in the CROSSOPUS HIMALAYICUS, Gray, to be noticed presently. We feel much doubt of its being correctly referred to *Crossopus**.

The greater number of small Shrews inhabiting the temperate regions of Europe, Asia, and North America, have the teeth always tipped with ferruginous or pitch-colour, a slender mouse-like tail with no scattered long hairs upon it, and (save in OTISOREX) the ear-conch concealed amid the fur. There are two distinct types of dentition.

In one, the upper quasi-incisors are much longer than their posterior spur (as in restricted SOREX), and the lower have but a single posterior spur more or less rudimental; the lateral small teeth which follow in the upper jaw are four in number (as in restricted SOREX), the first two being equal, the third somewhat smaller, and the last (as usual in all Shrews) minute. With this type of dentition we distinguish

1. SORICULUS, nobis. With the hind-feet of ordinary form and proportions, unadapted for aquatic habits; and the tail tapering and a little compressed at the extremity.

17. S. NIGRESCENS; *Corsira nigrescens*, Gray, Ann. & Mag. Nat. Hist. x. 261 (1842); *Sorex sikimensis*, Hodgson, Horsfield's Catalogue (1851). Length of head and body $3\frac{1}{4}$ in.; of tail $1\frac{1}{2}$ in.; hind-feet and claws $\frac{5}{8}$ in. Number of caudal vertebræ 15 (besides the extreme tip). Colour throughout blackish, a little tinged with rufous; the feet and claws pale. Very common in Sikim, and was formerly sent by Mr. Hodgson to the Society's Museum, and also to the British Museum, from Nepal.

* *Myosorex*, Gray, is founded on a Cape species, the SOREX VARIUS, Smuts, with ear-conch concealed amid the fur, and a slender tail (without scattered long hairs?); the teeth white, and the dentition slightly modified upon that of restricted SOREX; lower quasi-incisors "with an entire sharp upper edge."

[In a report printed in the J. A. S., bearing the date of Sept. 1854, Mr. Blyth gives a note on this species, which explains more fully the synonymy than does the present memoir, although it bears date more recently than the note alluded to. Mr. Blyth confirms Dr. Gray in referring *S. soccatus*, Hodgs., and *S. aterrimus*, Blyth, to this species; but he goes on to observe, that Mr. Hodgson has since *described* another, and perfectly distinct species, under the name of *S. soccatus*, which I presume is the S. SOCCATUS of the present memoir, a typical SOREX, whilst the former so-called species is the sole example of the genus SORICULUS, Blyth.

After explaining its synonymy, and alluding to the species since *described* by Mr. Hodgson as *S. soccatus*, Mr. Blyth says: "The dentition [*i. e.* of *S. nigrescens*] is that of CROSSOPUS, and not of CORSIRA (to which group Dr. Gray assigns the species); but this common little Sikim Shrew does not exhibit the modifications for aquatic habits which are characteristic of CROSSOPUS, Wagler." The following appears, therefore, to be the synonymy of this species:—

Corsira nigrescens, Gray, Ann. & Mag. Nat. Hist. x. 261. 1842.

Sorex Sikimensis, Hodgs. Ann. & Mag. Nat. Hist. New Ser. iii. 203.

—— *soccatus*, Hodgs. Calc. J. N. H. iv. 288 (not described); (?) Ann. & Mag. Nat. Hist. xv. 1845, 270.

—— *aterrimus*, Blyth, J. A. S. B. 1843, 128? (not described).

Soriculus nigrescens of the present memoir.—R. F. T.]

2. CROSSOPUS, Wagler (v. *Hydrosorex*, N. Duvernoy, and *Pinalia*, Gray). With the hind-feet large and ciliated, and the tail also compressed and ciliated beneath towards its extremity—in adaptation to aquatic habits.

N.B. S. FODIENS (v. *hydrophilus*), Pallas, and other Water Shrews of Europe and N. America constitute the types of this division; and Dr. Gray refers to it a Himalayan species, which, having *white teeth*, we very much suspect will prove to differ in other and more important particulars, even though it may exhibit the adaptive characters of an enlarged and ciliated hind-foot and compressed and ciliated tail-tip. It is thus described:—

18. CR. HIMALAYICUS, Gray, Ann. & Mag. Nat. Hist. x. 261 (1842). "Length of head and body $5\frac{1}{2}$ in.; tail 3 in.; hind-foot $\frac{3}{4}$ (nearly). Slate-coloured black, with scattered long hairs, which are longer and white-tipped on the sides and rump; lower part of the throat and middle of the belly rusty-brown;

tail elongate, scaly, with appressed dark brown hairs above and elongate rigid whitish hairs beneath, and brown elongated rigid hairs near the tip; feet rather naked; whiskers numerous, elongate, brown. *Teeth white.*" Probably from the neighbourhood of Simla or Masuri.

[The excellent description given by Dr. Gray of this species renders it somewhat unnecessary that I should give a detailed description taken from the same specimen by myself; but having sent one to Mr. Blyth, at his request, it becomes desirable that it should appear here, as any future allusion to it might tend to confuse instead of elucidate. General forms as in the C. FODIENS of Europe:—Ears hidden in the fur, very small and hairy. Tail very long and slender, thickly clothed with hair of a stiff nature, from a distance of about half-an-inch from its root to the tip, which has a brush or pencil of hairs about a quarter of an inch long. Nails very short; both fore and hind feet distinctly ciliated. Fur rather long, dusky at base, tipped with shining dark brown on all the upper parts; below the same, but with the tips paler, especially about the throat, which is stained with rufous; above and around the root of the tail are a number of long pale hairs, projecting through the fur for a length of about a quarter of an inch. Head and body about 6″; tail about 3″ 6‴; hind-foot and claws 11‴; fore-foot and claws $6\frac{1}{2}$‴. The teeth of this example are those of a restricted SOREX, and I feel no hesitation in saying, after a careful examination, that they have been introduced by the stuffer; also, in the process of preservation, the tail appears to have been slit up on the under side, thus rendering it difficult to decide whether it was ciliated like the feet; but, from the appearance of the hair on that part, I think that it resembled that of C. FODIENS. It is obviously a true CROSSOPUS.—R. F. T.]

In the other type of dentition, the lower quasi-incisors are distinctly serrated, with three or four coronal points; and the anterior point of the upper quasi-incisors is not prolonged beyond a level with its posterior spur; the lateral small teeth which follow in the upper jaw are five in number, and diminish gradually in size from the first backward. Tail cylindrical, not tapering, and furnished with a stiffish brush at the extremity. Such is the common British Land Shrew, S. VULGARIS, L. (formerly confounded by British writers with S. ARANEUS, Schreber), and which is the type of CORSIRA, Gray (v. *Amphisorex*, No. 1, Duvernoy, apud Gray). There are many other species*. We refer to it doubtfully.

* BLARIA, Gray (v. *Blarina*, Lesson), is founded on S. TALPOIDES, Gapper, Zool. Journ. v. 28, referred by Blainville to S. BREVICAUDATUS,

19. Cr. (?) CAUDATA; *Sorex caudatus*, Hodgson, Horsfield's Catalogue (1851); for the description seems to indicate a species closely affined to the European S. ALPINUS, Schinz, a skull-less example of which, from Mt. St. Gothard, is in our Museum; and S. ALPINUS is ranged among the species having the CORSIRA type of dentition by Prof. Schinz in his 'Synopsis Mammalium;' its tail, however, is naked, and compressed at the tip. "Length of the head and body $2\frac{1}{2}$ in.; of the tail the same, slender, nearly naked, and very slightly attenuated. Colour saturate blackish-brown, very slightly rufescent in certain aspects. Snout moderately elongated, furnished at the sides with long delicate hairs."

[After a very careful comparison of two specimens in the Museum at the India House with a specimen of the C. ALPINUS of Europe, which I had taken there for that purpose, I concluded that C. CAUDATUS and C. ALPINUS were very closely affined, if not perfectly identical. The naked compressed tip of the tail in the last-mentioned species, as remarked by Mr. Blyth, also occurs in one of the examples of C. CAUDATUS; indeed, were this specimen to be placed along with the European species, it would be almost impossible to distinguish them.

It is probable that many Himalayan species may be found to be identical with European ones; certainly among the Cheiroptera, the *Plecotus* and *Barbastellus* of Mr. Hodgson are identical with the European representatives of those genera, as I have ascertained by actual comparison; and the VESPERTILIO DARJELINGENSIS of that naturalist differs only from our V. MYSTACINUS in having the tips of the fur of the back brighter. —R. F. T.]

We now conclude this effort at a *Conspectus* of the Indian SORICINÆ by soliciting aid from all (probably not many persons in India) who take any interest in the subject. It will suffice if specimens could be sent in spirit to the Museum of the Society (if disembowelled, and the abdominal cavity cleaned of blood, so much the better for our present purpose, except with regard to the very diminutive species, examples of which are particularly acceptable), such being far preferable to badly prepared skins for being afterwards set up as stuffed specimens, besides permitting of much more satisfactory examination of their differential characters; and it is further desirable that

Say, a N. American species, which, we believe, only differs from CORSIRA in the large size of its fore-feet and in its very short tail:—and OTISOREX, DeKay, is founded on two minute N. American species, which do not appear to differ from CORSIRA except in having the ear-conch large and conspicuously visible above the fur.

three or four adults of each kind should be thus transmitted, to supply our collection with skeleton and stuffed specimens, in addition to at least one to be retained entire in spirit. The *micro-mammalia*, as they have been designated (as Bats, Shrews, Mice, &c.), require to be thus amply represented in museums, for their specific distinctions to be rightly understood in many cases; and the chaos of Indian Muridæ, in particular, will be never reduced to systematic order, with the synonyms correctly adjusted, until such a tolerably complete collection of them from all quarters has been brought together.

[The notes appended to the present memoir were most of them taken from specimens in the British and India-House Museums, at the request of Mr. Blyth, and kindly permitted by Dr. Gray and Dr. Horsfield; but having reached Calcutta too late for insertion, Mr. Blyth has requested me to add them to his memoir, and have the whole republished in the 'Annals and Magazine of Natural History.' I have acted in accordance with his wishes, and also added references to two species described by Dr. Horsfield, and given the description of what appears to be hitherto an undescribed species, in order to render it as complete a monograph of the Indian species as circumstances would permit.—R. F. T.]

IV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.*

By Thomas Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[With a Plate.]

[Continued from vol. xvi. p. 421.]

Pectinibranchiata.

This order comprehends a considerable number of families and genera. It is the largest and most important group of the Gasteropod Mollusks. In this summary it will be impossible to present a correct analysis, derived from personal observation, of the respiratory organs of every genus. If that were possible indeed to a single observer, an acquisition of great value would accrue to science. The author is deeply persuaded that even in such minute constituents of the organism as a *single* leaflet from the branchial apparatus, the microscope may reveal the presence of differences of shape, size, structure, &c., which may serve to establish the distinctness of species quite as clearly and convincingly as the grosser characters of the outward appendages. The branchial plates of two separate species, in general position, in form and size, &c., may to the casual eye of the descriptive naturalist, appear absolutely identical. Guided by the microscope, the minute anatomist, however, detects *organic* dissimilarities which enable him at once to assign the objects under view to two distinct animals. A thousand illustrations of this kind may be readily adduced to prove the importance of minute investigations of structure. False analogies suggested by general external resemblances of organs can be authoritatively corrected only by an appeal to the facts of ultimate structure. How utterly confused, how deeply deficient are the views of the comparative physiologists even of these advanced times, as to the history of the renal and urinary systems of the Invertebrate animals! How difficult, in any given instance of doubt, to state whether an organ is a kidney or not! The ultimate elements, those last factors which constitute the essence of the organ, are utterly unknown. For it is not even now determined what is and what is not *essential* to the kidney of an Invertebrate animal. This opprobrium applied but a short time since to the fluid systems and to the respiratory organs. How great are the honours yet in store in this field of research for the clear thinker and fruitful observer!

The general affinities of the Pectinibranchiate order of Mollusks are familiar to all. In all the genera, a spacious branchial chamber exists (Pl. V. figs. 1 & 2). It is a recess over-vaulted by the anterior termination of the mantle. It occupies the last turn of the spire. It is open in front. This arrangement will be afterwards contrasted with the closed character which it exhibits in the Pulmonifera. The Pectinibranchs admit of division into two suborders—the Holostomata and the Siphonostomata. In the former, the margin of the shell and mantle is entire; in the latter, it is either notched or produced into a canal or siphon (*f*). Through this prolongation of the mantle the water enters the chamber. In the Holostomata it penetrates at the same point in the fissure between the dorsum of the animal and the edge of the mantle. The machinery by which the ingress and egress of the water are effected resides in the branchial hood of the mantle. It performs regular respiratory movements. These movements, however, are aided by the invisible agency of cilia. The Pectinibranchs are prosobranchiate. The heart in all affects a position immediately behind the branchial organ. The aërated blood returning from the latter is received directly by the auricle of the former.

What is designated the branchial vault in the Pectinibranchs is not exclusively a respiratory chamber. It serves to lodge other organs. It contains the heart, the termination of the intestine, the excretory ducts of the reproductive system, and several varieties of glands (Pl. V. figs. 1 & 2). It is therefore by no means an unimportant part of the body of the mollusk. Between the position of the rectum and that of the branchiæ there obtains in this, as in the Pulmonifera, a constant relationship: one reason for this relationship is a mechanical necessity. The egressing current from the gills is thus adapted collaterally to convey away from the body the fæcal excreta. This current connects itself also with the functions of the generative system. It forms a vehicle for the mucus supplied by the glands of this chamber. By its aid the latter is enabled to invest the ova as they escape from the body—constituting thus a cocoon in which they are temporarily cradled. It is by skilfully subordinating the office of one organ to that of another, that Nature's contrivance surpasses man's. In her machinery a force is nowhere allowed to transpire unutilized. It is always deflected to a purpose; though sometimes to one whose significance may prove illegible to her observers.

As the details to which the reader's attention is now solicited are novel, and now for the first time published, it is desirable that a clear and concise method of presenting them should be adopted. The author proposes in the first place to describe the branchiæ in those genera especially of this order in which he has subjected these organs to a special examination. He will then return to a consideration of the glandular apparatus of this important cavity, and finally deduce such inferences with respect to their purpose and function, as their chemistry and the facts of their minute structure may appear to warrant.

The branchiæ of the Pectinibranchs (Pl. V. figs. 1 & 2 *a′ a′*) are almost always fixed to the *roof* of the cavity in which they are lodged. They occupy an intermediate position between the "gland of the mucosity" (fig. 1 *b*) and the colour-gland (fig. 1 *a*, fig. 2 *b*), which lies invariably to the extreme left. In some genera the gill is placed at the extreme left of the chamber—at a point, that is, which is the direct opposite of that of the rectum (fig. 1 *c*). This position is significant of the care with which Nature locates the breathing organ in order that it may receive the most direct influence of the aërating current as the latter enters the cavity. In the following account few differences in the relative anatomy of this organ will demand attention. The most striking diversities will be found to affect the figure or outline-form and ultimate structure of the individual laminæ or pectinations of the gill. These objects are entirely and exclusively microscopic (Pl. V. figs. 3, 4, 9, 13, 14): they are removed in structure far beyond the sphere of naked vision. Since however the individual parts of a pectinibranchiate gill constitute under all circumstances *sheets* whose opposite faces are more or less smooth, or more or less corrugated and folded, a little manipulative skill will be required to enable the student to put to the test of personal observation the particulars comprised in the following description.

The language commonly used by malacologists in describing the gills of this order of Mollusks is calculated to lead to many very false conceptions. They are first said to be "plumes." A 'plume' or feather is *bi*-pectinate, that is, it consists of a stem bearing 'barbs' on either side. Such a word, therefore, conveys to the mind an untrue image of the real object. The word "pectinate" is nearer, but still very erroneous, and very inadequate as an illustrative analogue. A leaf of the gill of a pectinibranchiate mollusk resembles in figure much more nearly a 'fan' than the tooth of a comb. A gill would be a series of fans laid side by side. It should accordingly be defined rather as flabelliform (fig. 4) than pecten-iform. The laminæ of this gill are comparable to a 'fan' moreover in this remarkable particular—they are capable of being closed and opened under the action of muscles. In fact, in other respects they constitute an apparatus immeasurably more beautiful and complex than it has hitherto entered into the dreams of naturalists to conceive.

The branchia (fig. 1 *a, a*) of every genus of this order is seated on a fixed base which forms a part of the roof of the respiratory chamber (*e, e*). In this respect it differs from the breathing organ of the Tectinibranchs, and resembles that of the Cyclobranchs. But the pectinibranchiate gill is distinguished from that of every branchiferous Gasteropod, and is brought near to that of a Lamellibranch by a curious incident of structural mechanism. Each and every leaf of the gill is stiffened and strengthened at one of its free borders by the insertion into its substance of a whalebone-like process of rigid cartilage (fig. 4 *a, a*, & fig. 7). The presence of this process imparts to this edge of the organule a thick straight appearance which stands in obvious opposition to the floating and flexible character of the other margin (fig. 4 *b*). As this process of cartilage is concealed in the substance of the dorsal border of the leaf, and embraced by a dense ciliated membrane, it can only be detected by tearing up the whole leaf into pieces by means of needles. Viewed on its flat surface the lamina presents a triangular outline (*a, b, c, d*). This is more or less the figure of the branchial laminæ throughout the entire Pectinibranchiate group. The terminology applicable in one genus will serve to designate the homologous parts in all others. That border which lodges the cartilage may be called the dorsal or cartilaginous (fig. 4 *a–f*); that which stretches from the distal point of the cartilage to the extreme end of the base, the free or flexible border (*a, b, g*) formed of the vascular loops; and thirdly, that may be called the fixed side (*c, c*) which is attached to the vault of the cavity throughout its entire extent, and is the mathematical base of the triangle. In some genera a portion of the gill is described as pendent and floating in the cavity. The power to exsert the gill is enjoyed by *Valvata*. It is, however, so exceptional a character, that the branchia in nearly every Pectinibranch may be stated to be sessile on a fixed base. But in describing the gills of this order, systematic naturalists without exception commit another error. In the Siphonostomata, embracing the carnivorous Gasteropods, the "branchial plumes are stated to be double, or to be two in number." In the Holostomata they are said on the contrary to be "single," that is, that there is but one branchial plume. If this error did not originate with, it certainly has been perpetuated by Dr. Sharpey. In his article "Cilia," in the 'Cyclopædia of Anatomy and Physiology,' he states that in reflecting the roof of the branchial chamber in *Buccinum, two sets* of gills are seen, one of which consists of two rows of laminæ (fig. 2 *b*), the other of one row (*a, a*). That structure which Dr. Sharpey describes as a "gill with two rows of laminæ," which is attached to the extreme left of the vault, *is a gland* (fig. 2 *b*; fig. 1 *d*). The details of this point will be given on another occasion. In external characters it looks like a gill. No one but the microscopic anatomist could note a difference. A deep difference however does exist. Here again is exemplified the service which minute special anatomy may render to the cause of general physiology.

His researches enable the author to affirm with confidence, that in all the Pectinibranchiata the gill is a *single organ*. Though in some of the Cyclobranchiata the organ is double, and may exhibit a bilateral symmetry, in the Pectinibranchs it is single. To this rule there is no exception. Since the constituent parts of every pectinibranchiate gill consist of triangular or fan-shaped leaves, strengthened at the dorsal border by a comb's tooth-like process of cartilage, the terms for the construction of an accurate and consistent general definition of the branchiæ in this family of Mollusks are established. A subdivision of these organs into two leading classes becomes essential, however, with a view to a more accurate description of structural minutiæ. In the genera *Buccinum* and *Littorina* the extreme representatives of these two classes occur. The branchial leaf of the former (fig. 4) is distinguished by smooth sides—that is, it is an unplicated lamina having the same minute structure in every part of its extent. In the latter (fig. 3) complex plications (*c, c–b, b*) occur which multiply to a considerable degree the area of the active surface. This is so remarkable a character, that if the plicæ were a little more prominent, each leaf of the gill of the Periwinkle might be correctly described as a bipinnate structure (fig. 3 B). The plicæ are however mere folds of the smooth surface of the lamina, as will be afterwards explained. These parts are so minute, that the malacologist, using merely the unassisted eye, would pronounce the gill-leaf of *Buccinum* and that of *Littorina* to be one and the same thing,—to be identically organized. But how *essentially* unlike! The evidence furnished by the ultimate anatomy of the *branchiæ* would require that the family of the Littorinidæ should be placed in juxtaposition with the Tectinibranchiata.

The pectinibranchiate gill (fig. 1 *a, a*; fig. 2 *a, a*) may be defined then as a series of parallel blood-vessels-bearing leaflets, decreasing in size from the centre of the series to either end, projecting at right angles and vertically depending from the walls of the containing chamber. The long axis of the entire organ is parallel with the line of the rectum and that of the glands peculiar to this cavity (fig. 1 *d, b*). Though only two main varieties of anatomical structure occur among the branchiæ of this order, the diversities observable in the *size* and *shape* of the laminæ in intermediate examples are as numerous not only as the genera but really as the species. In the genus *Trochus* (figs. 13 & 14) they are more or less similar in all the species. In every species, however, some peculiarity is distinguishable in the contour of the laminæ, which suffices to establish specific independence. Those of *Trochus magus* (fig. 13) are triangular, the dorsal border (*a, d*) being slightly convex, the free or flexible border (*b*) being gently concave, while the distal apex is rounded (*a*). The base (*c*) of the longest lamina, which occupies always a position in the centre of the gill, measures about $\frac{1}{10}$th of an inch in full-grown specimens.

In *Trochus cinerarius* (fig. 14), a closely allied species, the distal angle (*a*) is elongated into an acute apex, the free border (*b*) is at first convex and then sweeps into a very prolonged base (*e, c*), giving to the attached border twice as great a length as in that of the former species. Other varieties of figure occur in the gill-leaves of *Trochus umbilicatus*, and *T. tumidus**. The

* In arriving at a knowledge of the exact figure of the branchial laminæ, I have invariably adopted one method of examination. It has consisted in cutting out a few leaves or a small portion of the centre of the gill; the section being coincident with the plane of the laminæ, and at right angles with the long axis of the entire organ. This portion is then carefully

cartilage which occupies the dorsal edge is curved at its point in some species (fig. 12), so that it acquires, its root being the fulcral point, all the resilient qualities of a bow. In others it is blade-shaped (fig. 7). It tends always to straighten itself. This tendency is expended upon the flat surface and the free margin of the laminæ, which are thus maintained in a tightened state, like outstretched or expanded sheets. This is undoubtedly the true purpose which this peculiar cartilage is intended to fulfil in the gills of this order of Mollusks. Its existence has never yet been suspected by anatomists. From the mechanical, lever-like character of its office, it is evident that upon its duly regulated action must depend the function of the entire leaflet. Without it, a sheet of such surpassing delicacy as an individual branchial lamina could not sustain the required vertical position. Without some such contrivance the leaflets would be driven, crushed and folded confusedly by every current and pressure. An elastic apparatus, of inconceivable beauty and perfection, is realized in these hyaline invisible and hidden parts. They hold, with a force of immeasurable gentleness, the respiratory laminæ at such a degree of tenseness as best favours the transit of the water between them, and of the blood throughout the extent of their plane superficies. No crumpling or folding or confusion of any kind can happen even in the relative position of structures of such extreme tenuity and slenderness. And yet it has never occurred to the curiosity of any one of the thousand observers by whom these organs have been witnessed, to catechise Nature as to the mechanism by which such wonders, though minute, are accomplished! In organic workmanship, minuteness and perfection are often twin qualities of the same machinery! These cartilages are peculiar to the gills of the Pectinibranchiata, and as the unfolding of details proceeds, it will be seen that they undergo variations of size and shape, but never of relative position, according to the differences of families, genera, and even of species. Into the branchial system of this large and important order they are special importations, fulfilling purposes of a special nature.

But the office of the border-cartilages is not restricted to the end which has just been defined. They conduct and protect the larger afferent and efferent blood-channels of the laminæ (fig. 3 *e*). It is by thus transmitting a primary column of blood

placed on the glass slip, floated in *salt* water if the specimen be marine in habits, in fresh water if from a freshwater habitat, and then lightly covered with a plate of thin glass. A few laminæ at the same time are detached by means of needles and torn up, in order that the objects may be examined under different points of view. Various reagents are used in the examination of the vessels, cartilages, muscles and fibres, &c. of the organ.

from the fixed border to the apex of the leaflet, that every single spot of the flat surface of the latter is rendered available in the active operation of breathing.

When a single lamina is detached and placed singly, floating in salt water, under the microscope, and viewed as a transparent object, it may be supposed that the spectacle must be one of extreme definedness, every one of whose constituent elements may be readily singled out and read by the eye. This is an *à-priori*, and therefore as usual an erroneous fancy. Nothing is so difficult to the unpractised observer as to read clearly and accurately the spectacle under view. It demands an exercised eye even to distinguish an epithelial particle from a blood-corpuscle, a blood-channel from the crease or fold of the lamina, a near object from one placed at a greater focal distance. Practice and perseverance will however enable the student to interpret with confidence and accuracy all the subtle elements of this inconceivably beautiful structure.

A little experience in the art of viewing the branchial organs of the Gasteropod Mollusks will suffice to assure the least interested observer, that the blood-channels traverse the plane extent of the laminæ in parallel vessels, of uniform diameter, separated from each other by appreciable intervals, and bounded by individual and independent walls (fig. 4 *d, d*). In *Trochus* they appear to run (fig. 13 *e*) from the dorsal edge (*a*) to the free border (*b*) along one face of the leaf, and back again along the other surface, looping round the edge. On both surfaces they are invested in a similar manner by ciliated epithelium, the cilia being large at the edges and small over the flat face of the lamina.

Although the preceding account conveys an exact illustrative image of the type which prevails throughout the branchial system of this multitudinous order, yet as this occasion is the first on which these particulars have been published, it is desirable to enter into an examination of some few other examples of the pectinibranchiate gill.

In *Phasianella* the branchia is said to be partially detached and free in its cavity, but in other relations it imitates the type of the Trochidan organ.

The Paludinidæ are prosobranchiate gasteropod mollusks which inhabit fresh water. It is curious to observe, that this marked contrariety of habitat should occasion no variation of place or structure in the organ of breathing. The branchia of this family, like those of all other Pectinibranchs, affects a position on the vault of the thoracic chamber, having the rectum and generative ducts parallel to it on the right side, and the mucous glands on the other. A siphon exists on the left of the breathing cavity, while on the right the rectum, as in Lymneadæ, is prolonged in form of a tube beyond the edge of the mantle on the right. In a large specimen of *Paludina vivipara*, it is easy to extract the animal out of its shell by cracking the latter at different points. The position of the organs contained in the branchial vault may be now seen through the mantle. The whole cavity, as in all Pectinibranchs, is ciliated. On the exterior it is also ciliated to a short distance beyond the edge of the mantle. It lies obliquely in the cavity extending from the posterior left corner to the right anterior end. The gill is constructed in exact conformity with the pectinibranchiate model. The leaves of which it is composed are triangular in shape, the base of the triangle being the free border. They rest on a fixed base, and carry a rigid process of cartilage in the substance of the dorsal margin. The blood-channels and the vibratile cilia exhibit the same disposition as those of *Buccinum*, which will be presently explained at length. The heart is situated at the extreme posterior boundary of the cavity near the point at which the rectum joins the branchia. The ovary, filled with young, is seen on the right side of the rectum. The specimen from which the preceding account has been drawn had been for some time preserved in spirit; but the author believes that near the dorsal edge of each branchial lamina in *Paludina, slight traces* of secondary pinnæ, or plications, will be discovered, such as those, far more prominently developed, which are now to be figured and described in the Littorinidæ. If this feature of structure should, on a further examination of fresh examples, be proved to exist, a new point of relationship between the genera *Paludina* and *Littorina* will have been established. In describing their respiratory system, it was once intended to place the Littorinidæ apart as a separate group, in order that contrast of position might attract towards them immediately the attention of malacologists. The author, however, thinks that, for the present—that is, until, by further search, other examples of the same formation shall have been collected,—it is better to place the Littorinidæ here, between the Paludinidæ and Turritellidæ (British Mollusca), rather than dislocate the arrangement of systematists, even at the inconvenience of returning afterwards to the description of the smooth or unplicated variety of branchiæ. A singular abnormity occurs in the gills of the genus *Valvata*. It is protruded for a considerable distance beyond the shell, at the left side of the body of the animal. It consists of a long straight axis, from the opposite sides of which filiform pinnæ or secondary processes project. These again bear minuter pinnulæ, which are the ultimate processes. This gill may be regarded as a transitional variety between the plain, or smooth, type of the lamina in the Paludinidæ and the plicated form of the organ which prevails probably throughout the Littorinidan family. An opportunity of examining minutely a recent specimen of *Valvata* has not yet occurred to the author.

In the genus *Littorina*, the last turn of the shell is very large relatively to the second and the third. By this criterion, the capacity of the respiratory chamber may be estimated. It presents a considerable size in these mollusks compared with the bulk of the entire body. The augmented dimensions of the cavity are due to the increased volume of the contained organs (fig. 1). The branchia (fig. 1 *a*, *a*) is highly developed, and occupies a large share of the cavity. It extends from the hindmost boundary to the root of the siphon. It lies obliquely from left to right along the roof of the chamber. Viewed as a whole, it will be observed to consist of two halves (fig. 2 *a*, *a*), which are divided by a clearly marked line extending from one extreme of the organ to the other. One of these halves (fig. 3 *a*, *a*) corresponds with the dorsal or cartilaginous borders of the leaves, and consists of a series of parallel unbending rigid lines or filaments; the other half (fig. 3 *g*), more wavy, flocculent, soft and flexible, coincides with the membranous portion of the laminæ. To the left of the gill is situated a peculiar gland (fig. 1 *d*) having a bipectinate appearance, less developed in this mollusk than in *Buccinum*, and which Dr. Sharpey, and after him all systematic malacologists, has described as a *double*, though rudimentary gill. It will be shown that it is a true gland. To the left of the branchia there lies a large glandular mass, which is always enveloped in viscid mucus, and which exhibits a leafy or laminose structure. On the reflected roof (as shown in fig. 1), still further to the left, is observed another glandular mass (*e*), which some anatomists have described as the renal organ; and, lastly, a duct which belongs to the reproductive system (*j*). The structure of these glands will be discussed on another occasion: the branchia only will be at present described. Powdered Lycopodium strewn lightly over the fresh organ will move in one definite direction; namely from the right, or cartilaginous border, to the left, or membranous (arrows, fig. 1 *a*, *a*). This current, examined more closely, will be found to be subdivided into as many rivulets as there are spaces between the leaves of the entire organ. Of course these superficially indicated currents are but the edges of vertical sheets of water which are in the act of traversing the spaces between the laminæ. These currents are impelled by two forces, one of which is due to the action of the numerous minute muscles fixed to the cartilaginous margins of the laminæ (fig. 14 *c*, *d*), whose office it is to furl and unfurl, approximate and separate the individual leaves. By this contrivance a mechanical power is capable of being exerted on the strata of water interposed between the leaves, under which it is driven forwards at a speed regulated by the necessities of the breathing function. The second force is the ciliary. The large cilia which occupy the edges, and which are arranged in rows (fig. 3 *a, a*), are capable of raising a sensible current. The minute cilia which are distributed over the flat surfaces of the laminæ drive along only microscopic streams.

By means of a thin sharp scalpel, a section may be easily made through the gill, parallel with the plane of the laminæ, and through the substance of the vault. If this section be made about the middle of the gill, one of the largest laminæ may be readily detached and placed as an individual object under the microscope. Such an object is represented in Pl. V. fig. 3. The dorsal margin curves like a reaping-hook (*a, a*). It is stiffened by a large sickle-shaped cartilage (*a, e*) which extends from the root to the apex: it supports the whole organ *in situ*. Within this border, running along the side of the cartilage, are also concealed two large vessels, with which many of the ultimate blood-channels of the lamina are connected. Along this dorsal edge are disposed two rows of large cilia, which propel currents in two opposite directions, downwards along one side, and upwards along the other. Every part of the leaf beyond this cartilaginous border consists of a soft membranous substance (*h*), thickly vascular, composed, in fact, of little more than vessels. The next feature to be noticed in the structure of this branchial lamina is a series of duplicatures (*c, c* and *b, b*) of this surface, and is singularly distinctive of the branchial organ of this family of Mollusks. At first they look like accidental folds of a delicate membrane; but as they occur in every single leaf throughout the organ, it follows that they are organic formations. If the leaflet is laid carefully on the glass slip, floating in water, and gently covered, *without pressure*, the true character of these parts may be most clearly determined. They consist undoubtedly of a *bifid* fold (B) of only one half of the lamina, for a similar fold exists on the opposite surface. Each fold is made up of two parts, which are united gradually at either end, and separated by an interval in the middle. The long axis of each fold is at right angles with the line of the dorsal margin; but the row is parallel with the latter. Slightly beyond this row of plicæ, and nearer to the centre of the leaflet, is to be observed a second and smaller system (*c, c*). The folds are formed in the latter case precisely as in the former. These two systems of plications are separated from each other by a narrow space of smooth membrane. All that portion of the lamina which intervenes between the second row of folds and the extreme apex (*j*) of the lamina is a plain unplicated surface, sustaining a double series of parallel blood-channels. The anatomy of the folded portion of the leaf may be better understood on a tranverse section (such section is represented at fig. B). It will be seen that the duplications of the surface are the same on both sides (*f, f*), and that the opposite folds are formed upon the same transverse axis.

The next problem to be solved in the analysis of this most beautiful mechanism relates to the disposition of the blood-vessels (*h, h*). This question could never be determined by injections, however fine or successful. The practised eye, reading the same structure throughout an extended series of varieties and modifications, may infallibly decipher the blood-system even of these subtle and delicate laminæ. The leaf tapers away into a slender point at the extreme membranous end (*j*). If the same blood-channel, or the same drop of blood, travelled from the dorsal border (*a, a*) across the entire length of the laminæ, as far as the tapering point (*j*), it is evident that such a portion of blood would undergo an excessive degree of aëration, while that which traversed the space at either apex (*i, h*) would fall short of the required amount of oxygenation. This inconvenience is obviated by giving to the vessels a *generally* oblique direction across the plane of the lamina (*d, b*). The vessels as they traverse the folds (*c, c* and *b, b*) maintain the same character and direction as they exhibit on the smooth portions. This fact proves that these folds are really none other than duplications of the surface. They serve, notwithstanding, to multiply the active superficies of the little organ, and the vessels which they carry, although unaltered in direction, are smaller in diameter and more closely arranged. The ciliary action over these portions is also more active and vigorous than on other parts. The vessels are most distinct in outline and disposition about the central region of the leaf (*h, h*, fig. 4 *d*). That the channels are conduits, distinct and individualized, separately walled, running side by side, and seldom inosculating, may be unquestionably proved by the steady examination of this part. That the channels loop around the free edge (figs. 5 & 6) to gain the other side, along which they return, the observer may convince himself by focusing the microscope at this border. The appearance is then such as is shown in fig. 5, and fig. 9 *b*. The cilia of the flat surface are seated on a pavement epithelium, those of the borders stand out like filaments from a larger description of cell (fig. 8).

The author has proved, that in all the species of the genus *Littorina* discoverable on the coast around Swansea, the branchial laminæ are constructed on the model (fig. 3) of that just described. The duplications are not of the same precise size and character in all; but in all they exist. He would propose this incident of structural type as a criterion of relationship between the several genera of the family of the Littorinidæ. He has not examined the branchiæ of *Lacuna, Assiminia, Jeffreysia* and *Skenea*; but those of the genus *Rissoa* discover a marked tendency towards this peculiarity of formation.

Several families must now be passed over as hitherto unexamined. The branchiæ of the Muricidæ may probably, however, be considered as typically representative of those groups which intervene between them and the Littorinidæ.

The whole of this extensive family is said by systematic authors to be characterized by the possession of *two gills*; one described as doubly pectinated, and the other as singly pectinated. As formerly stated, Dr. Sharpey has adopted this definition in his article "Cilia," in the 'Cyclopædia of Anatomy and Physiology.' The branchial chamber in this family (fig. 2) is constructed on the same principle as that of other Pectinibranchs. It is a capacious vault, open in front from one side to the other by a fissure. On the left side the edge of the mantle is prolonged into an extended recurved siphon. The glands (*c, b*) of the cavity, as will be explained afterwards, are highly developed; one of them so much so as to have led to the idea that it was a second branchia. The true gill (*a, a*), which is a single organ, stands between this supposed supplementary gill and the large mucous gland (*c*), to the left of which is observed the rectum (*e*). In the Muricidæ, the third gland (fig. 1 *g*), called by some authors the renal gland, is not visible within the boundary of this cavity. The whole of the interior of the chamber is actively ciliated; the exterior is *not* so. The epithelium here is smooth. Little peculiarity exists in the branchial system of this family (fig. 4). The organ is large (fig. 2 *a, a*); it has the shape of two cones laid base to base. The broadest laminæ are therefore in the middle, the smallest at either end. It is so situated as to receive directly the column of water as it enters by the siphon (*f*). The course of this water, as indicated by the arrows (fig. 1), is from left to right; it thus passes first, and in the most pure state, over the branchiæ, then over the mucous gland, and lastly over the rectum. The planes of the branchial laminæ (fig. 4) are coincident in direction with the main water-current in passing from the left to the right side of the branchial cavity. Nothing is so easy as to determine the figure of the gill-leaves in any of the larger genera of this family. *Buccinum* is a familiar example.

The gill of *Buccinum undatum* is composed of many hundreds of leaves. These leaves, towards the centre of the organ, are regularly triangular in figure (fig. 4 *a, a*). At the extremities, each lamina loses more rapidly in vertical depth than in length, so that at last they become scarcely visible creases of the pallial membrane. The membranous border is drawn out to a considerable length (g) beyond that part of the gill which is apparent to the naked eye. By this extension of the active branchial surface, the action of the aërating current on the blood is prolonged. In no single instance of the pectinibranchiate gill are the cartilages of the laminæ so developed as in this family. It is here that the true structure and office of these singular elements of the branchial mechanism may be most advantageously studied. In the branchia of *Buccinum* they are straight, sword-shaped blades (fig. 7); they are skilfully fitted into the dorsal or thick edge of the lamina (fig. 4 *a, f*); they act the part of beams, or arms, whereon is hung the sheet of the leaflet (*a, g*). Without them, the latter could not by any means be held *in situ*; that is, could not be maintained at that degree of expansion essential to the proper and adequate contact of the blood with the water. To the bases of these cartilaginous beams, muscles (fig. 14 *c, d*) are attached, which are capable of influencing the entire leaf. Under their action it may be either stretched lightly or folded together like a closed fan. The flat surface of the branchial lamina in *Buccinum* is always unplicated.

In the fresh specimen it may be seen, with perfect clearness, that it is traversed by waving parallel blood-channels (fig. 4 *d, d*). In no instance among the Pectinibranchs is it more easy to convince oneself that these vessels loop at the free flexible margin (*c*) of the leaf than in *Buccinum* (fig. 5). The laminæ are considerable in superficial area (*a, g*), exhibiting a surface equalling a tenth of a square inch. The vessels (*d*) are prominent, being readily traced by $\frac{1}{2}$ an inch power. The walls display a granulated character (fig. 5 *g, g*), in consequence of the contents of the epithelium. This circumstance individualizes each blood-channel most clearly. The flat surface of the leaf is also covered by a flat, scaly, polygonal epithelium (fig. 6), the cells of which are filled with minute granules, and armed with short cilia. Along the base or fixed border of each leaf run two large vessels (fig. 4 *c, c*), one of which is afferent, the other is efferent. Thus, in brief, is written the anatomical history of this remarkable organ. It is at once evident that the key-stone of this structure is the beam of cartilage, which imparts strength and rigidity to the dorsal margin of the slender sheet; and, further, constitutes a point of attachment to a system of muscles, by which, as by a lever, the entire apparatus may be extraordinarily furled and unfurled, and otherwise variously controlled.

Another example of the Muricidan gill may be described, in order to show, that in two closely allied species of the same genus a striking difference of structure may occur in one and the same organ.

The *apices* of the laminæ in the gill in *Purpura lapillus* are curved sharply (fig. 9 *a*). In *Buccinum*, as just stated, the dorsal border terminates in a straight point. Although this trait is only a microscopic incident of formation, it is quite enough to constitute the distinctness of the species. In every other respect the laminæ discover the same structure as that just explained in *Buccinum*. The gill-leaves of *Murex* and *Nassa* exhibit also slight variations of *shape*, compared with the standard figure of those of *Buccinum*. From such examples the naturalist may well exclaim, how marvellous and unaccountable, that in establishing the independence of species, Nature should change the very fabric of the minutest parts of the body!

In the Conidæ and Cypræadæ, the author has every reason to believe that the branchiæ conform with exactness to the type of those of *Buccinum*. They may vary in the special outline of the laminæ, but not in essential structure. They lie in the branchial chamber in the same oblique position, and exhibit the same relation to the glands of the cavity.

Although the transition may be strange and abrupt, it is convenient at this point to pass to the consideration of the pulmoniferous Gasteropods; not because there is much in common between their breathing system and that of the branchiferous orders, but because the glands contained in the thoracic cavity of the Pulmonata correspond in structure and dependencies most intimately with those which are contained in the branchial chamber of the Pectinibranchs last described. According to this distribution of subject, the "glands" of the respiratory cavity of both the branchiferous and pulmoniferous orders will come to be considered under one head.

[To be continued.]

V.—*On the Origin of the Geographical Distribution of Crustacea.* By Mr. James D. Dana.

[The present paper is the conclusion of Mr. Dana's Report on the Geographical Distribution of the Crustacea. As the opinions here put forward appear to be of great importance in the study of the geographical distribution of animals, we have thought it advisable to transfer this portion of Mr. Dana's work to our pages; but the tables of facts on which they are founded would occupy too much space; they will be found in Silliman's Journal, vols. xvi. xviii. xix. & xx. —Eds.]

The origin of the existing distribution of species in this department of zoology deserves attentive consideration. Two great causes are admitted by all, and the important question is, how far the influence of each has extended. The first is, *original local creations*; the second, *migration*.

Under the first head, we may refer much that we have already said on the influence of temperature, and the restriction of species to particular temperature regions. It is not doubted that the species have been created in regions for which they are especially fitted; that their fitness for these regions involves an adaptation of structure thereto, and upon this adaptation, their characteristics as species depend. These characteristics are of no climatal origin. They are the impress of the Creator's hand, when the species had their first existence in those regions calculated to respond to their necessities.

The following questions come under this general head:—

1. Have there been local centres of creation, from which groups of species have gone forth by migration?

2. Have genera only and not species, or have species, been repeated by creation in distinct and distant regions?

3. How closely may we recognize in climatal and other physical conditions, the predisposing cause of the existence of specific genera or species?

With regard to the *second* head, migration, we should remember, that Crustacea are almost wholly maritime or marine; that marine waters are continuous the globe around; and that no sea-shore species in zoology are better fitted than crabs for migration. They may cling to any floating log and range the seas wherever the currents drift the rude craft, while the fish of the sea-shores will only wander over their accustomed haunts. Hence it is, that among the Pacific Islands the fishes of each group of islands are mostly peculiar to the group, while the Crustacea are much more generally diffused.

A direction and also a limit to this migration exist, (1) in the currents of the ocean, and (2) in the temperature of its different regions. Through the torrid zone, the currents flow mainly *from the east* towards the west; yet they are reversed in some parts during a certain portion of the year. But this reversed current in the Pacific never reaches the American continent, and hence it could never promote migration to its shores. Again, beyond 30° or 35° of north or south latitude, the general course of the waters is *from the west*, and the currents are nearly uniform and constant. Here is a means of eastward migration in the middle and higher temperate regions. But the temperate regions in these latitudes are more numerous than in the tropics, and species might readily be wafted to uncongenial climates, which would be their destruction; in fact they could hardly escape this. Moreover, such seas are more boisterous than those nearer the equator. Again, these waters are almost entirely bare for very long distances, and not dotted closely with islands like the equatorial Pacific.

In the northern hemisphere, on the eastern coasts especially, there are warm currents from the south and cold currents from the north. The former overlie the latter to a great extent in the summer, and may aid southern species in northward migrations. Cape Hatteras is nearly the termination of the summer line of 70° (see Maury's Chart), a temperature which belongs to the subtorrid region in winter. On the China coast, at Macao, there is a temperature of 83° in July, and in the Yellow Sea, of 78° to 80°. But such northward migrations as are thus favoured, are only for the season; the cold currents of the winter months destroy all such adventurers, except the individuals of some hardier species that belong to the seas or have a wide range in distribution. Sea-shore Crustacea are not in themselves migratory, and are thus unlike many species of fish. Even the swimming Portunidæ are not known voluntarily to change their latitudes with the season.

The following is a brief recapitulation of the more prominent facts bearing on these points :—

1. The distribution of individuals of many species through twelve thousand miles in the torrid zone of the Oriental seas.

2. The very sparing distribution of Oriental species in Occidental seas.

3. The almost total absence of Oriental species from the west coast of America.

4. The world-wide distribution within certain latitudes of the species we have called cosmopolites.

5. The occurrence of closely allied genera at the Hawaiian Islands and in the Japan seas.

6. The occurrence of the same subtorrid species at the Hawaiian Islands and at Port Natal, South Africa, and not in the torrid zone intermediate, as *Kraussia rugulosa* and *Galene natalensis*.

7. The occurrence of identical species in the Japan seas and at Port Natal.

8. The occurrence of the same species (*Plagusia tomentosa*) in South Africa, New Zealand, and Valparaiso; and the occurrence of a second species (*Cancer Edwardsii* (?)) at New Zealand and Valparaiso.

9. The occurrence of closely allied species (as species of *Amphoroidea* and *Ozius*) in New South Wales and Chili.

10. The occurrence of the same species in the Japan seas and the Mediterranean, and of several identical genera.

11. The occurrence of a large number of identical species in the British seas and the Mediterranean; and also in these seas and about the Canary Islands.

12. The occurrence of closely allied, if not identical, species (as of *Palæmon*) in New Zealand and the British seas; and also

of certain genera that are elsewhere peculiarly British, or common only to Britain and America.

13. An identity in certain species of Eastern and Western America.

The following are the conclusions to which we are led by the facts :—

I. The migration of species from island to island through the tropical Pacific and East Indies may be a possibility; and the same species may thus reach even to Port Natal in South Africa. The currents of the oceans favour it, the temperature of the waters is congenial through all this range, and the habits of many Crustacea, although they are not voluntarily migratory, seem to admit of it. The species which actually have so wide a range are not Maioids (which are to a considerable extent deep-water species), but those of the shores; and some, as *Thalamita admete*, are swimming species.

II. The fact, that very few of the Oriental species occur in the Occidental seas, may be explained on the same ground, by the barrier which the cold waters of Cape Horn and the South Atlantic present to the passage of tropical species around the Cape westward, or to their migration along the coasts.

Moreover, the diffusion of Pacific tropical species to the Western American coast is prevented, as already observed, by the westward direction of the tropical currents, and the cold waters that bathe the greater part of this coast.

III. When we compare the seas of Southern Japan and Port Natal, and find species common to the two that are not now existing in the Indian Ocean or East Indies, we hesitate as to migration being a sufficient cause of the distribution. It may however be said, that driftings of such species westward through the Indian Ocean may have occasionally taken place, but that only those individuals that were carried during the season quite through to the *subtorrid* region of the South Indian Ocean (Port Natal, &c.), survived and reproduced; the others, if continuing to live, soon running out under the excessive heat of the intermediate equatorial regions. That they would thus run out in many instances is beyond question; but whether this view will actually account for the resemblance in species pointed out, is open to doubt.

IV. When, further, we find an identity of species between the Hawaiian Islands and Port Natal—half the circumference of the globe, or twelve thousand miles, apart—and the species, as *Galene natalensis,* not a species found in any part of the torrid region, and represented by another species only in Japan, we may well question whether we can meet the difficulty by appealing to migration. It may however be said, that we are not as yet thoroughly acquainted with the species of the tropics, and that facts may hereafter be discovered that will favour this view. The identical species are of so peculiar a character that we deem this improbable.

V. The existence of the *Plagusia tomentosa* at the southern extremity of Africa, in New Zealand, and on the Chilian coasts, may perhaps be due to migration, and especially as it is a southern species, and each of these localities is within the sub-temperate region. We are not ready however to assert, that such journeys as this range of migration implies are possible. The oceanic currents of this region are in the right direction to carry the species eastward, except that there is no passage into this western current from Cape Horn, through the Lagulhas current, which flows the other way. It appears to be rather a violent assumption, that an individual or more of this species could reach the western current from the coast on which it might have lived; or could have survived the boisterous passage, and finally have had a safe landing on the foreign shore. The distance from New Zealand to South America is five thousand miles, and there is at present not an island between.

VI. Part of the difficulty in the way of a transfer of species between distant meridians might be overcome, if we could assume that the intermediate seas had been occupied by land or islands during any part of the recent epoch. In the case just alluded to, it is possible that such a chain of interrupted communication once existed; and this bare possibility weakens the force of the argument used above against migration. Yet as it is wholly an assumption, we cannot rely upon it for evidence that migration has actually taken place.

VII. The existence of the same species on the east and west coasts of America affords another problem, which migration cannot meet, without sinking the Isthmus of Darien or Central America, to afford a passage across. We know of no evidence whatever that this portion of the continent has been beneath the ocean during the recent epoch. An argument against such a supposition might be drawn from the very small number of species that are identical on the two sides, and the character of these species. *Libinia spinosa* occurs at Brazil and Chili, and has not been found in the West Indies. *Leptopodia sagittaria*, another Maioid, occurs at Valparaiso, the West Indies, and the Canaries.

VIII. The large number of similar species common to the Mediterranean and British seas may be due to migration, as there is a continuous line of coast and no intermediate temperature rendering such a transfer impossible; and the passage farther south to the Canaries of several of the species is not beyond what this cause might accomplish. Still, it cannot be asserted that in all instances the distribution here is owing to migration; nor will it be admitted unless other facts throw the weight of probability on that side.

IX. But when we find the same temperate zone species occurring in distant provinces, these provinces having between them no water-communication except through the torrid or frigid zone, and offering no ground for the supposition that such a communication has existed during the recent epoch, we are led to deny the agency of voluntary or involuntary migration in producing this dissemination. An example of this, beyond all dispute, is that of the Mediterranean Sea and Japan. No water-communication for the passage of species can be imagined. An opening into the Red Sea is the only possible point of intercommunication between the two kingdoms; but this opens into the torrid zone, in no part of which are the species found. The two regions have their peculiarities and their striking resemblances; and we are forced to attribute them to original creation, and not intercommunication.

X. The resemblances found are not merely in the existence of a few identical species. There are genera common to the two seas that occur nowhere else in the Oriental kingdom, as *Latreillia, Ephyra, Sicyonia,* &c.; and species where not identical having an exceedingly close resemblance.

Now this *resemblance* in genera and species (without exact identity in the latter) is not explained by supposing a possible intercommunication. But we may reasonably account for it on the ground of a similarity in the temperature and other physical conditions of the seas; and the well-known principle of "like causes, like effects," forces itself upon the mind as fully meeting the case. Mere intercommunication could not produce the resemblance; for just this similarity of physical condition would still be necessary. And where such a similarity exists, creative power may multiply analogous species; we should almost say, *must*; for, as species are made for the circumstances in which they are to live, identical circumstances will necessarily imply identity of genera in a given class, and even of specific structure or of subgenera.

If then the similarity in the characters of these regions is the occasion of the identity of genera, and of the very close likeness in certain species (so close that an identity is sometimes strongly suspected where not admitted), we must conclude that there is a possibility of actual identity of species, through original creation. This, in fact, becomes the only admissible view, and the actually identical species between Japan and the Mediterranean are examples.

XI. When we find a like resemblance of genera and species between temperate-zone provinces in opposite hemispheres that are almost exact antipodes, as in the case of Great Britain and New Zealand, we have no choice of hypotheses left. We must appeal directly to creative agency for the peopling of the New Zealand seas as well as the British, and see, in both, like wisdom, and a like adaptedness of life to physical nature. The *Palæmon affinis* of the New Zealand seas is hardly distinguishable from the common *P. squilla* of Europe, and is one example of this resemblance. It may not be an identity; and on this account it is a still better proof of our principle, becauset here is no occasion to suspect migration or any other kind of transfer. It is a creation of species in these distant provinces, which are almost identical, owing to the physical resemblances of the seas; and it shows at least, that a very close approximation to identity may be consistent with Divine Wisdom.

The resemblance of the New Zealand and British seas has been remarked upon as extending also to the occurrence in both of the genera *Portunus* and *Cancer*. It is certainly a wonderful fact that New Zealand should have a closer resemblance in its Crustacea to Great Britain, its antipode, than to any other part of the world—a resemblance running parallel, as we cannot fail to observe, with its geographical form, its insular position, and its situation among the temperate regions of the ocean. Under such circumstances, there must be many other more intimate resemblances, among which we may yet distinguish the special cause which led to the planting of peculiar British genera in this antipodal land.

The close resemblance in species and genera from Britain and New Zealand, and from Japan and the Mediterranean, and the actual identity in some species among the latter, prove therefore that, as regards the species of two distant regions, identity as well as resemblance may be attributable to independent creations, these resemblances being in direct accordance with the physical resemblancesof the regions. As this conclusion cannot be avoided, we are compelled in all cases to try the hypothesis of migration by considering something beside the mere possibility of its having taken place under certain assumed conditions. The possibility of independent creations is as important a consideration. After all the means of communication between distant provinces have been devised or suggested, the principle still arises, that it is in accordance with Divine Wisdom to create similar and identical species in different regions where the physical circumstances are alike; and we must determine by special and thorough investigation, whether one or the other cause was the actual origin of the distribution in each particular case. Thus it must be with reference to the wide distribution of species in the Oriental tropics, as well as in the European temperate regions, and the temperate zone of the South Pacific and Indian Oceans.

XII. With respect to the creation of identical species in distant regions, we would again point to its direct dependence on a near identity of physical condition. Although we cannot admit that circumstances or physical forces have ever created a species (as like can only beget like, and physical force must result simply in physical force), and while we see in all nature the free act of the Divine Being, we may still believe the connexion between the calling into existence of a species and the physical circumstances surrounding it, to be as intimate nearly as cause and effect. The Creator has, in infinite skill, adapted each species to its place, and the whole into a system of admirable harmony and perfection. In His wisdom, any difference of physical condition and kind of food at hand, is sufficient to require some modification of the intimate structure of species, and this difference is expressed in the form of the body or members, so as to produce an exactness of adaptation, which we are far from fully perceiving or comprehending with our present knowledge of the relations of species to their habitats.

When therefore we find the same species in regions of unlike physical character, as, for example, in the seas of the Canaries and Great Britain—regions physically so unlike—we have strong reason for attributing the diffusion of the species to migration. The difference between the Mediterranean and Great Britain may require the same conclusion for the species common to these seas. They are so far different, that we doubt whether species *created* independently in the two could have been identical, or even have had that resemblance that exists between varieties; for this resemblance is usually of the most trivial kind, and affects only the least essential of the parts of a species.

The continental species of Crustacea from the interior of different continents are not in any case known to be identical; and it is well understood that the zoological provinces and districts of the land are of far more limited extent than those of the ocean. The physical differences of the former are far more striking than those of the latter. As we have observed elsewhere, the varieties of climate are greater; the elevation above the sea may vary widely; and numberless are the diversities of soil and its conditions, and the circumstances above and within it. Hence, as the creation of each species has had reference most intimately to each and all of these conditions, as well as to other prospective ends, an identity between distant continental regions is seldom to be found, and the characteristic groups of genera are very widely diverse. Comparatively few genera of Insects have as wide a range as those of Crustacea; and species, with rare exceptions, have very narrow limits. Where the range of a species in this class is great, we should in general look to migration as the cause, rather than original creation; but the considerations bearing on both should be attentively studied, before either is admitted as the true explanation.

Throughout the warmer tropical oceans, a resemblance in the physical conditions of distant provinces is far more common and more exact than in the temperate zone; and hence it would seem that we cannot safely appeal to actual differences as an argument against the creation of a species in more than one place in the tropics. The species spread over the Oriental torrid zone may hence be supposed to owe their distribution to independent creations of the same species in different places, as well as to migration. Yet we may in this underrate the exactness of physical identity required in regions for independent creations of the same species. We know that for some chemical compounds, the condition of physical forces for their formation is exceedingly delicate; and much more should we infer that, when the creation of a living germ was concerned, a close exactness in the conditions would be required in order that the creation should be repeated in another place. Infinite power, it is true, may create in any place; but the creation will have reference to the forces of matter, the material employed in the creation. The few species common to the Oriental and Occidental torrid seas seem to be evidence on this point. The fact that the Oriental species have so rarely been repeated in the Occidental seas, when the conditions seem to be the same, favours the view that migration has been the main source of the diffusion in the Oriental tropics.

As we descend in the order of Invertebrates, the species are less detailed in structure, with fewer specific parts and greater simplicity of functions, and they therefore admit of a wider range of physical condition; the same argument against multiplication by independent creations in regions for the most part different, does not, therefore, so strongly hold. As we pass, on the contrary, to the highest groups in Zoology, the argument receives far greater weight; and at the same time there are capabilities of migration increasing generally in direct ratio as we ascend, which are calculated to promote the diffusion of species, and remove the necessity of independent creations.

Migration cannot therefore be set aside. It is an actual fact in nature, interfering much with the simplicity which zoological life in its diffusion would otherwise present to us. Where it ends, and where independent creations have taken place, is the great problem for our study. This question has its bearings on all departments of Zoology; but in few has migration had the same extended influence as in that of Crustacea. Mollusks, if we except oceanic species, are no travellers, and keep mostly to narrow limits.

XIII. There is evidence, in the exceedingly small number of torrid-zone species identical in the Atlantic and Indian Oceans, that there has been no water-communication across from one to the other in the torrid zone, during the period since existing species of Crustacea were first on the globe.

XIV. As to zoological centres of diffusion for groups of species, we can point out none. Each species of Crustacea may have had its place of origin and single centre of diffusion in many and perhaps the majority of cases. But we have no reason to say that certain regions were without life, and were peopled by migration from specific centres specially selected for this end. If such centres had an existence, there is at present no means by which they may be ascertained. The particular temperature region in which a species originated may be ascertained by observing which is most favourable to its development: we should thus conclude that the *Ranina dentata*, for example, was created in the subtorrid region, and not the torrid, as it attains its largest size in the latter. By pursuing this course with reference to each species, we may find some that are especially fitted for almost every different locality. Hence we might show, as far as reason and observation can do it, that all regions have had their own special creations.

The world, throughout all its epochs in past history, has been furnished with life in accordance with the times and seasons, each species being adapted to its age, its place, and its fellow species of life.

VI.—*On* Anthracosia, *a Fossil Genus of the Family* Unionidæ. By William King, Professor of Mineralogy and Geology in Queen's College, Galway, Corresponding Member of the Natural History and Medical Society of Dresden, &c.

[With a Plate.]

The lakes, rivers and estuaries of the Carboniferous period were inhabited by two groups of Bivalves; the generic characters of neither have as yet been fully described. One group includes forms having much of the external aspect of ordinary species of *Unio*; while the other comprises members possessing the outward appearance of certain aviculoid forms of *Modiola*.

But as external resemblances are not always to be depended on in determining the genus of a fossil shell, some palæontologists have gone no further, in the present case, than merely to refer the bivalves in question to the genera named; while others have placed the Unioniform shells in the totally distinct genus *Cardinia*, and the Modioliform species in that of *Myalina*.

As it is possible that I may have to notice the last-named genus on a future occasion, I purpose confining myself, in the present paper, to the Unioniform group.

Some years back, when residing in Newcastle-on-Tyne, I occasionally obtained some good casts and testiferous specimens of the so-called fossil Unios from Jarrow pit and some others in that district; also from a clay-ironstone band near Whitley.

On examining these specimens, I ascertained that they possessed certain characters sufficiently distinctive, and were deficient in a very important one, to warrant their removal from the genus in which they were usually placed. This led me to propose, in the Annals for November 1844*, a new genus for the fossils in question, under the name *Anthracosia*, on the occasion of my nominating and describing some other fossil genera,—intending to publish the diagnosis of it shortly afterwards. I need not enter into any explanation of the causes which have prevented this intention being carried out; suffice it to say, that, as several parties have adopted the name I proposed, and as no one, that I am aware of, has yet published any generic description of these fossils, I feel myself bound to take up the subject, even after the lapse of so many years.

The character which *Anthracosia* is deficient in, exists in all the known genera of *Unionidæ*. It consists of a largish scar in each valve, situated immediately behind the impression of the anterior adductor muscle, and which is evidently supplementary to the usual number of retractor muscles belonging to the foot of other Dimyarian shells, and inserted within or near their umbonal cavities. To distinguish the scars left by the *supplementary muscles* from those produced by the ordinary anterior foot-retractors, they have sometimes been termed "supplementary pedal muscular scars."

Reverting to the Unioniform fossils, several fine casts have passed under my notice; but in none have I observed the "supplementary scars,"—only those usually situated, as in ordinary bivalves, within or near the umbonal cavities. The remarkably fine cast, represented in Pl. IV. fig. 5, is exceedingly instructive in this respect.

The absence of these scars appears to have given rise to the opinion, that the fossils under consideration, though admitted to be freshwater species, belong to a marine genus, or, at least, to one (*Cardinia*) originally formed for some well-characterized marine shells.

* "On a new Genus of Palæozoic Shells."—Annals and Magazine of Natural History, vol. xiv. 1844.

But, notwithstanding the *absence* in *Anthracosia* of the supplementary scars peculiar to the *Unionidæ,* there can be little doubt, from the *presence* of another essential feature, of the genus belonging to the family just named.

In most Dimyarians, the ligament extends from the corselet (where it covers the cartilage, when this last part is external) to a little in front of the umbones; but the umbonal portion is seldom well developed, except in certain species—notably in *Cyprina Islandica,* in each valve of which it occupies a rounded cavity, excavated in the hinge-plate immediately beneath the umbone, and in front of the cartilage. In the *Unionidæ,* however, the umbonal portion is as much developed as the corselet division; and that part of the hinge-plate, on which it is situated, is never separated from the teeth by so marked a line of demarcation as prevails in marine shells. These peculiarities may be distinctly observed in our British Unios: they are also to be seen in *Unio littoralis,* and more or less in all the American species. In these, as well as marine shells, the corselet ligament is more compact than the umbonal portion,—the latter being composed of imperfectly conjoined laminæ, which, in *Unionidæ,* produce a number of parallel curving linear impressions, commencing from above the cardinal teeth, and descending behind them, nearly to the inner or free margin of the hinge-plate. When the umbonal portion of the ligament is removed, impressions of its constituent laminæ are quite obvious on the hinge-plate.

The fossil genus *Anthracosia* has evidently possessed the ligamental peculiarities of the *Unionidæ* in an eminent degree, as that part of the hinge-plate on which the umbonal ligament was implanted is comparatively large and deeply excavated;—indeed, in the typical species it is much larger and deeper than in any existing forms that have passed under my notice.

I repeat then, there can be little doubt that its ligamental characters prove the genus *Anthracosia* to be a member of the family *Unionidæ*; but as its mollusk was not furnished with the usual supplementary pedal muscles, it may be considered as representing an abnormal section.

Family Unionidæ.

Genus Anthracosia*, *nobis.*

Syn. *Unio,* Sowerby and others.
Pachyodon, Brown (not Stutchbury).
Cardinia (in part), Morris and others.

Diagnosis.—Equivalved: inequilateral. *Teeth*—one in each

* From ἄνθραξ = *carbon,* in allusion to the carbonaceous deposits in which the genus is usually found.

valve below the umbone, rather low and massive: crown of tooth of right valve excavated anteriorly and ridged posteriorly: crown of tooth of left valve ridged anteriorly and sloped posteriorly. *Umbonal ligamental fulcra,* each a furrow excavated in the hinge-plate, between the umbone and tooth. *Scars of the anterior set of pedal muscles* situated above the anterior adductor muscular impressions.

Typical species, *Unio Beaniana**.

The dental system of *Anthracosia* is much simpler than that of most *Unionidæ;* and it differs so much from what usually prevails in the family as to appear formed on a totally different plan. The dental formula is merely—*Cardinals* $\frac{1}{1}$; and the interlocking of the teeth is simply thus—the excavation of the right-valved tooth receives the ridge of the left-valved one; and the ridge of the former fits on to the slope of the latter, as is exhibited in the diagram section represented under fig. 3, Pl. IV. In other dentiferous *Unionidæ,* however much the cardinal teeth may vary in form and direction, they all appear to be formed on one plan; and their formula is thus:—*Cardinals* $\begin{matrix}\text{Left}\\\text{Right}\end{matrix}\frac{2}{1}$: with or without *Laterals,* the left-valved *two* clasping the right-valved *one* (*vide* Pl. IV. fig. 4). Hence in the latter shells the teeth interlock each other completely, and much more securely than in *Anthracosia.* In the latter genus, however, this defect was undoubtedly compensated by the unusual size of the umbonal portion of the ligament. None of the testiferous specimens which I have examined, of the type of *Anthracosia,* exhibit the least appearance of posterior teeth; nor do casts of some other species before me afford any indication of their presence in the genus. It will thus be obvious that the genus *Cardinia,* which possesses well-developed posterior teeth, and which is furnished with some other differential characters, is not the proper group, as some appear to think, for the shells under consideration.

The fulcra of the umbonal ligament of *Anthracosia,* although simply an enlargement of a peculiar feature of the *Unionidæ,* nevertheless form a well-marked character in the diagnosis of the genus. In the typical species they are widish furrows, broadest and deepest on the inner or free margin of the hinge-plate: that of the left valve is more deeply excavated than the right-valved one. The linear impressions of the laminæ forming the umbonal ligament are rather prominently marked on both fulcra, and they curve suddenly down (forming a deep sinus) to the inner margin of the hinge-plate (*vide* Pl. IV. fig. 2).

Judging from the species represented under fig. 6, Pl. IV., the cartilage appears to have been of the usual size. Several speci-

* *Vide* Supplementary Note.

mens have occurred to me in which this structure is equally well preserved; and I perceive that Captain Brown represents it in his *Pachyodon* (*Anthracosia*) *rugosus**.

The impressions of both adductor muscles are usually well displayed on casts. The anterior one, which is by far the most distinct, is strongly jagged in most species. The pallial line, exhibiting the simple character prevailing generally in the family, is also often very well marked. The scars produced by the anterior pedal muscles are limited to the umbonal cavity and the edge of the hinge-plate, as in Dimyarians generally (*vide* Pl. IV. fig. 5). I have searched repeatedly and carefully on casts of various species for the supplementary scars, without however observing any that I could safely conclude were such. Occasionally I have seen marks on or near the part where they usually occur; but I feel perfectly satisfied that they can only be considered as accidental, having never seen them on good sharp casts. It is necessary to mention this, as some persons might look upon such marks as having been produced by the supplementary retractors of the foot.

Probably the absence in *Anthracosia* of a character hitherto never found to be absent in the *Unionidæ*, might give rise to the opinion that the genus ought to be placed in another family. Further discoveries may render such a step necessary. I feel persuaded, however, that whatever may hereafter be discovered, the relationship between *Anthracosia* and the *Unionidæ*, contended for in this paper, will not be in the least weakened. At present I am only disposed to go the length of regarding it as the type of an abnornal section of the family.

Anthracosia appears to be confined to deposits of the Carboniferous system; for all the *Unionidæ* hitherto described as occurring in secondary and tertiary deposits are normal forms of the family. The Eocene *Unio Solandri*, and a small Neocomian species before me, exhibit the supplementary scars. Mantell detected them in his *Unio Valdensis*; and they are well displayed on a Jurassic species found in the Gristhorp plant-beds, and described some years ago by my friend Mr. Bean, under the name of *Unio distortus*. This specimen appeared to me so interesting as regards the character under consideration, that Mr. Bean kindly allowed me to make the sketch which is given in Pl. IV. fig. 7.

Although none of the Carboniferous species that I have seen display the supplementary scars, it must not be considered that I have no belief in the existence of normal *Unionidæ* during the primary period. The highly interesting form named *Anodon*

* "Description of some new species of the genus *Pachyodon*."—Ann. & Mag. of Nat. Hist. vol. xii. p. 391, Pl. 15. figs. 6 & 7 (1843).

Jukesii by Forbes, and occurring in the Knocktopher plant-beds, is calculated to settle this point; for should it possess the scars in question, the conclusion must arise that normal species of the family existed in the Devonian epoch,—also contemporaneously with *Anthracosia*.

Supplementary Note.

Not being able to identify the type of *Anthracosia* with any published species, I am under the necessity of publishing it as new, naming it after my friend Mr. Bean.

Anthracosia Beaniana, King.

Diagnosis.—Oval : very inequilateral. *Umbones* small. *Valves* thin, rather tumid, and marked with nearly obsolete wrinkles.

This species has some resemblance to Brown's *Pachyodon bipennis*; but it differs from the latter notably in the anterior end being much shorter. The valves throughout their length are evenly rounded, giving no marked prominence to the umbones. It does not appear to have much exceeded an inch or so in length.

It occurred to me in the coal-measures near Newcastle-on-Tyne*.

Belmont, near Galway,
December 12, 1855.

EXPLANATION OF PLATE IV.

Fig. 1. *Anthracosia Beaniana*, King. a, Left valve (which is restored behind the black line); b, Right valve.

Fig. 2. Dental system of the same species; enlarged. *a*+, posterior slope, *b*+, anterior ridge of cardinal tooth of left valve, a; *a*, posterior ridge (fitting on posterior slope (*a*+) of tooth of opposite valve), *b*, anterior excavation (receiving anterior ridge (*b*+) of tooth of opposite valve) of right valve, b; o, o, ligamental fulcra on hinge-plate.

Fig. 3. Diagram exhibiting vertical section of cardinal teeth of the same

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* A few days ago (Dec. 22) I received from Professor Sedgwick for the Library of Queen's College, Galway, the Third Fasciculus of his "Synopsis of the Classification of the British Palæozoic Rocks," in which I perceive that Professor M'Coy has published a genus under the name *Carbonicola*. My friend evidently thinks it synonymous with *Anthracosia*, which he admits being aware that I intended describing! However, *if* the genus *Carbonicola* possess the characters diagnosed by Professor M'Coy, it is clearly not the same as my *Anthracosia*, which does not possess any lateral teeth. There are certain errors in the remarks under the genus *Carbonicola* which it must be obvious to any one that I am not called on to correct; but it is otherwise with several interspersed throughout the work. Some of those now alluded to, I purpose correcting in future Numbers of the 'Annals,' and the remainder I hope to put right, should I have an opportunity of bringing out a new edition of my Monograph.—Dec. 27, 1855.

species. A, anterior end; B, posterior end; *a*, posterior ridge; *b*, anterior excavation of cardinal tooth of right valve, b; *a*+, posterior slope; *b*+, anterior ridge of cardinal tooth of left valve, a; *c*, umbonal ligament.

Fig. 4. Diagram exhibiting vertical section of the cardinal teeth of *Unio littoralis*. *a*, single tooth of right valve, b, clasped by the two teeth, *b*, of left valve, a. The remaining letters have the same references as in fig. 3.

Fig. 5. *Anthracosia acuta*, Sowerby. Cast, exhibiting adductor muscular impressions, *a*, *a*—scars of the anterior set of foot-retractors, *b*—and pallial line, *c*.

Fig. 6. *Anthracosia Smithii?* Brown. Testiferous specimen, exhibiting the cartilage, *a*.

Fig. 7. *Unio distortus*, Bean. Jurassic. Cast in Mr. Bean's Museum, exhibiting anterior adductor muscular impression, *a*—scars of the anterior set of foot-retractors, *b*—supplementary scar, *c*—and a portion of pallial line, *d*.

VII.—*On the Genus* Assiminia.

[We have received a further communication on this subject from Mr. Clark, in reply to the observations of Dr. Gray in our last Number, which we must decline publishing, the question having been sufficiently discussed in our pages to enable the reader to form his own opinion on the matter in dispute. We cannot however, in fairness to our correspondent, refuse insertion to the two following paragraphs, which we trust will terminate the correspondence on this subject.—Eds.]

"With respect to the generic maxims propounded by Dr. Gray," Mr. Clark observes—"I dissent from them,—and disagree with Dr. Gray's restriction of the number of the species of a genus, except under more stringent conditions than he has stated. Dr. Gray's comparison of *Assiminia* and *Truncatella* is decidedly incorrect, and I maintain the position that the so-called *Assiminia Grayana* is malacologically a well-marked *Truncatella*.

"I would also draw attention to the unfair manner in which Dr. Gray has commented on some of my statements: there is a studied reticence in his observations on important points, the correlative incidents of which are passed over without that notice which would have supplied corrections and explanations. To give an instance: in these 'Annals' for October I observed that I was 'not surprised that my logic should not find favour with one who considers that a genus must be restricted in the number of its species, *however similar these may be in every essential character*.' Dr. Gray quietly suppresses every allusion to the words which I have marked in italics, probably from a fixed idea that essential characters are of no importance in the establishment of genera. If I am correct in this supposition, I must still decline to entertain the belief that such views are held by modern zoologists, notwithstanding Dr. Gray's repeated assertion that such is the case."

BIBLIOGRAPHICAL NOTICES.

Recherches sur les Crinoides du Terrain Carbonifère de la Belgique. Par L. de Koninck et H. le Hon. Bruxelles. 1854.

This volume, which has been reprinted from the Memoirs of the Royal Academy of Belgium, embodies the researches of the authors on the crinoidal remains which have been found in the carboniferous limestone of that country. One of the authors, Prof. de Koninck, has long been known as an acute and zealous palæontologist, and his work, published in 1842, 'On the Fossils of the Mountain Limestone of Belgium,' was an important addition to geological science, affording us another term of comparison with the British species, as well as the affinities and distribution of these upper palæozoic forms.

At the time of publication of the former work, although containing descriptions of 500 species from this deposit, only fifteen species of Crinoids were then recognized. Since that period, by more active researches, and under very favourable circumstances, a large number of specimens have been obtained, from which the authors have eliminated, described, and fully illustrated in this work no less than fifty-three species from Belgium alone. The conditions under which some portion of the carboniferous series of Belgium occurs, either as decomposed limestone or of an argillaceous character, have permitted the extraction of many specimens in a perfect state of preservation. By this means the authors have been enabled to study with more precision and detail than is usual in limestone fossils, the structure of certain little-known species of Crinoids, and have further been enabled to confirm or modify the previously received opinions, as well as suggest others, respecting the organization and probable habits of these singular and interesting animals. The fifty-three species belong to eleven genera, of which four are new, viz. Mespilocrinus, Graphiocrinus, Forbesiocrinus and Lageniocrinus. According to the opinion of Prof. de Koninck, the carboniferous limestone series of Belgium is divided into an upper and lower; the former, that of Tournay, being characterized by the *Spirifer Sowerbyi*, Fischer; the latter, that of Visé, by the presence of *Productus giganteus*, Mart., *P. striatus*, Fisch., and *Spirifer striatus* and *S. bisulcatus*. This distribution of species does not, however, accord with the notions of some geologists. Taking however the facts as stated by Prof. de Koninck with regard to the distribution of the species of Crinoids, nine belong exclusively to the lower or *Productus giganteus* horizon; these are—and we quote them for the purpose of further investigation in this country—*Cyathocrinus mammillaris, Poteriocrinus calyx, P. M'Coyanus, P. Phillipsianus, P. conoideus, Rhodocrinus uniarticulatus, Mespilocrinus granifer, Actinocrinus tricuspidatus, Lageniocrinus seminulum.* The first three species have also been found in England.

The remaining forty-four species belong to the superior horizon of *Spirifer Sowerbyi*, and are characteristic of this stage in Belgium. Twenty-four of these latter are also found in the British deposits.

The prefatory matter contains an historical introduction on the

Crinoidea, in which the authors give a general review of the phases in the history of this family, and a summary of the various opinions as to their affinities and classification which have been suggested by the principal writers on the subject. A valuable list is also given, arranged in chronological order, of the works, memoirs and papers of the naturalists who have alluded to the Crinoidea, from the 'De Natura Fossilium' of Agricola in 1558 to the present time, and which includes no less a number of publications than 346! One would have little thought that this almost palæozoic dynasty should have met with so many complimentary inquiries; fortunately for them, their "*histoire*" has been protected by better conservators than those in one of our public departments, where, it has been stated, some valuable historical documents have been carelessly disposed of by those who had them in charge!

If however the Crinoidea have had a copious literature, they have not been so fortunate in their generic names, as is evidenced by the use of such words as Gilbertsocrinus, Hallocrinus, and Woodocrinus, a system commenced by Phillips, adopted by D'Orbigny, and followed by De Koninck. Surely those naturalists who have studied and deciphered the organic structure of these remains, and been thus led to regard these forms as distinct from the cognate genera, might have suggested generic names more consistent with, and expressive of, their true characters, than many of the mongrel words that have been assigned to members of this family. No wonder the classical scholar repudiates the natural-history nomenclaturist or modern wordmonger for fossil genera and species. Following out the idea as above noticed, we should not be surprised to hear of some new American Crinoid with the happy cognomen of *Unclesambocrinus*.

In other departments of palæozoology it would not more excite our astonishment to hear of such names as Grayoconcha, Gouldornis, or Owenotherium, terms which, if unappropriated at present, are quite at the service of the incipient palæontologist who despairs of finding explicative terms for generic groups. Nor is the species-maker blameless. To say nothing of the goodnatured intent of those who name species and varieties after great men and their friends—and indeed we wonder we have not yet heard of a *Trilobites Albertianus*,—we think it a proper subject for animadversion, that the species already rejoicing in good personal appellations should, on account of their less worthy relations, have their patronymic degraded by the prefix "*sub*," as we see in the *Terebratula sub-Bentleyi*, *Ammonites sub-Bakeriæ*, &c.

In the chapter on the general considerations of the Crinoidea, the authors have given some details respecting the classification, structure and organization of these bodies, and have discussed the principles of nomenclature as applied to the different parts, as well as suggested a more easy and consistent notation for the different pieces forming the calyx or terminal part.

Appended to the memoir is a description of a new genus of Crinoids, recently obtained by a zealous collector, Mr. Wood, from the mountain limestone near Richmond in Yorkshire, and which, from the perfection of the specimens obtained, leaves little to desire respecting its illustration. This genus, Woodocrinus, is allied to Cyathocrinus and Forbesiocrinus, differing from the latter in possessing subradial pieces, and from the former in having five of these plates instead of four. Another peculiarity is found in the stem, which, unlike most of the Crinoids, is very slender at the commencement and gradually increases in diameter with its length.

Prof. de Koninck is at present engaged on a general treatise of the Crinoidea, and has recently visited this country for the purpose of obtaining specimens and examining the collections in order to perfect his work; therefore any assistance connected with this subject would not be rendered in vain; for although two valuable works are in progress, those of Mr. Austin and M. d'Orbigny, there is still room for further researches on these singular lilyform creatures, which swarmed so abundantly in the earlier seas, and whose almost entire absence in the present ocean is probably compensated for, or at least represented by, the higher members of the same family of Echinoderms.

A Lecture on the Geological History of Newbury, Berks. By T. Rupert Jones, F.G.S.

This pamphlet, containing the substance of a lecture delivered before the members of a scientific institute, has however more than a local interest. In treating of the physical history of a limited district, the author has brought forward certain geological truths in a clear and intelligible manner. Popular lectures are not always satisfactory, partly from the *ad captandum* style, sometimes from a discursive array of undigested facts, and frequently from the lecturer speaking *at* and not *to* the audience.

The value of elementary instruction depends upon the correctness of the facts stated, and the clearness and methodical manner with which they are enunciated. In this respect Mr. Jones has been successful, by arranging the leading principles of geological science in a concise and common-sense manner. Geology is treated as a history, the records of which are to be sought for beneath the surface, in the constitution of the soils and subsoils of the district, in the beds of earth and stone, which compose the frame-work of hill and valley, and constitute, as it were, the many-leaved stony volume of the earth's primæval history. Cuvier long ago remarked, that the geologist was an antiquary of a new order. Just as the antiquary finds materials for history in the many buildings of towns and cities, whether perfect or in ruins, which have been erected for ecclesiastical, military or civil purposes, at different periods, in distinct styles, of various materials, and often rich with sculpture and inscriptions,—so the geologist examines the many different rocks and soils of which the crust of the earth consists, notes the relative position of the several layers, studies their minerals, and compares their fossils.

In the deeper valleys around Newbury, the different members of the cretaceous formation crop out; and these are covered nearer the town by some of the members of the middle and lower tertiary series, which in their turn are overlaid by deposits of gravel, the adjacent valleys of the Kennett and Lambourne being partially occupied by peat-accumulations. As the different deposits here exhibited are but continuous portions of strata spread over more extensive areas, any remarks concerning the origin of local phænomena necessitate an inquiry into the successive changes which have obtained over larger regions of the earth's surface.

It is thus that local geology, when well explained, embraces larger views, embodies general principles, and points to their practical bearings. In this spirit the lecture is conceived. By examining the nature of the deposits, it is shown how these have been accumulated by the action of seas and rivers during a long period of time, under various conditions of climate, and with many changes in the relative position of land and sea. The order of the succession of these changes, and the description of their results, together with notices of the animals and plants that tenanted the lands and waters during this long period, are also treated of in this lecture.

Nor are the higher inducements to the study of natural science overlooked. There are a large class, even at present, to whom the nature and tendencies of geological science are a sealed book, and whose personal respect for its teachings, if it has dawned, has certainly not passed the miocene period. With some notions that the ground beneath us yields certain treasures, they have but little knowledge that it exhibits an order and arrangement consistent with the dictates of Infinite Wisdom. These persons, well-meaning though they may be, belong to a class not entirely extinct, who regard any allusion to the Volume of Nature as a book replete with lessons of divine truth, with feelings somewhat approaching to horror, forgetting that there is no true piety in depreciating the evidences to be derived from the study of the works of Nature.

The Appendix contains tables of the geological formations; diagrams illustrative of the geological structure of parts of Hampshire and Berkshire; detailed sections of the strata at some of the localities near Newbury which yield fossils, as well as an account of the peat-beds of the Kennet Valley, and also notices and illustrations of some of the characteristic fossils of the formations; so that this little treatise forms not only a useful guide to the physical structure of the district, but is also explanatory of the characters of the tertiary deposits in the western area of the London basin, while it may be equally consulted with advantage by the general reader, for the concise manner with which the leading points are enunciated.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

November 28, 1854.—Dr. Gray, Vice-President, in the Chair.

On two New Species of Dacnis, and on the General Arrangement of the Genus. By Philip Lutley Sclater, M.A.

1. Dacnis hartlaubi, Sclater. *D. turcoso-cærulea; gula loris et fascia per oculos lata cum cervice laterali et dorso superiore velutino nigris; alis caudaque minus splendide nigris; secondariorum marginibus externis cæruleis; rostro et pedibus nigris.*

Long. tota 4·5; alæ 2·6; caudæ 1·8 poll. Angl.

Hab. In Nova Grenada.

Obs. Similis *D. angelicæ,* sed major, gula nigra, ventre crissoque cæruleis concoloribus neque albis.

I have as yet seen only one example of this *Dacnis,* which is in the fine collection of birds in the Bremen Museum. In its upper colouring it resembles *D. angelica,* but wants the broad black front of that species. The lower plumage comes nearer that of *D. cayana,* but the black does not reach so far down the throat. It slightly exceeds the latter species in size. The bill and legs are black.

2. Dacnis egregia, Sclater. *D. turcoso-cærulea; fronte gula loris et fascia per oculos lata cum cervice laterali, dorso superiore, alis caudaque nigris; tectricibus alarum minoribus et secondariorum marginibus externe cæruleis; tectricibus subalaribus et ventre medio crissoque cum tibiis flavis.*

Hab. In Nova Grenada.

Obs. Species *D. angelicæ* forma crassitie et coloribus fere æqualis, sed ventre crissoque et tectricibus subalaribus flavis nec albis.

I am indebted to Mr. G. R. Gray for allowing me to name this pretty *Dacnis,* of which one specimen was lately acquired by the British Museum from M. Parzudaki of Paris. In its plumage above it resembles *D. angelica.* A glance, however, at its lower surface, where a bright yellow takes the place of the pure white belly and underwing-coverts of the other species, is sufficient to show its distinctness.

Since I wrote some papers on the genus *Dacnis* in Sir William Jardine's 'Contributions to Ornithology,' Professor Reichenbach of Dresden has treated of this family in his 'Handbuch der Speciellen Ornithologie,' part iv. Professor Reichenbach is unpleasantly surprised, he there says, to find that I have described a *Dacnis cayana,* which is by no means *cayana,* but no other than his third species, *D. cyanomelas.* Now, I admit that my *D. cayana* is nothing more than Prof. Reichenbach's third species, which he calls *cyanomelas*; but I maintain that this very bird is no other than the true *cayana* of Linnæus. There is no such bird in existence as that characterized by Prof. Reichenbach as *cayana*. Brisson's description, it is true, is bad, and Buffon's figure worse, but they can be respectively intended for no other bird than the common black and blue species which is called by Prof. Reichenbach *D. cyanomelas*.

I am in my turn unpleasantly surprised to find that Prof. Reichenbach has removed my *Dacnis cœrebicolor* into his genus *Arbelorhina*, with which it has nothing to do; that he has made *Dacnis flaviventris* of D'Orbigny's Voyage a *Conirostrum*, which it certainly is not, and has unnaturally placed the hook-billed *Diglossæ* in the middle of the typical *Dacnidinæ*.

The *atricapilla* of my former synopsis, Prof. Reichenbach has with some reason made the type of his new genus *Chlorophanes*.

Descriptions of Six New Species of Birds of the Sub-family Formicarinæ. By Philip Lutley Sclater, M.A.

1. Myrmeciza leucaspis, Sclater.

Supra cinnamomea, subtus alba; vitta laterali utrinque ab angulo oris ad ventrem descendente nigro; lateribus corporis cum ventre imo crissoque olivascenti-cinnamomeis; rostro nigro, mandibula inferiore, nisi basi, alba; pedibus pallidis; orbitis nudis.

Long. tota 5·5; alæ 2·8; caudæ 1·8.

Hab. In Peruvia, Chamicurros; in Nova Grenada; et Rio Negro, Cobati.

The first specimen of this bird that came into my possession seems by its make to be a Bogota skin. I have lately obtained a second from the MM. Verreaux of Paris, marked 'Peru.' But a more satisfactory locality is Chamicurros, on the Huallaga, one of the confluents of the Peruvian Amazon, whence Mr. Gould has lately received several examples, along with many other interesting birds. Mr. Gould's specimens were collected in the month of October, 1852. Male and female, so labeled, are coloured alike, and noted, "Irides red, skin around the eyes and legs light blue." My Bogota skin, and one in the MM. Verreaux's collection, have the base of the interscapularies light fawn-colour, forming a large blotch, which, however, as is often the case in the birds of this sub-family, is only to be seen when the feathers are raised.

A specimen of this bird in the British Museum is from Cobati, on the Rio Negro.

The upper plumage of the *Myrmeciza leucaspis* is wholly dark cinnamon-colour, and divided from the pure white of the lower surface by a black band. The wing-feathers are blackish within; the twelve rectrices are wholly darkish cinnamon-red. The white of the lower surface narrows as it descends, terminating in a point, and leaving the sides of the belly and crissum dusky olivaceous cinnamon-colour.

2. Myrmeciza margaritata, Sclater.

♂ *Cinereus, subtus dilutior, ventre medio crissoque albescentibus;*

alis caudaque nigris, rectricum apicibus albis; remigibus secondariis et alarum atque caudæ tectricibus superioribus omnibus maculis magnis, rotundis, albis terminatis.

♀ *Fusco-brunnea; subtus pallide cervino-rufa; maculis alarum et caudæ clare cervinis neque albis.*

Long. tota 5·3; alæ 2·8; caudæ 1·8.

Hab. In Peruvia, Chamicurros.

My examples of this curiously marked bird were obtained from the MM. Verreaux, and are from the same locality as the preceding species. Mr. Gould's collection from Chamicurros likewise contains specimens of both sexes.

The round spots, which render this bird a very recognizable species, are placed in the wing-coverts at the apex of each feather. In the secondaries they occupy the end of the outer web, being in the first six nearest the primaries rather small, in the three outer larger and squarer in form. The upper tail-coverts are much produced, and are conspicuously terminated with oval white spots. The tail-feathers are ended only with spots, which are larger on the outer rectrices.

3. Hypocnemis melanolæma, Sclater.

Cinereus, subtus valde dilutior; interscapularibus basi niveis; loris et oculorum ambitu cum cervice laterali et gutture toto nigris; linea superciliari indistincte albida; tectricibus alarum nigris, fascia terminali alba; remigibus et rectricibus fuscis, externe cinereis; rostro nigro, pedibus pallidis.

Long. tota 5·0; alæ 2·5; caudæ 1·6.

Hab. In Peruvia, Chamicurros.

This species seems nearly allied in form to the bird named *Hypocnemis pœcilonota* by Dr. Cabanis (Orn. Not. in Wiegm. Archiv f. Nat. 1847. p. 213), and I have therefore placed it temporarily in the same genus. My specimen comes, like those of the preceding species, from MM. Verreaux's Peruvian collection; and Mr. Gould has one example marked "*male, irides red,*" from Chamicurros, which agrees with mine. From the same Peruvian collection I have also *Hypocnemis pœcilonota* (Cab.) and *H. cantator* (Bodd.), the type of the genus, or a species hardly to be distinguished therefrom.

4. Hypocnemis melanosticta, Sclater.

♂ *Ex cinereo olivascens; interscapularibus basi niveis; tectricibus alarum nigris, albo anguste terminatis; loris et regione auriculari nigris; subtus cinereus, gutture toto et ventre medio albis; punctis paucis rotundis in summo pectore nigris; rostro nigro, pedibus pallidis.*

♀ *Supra rufescenti-olivacea, alarum tectricum marginibus et abdomine toto pallide ochraceis; gutture, sicut in mari, albo; mandibula inferiore, nisi apice, alba.*

Long. tota 5·0; alæ 2·5; caudæ 1·6.

Hab. In Peruvia, Chamicurros.

The Peruvian collection of the MM. Verreaux contained several examples of this prettily marked Ant-Thrush, and Mr. Gould has also ♂ and ♀ from Chamicurros. Both sexes show the white blotch at the base of the interscapularies. In form they nearly resemble *H. melanolæma* and *pœcilonota*. Below the white throat, both in male and female, are eight or ten round blackish spots, forming a sort of collar, which renders this species easily recognizable.

5. Formicivora caudata, Sclater.

♂ *Supra niger albo-striatus; nucha nigra; dorso postico ferrugineo; alis caudaque nigris; tectricibus alarum albo, remigibus autem primariis et secondariis rufo limbatis; rectricum macula terminali alba; subtus albus, sparsius nigro-striatus; ventre crissoque clare ferrugineis.*

♀ *Striis corporis superioris et tectricum alarum marginibus subrufescentibus; dorso postico et ventre dilutius ferrugineis; striis pectoris sparsioribus, in gula fere evanescentibus.*

Long. tota 5·8; alæ 2·1; caudæ 3·1.

Hab. In Nova Grenada.

A close ally of *Formicivora ferruginea* (Temm.) and its affines, from all of which, however, it may be distinguished by its extremely lengthened tail. My specimens were purchased in Paris, and are Bogota skins.

6. Pithys erythrophrys, Sclater.

Olivaceo-brunneus, subtus medialiter albus; fronte loris et regione superciliari utrinque clare ferrugineis; loris et regione auriculari nigris; striis quibusdam indistinctis in lateribus pectoris cinereis; alis caudaque nigricanti-brunneis, illius remigibus clare rufo-brunneo limbatis et tectricibus omnibus maculis parvis terminalibus albis.

Long. tota 4·5; alæ 2·7; caudæ 1·7.

Hab. In Nova Grenada.

This is not a true *Pithys*, I think, but I have placed it as such, as being allied to *Pithys leucophrys* ex Nova Grenada. But is the New Grenadian bird really identical with Tschudi's *Pithys leucophrys*?

Notes on the Habits of some Indian Birds. Part VI. By Lieut. Burgess.

Family Fringillidæ. Sub-Family Pyrrhulinæ.

Genus Pyrrhulauda.

Pyrrhulauda cruciger (Temm.).

Black-bellied Finch Lark.

This little finch lark is common in Western India, on open plains and grassy plots of ground. It is remarkable for its habit of squatting close on the ground when approached, trusting most probably to the similarity in colour of the plumage of the wings and back with that of the burnt grass and dusty ground to escape notice. This little lark breeds during the months of January and February, building its nest, which is composed of grass, threads, &c., in a hollow in the grassy plains which it inhabits. A nest of this species which was brought to me at the end of January was composed chiefly of grass; it contained two small eggs, of a grey tint, speckled with brown. They have been unfortunately broken. Dr. Jerdon says: "I was fortunate enough to obtain the nest and eggs of this bird very lately (February). The nest is composed of woven thread mingled with some fibres of grass and one or two small fragments of cloth. The sides are hardly raised at all; it was placed in a slight hollow on the open plain near a river, and contained two eggs, of a slight greenish-grey tint spotted with brown, chiefly at the larger end."

Tribe Scansores.

Family Psittacidæ. Sub-family Macrocercinæ.

Genus Palæornis.

Palæornis torquatus, Vigors.

The Red-ringed Parrakeet is by far the most common of its tribe throughout Western India, as probably throughout that continent. They associate in large flocks, doing much injury to fruit-trees and crops of grain. As the grain-crops ripen, they frequent the trees in the neighbourhood, whence they make descents on the fields, retiring to them with the heads of the grain plants, to eat at their leisure. As far as my observations go, they prefer carrying off the ears of the plant to eating the grain in the field. On the approach of night they retire in large flocks to the shelter of thick mango and other trees. This Parrakeet breeds during the month of March, in holes in buildings and trees, laying three or four eggs, of a pure white colour, $1\frac{3}{10}$ths of an inch in length by 1 inch in width.

Palæornis Alexandri. Large red-ringed Parrakeet.

I have never met with this large species, but I see that Dr. Jerdon mentions having obtained four young ones from a hole in a tree, in the month of December.

Palæornis bengalensis. Red-headed or Plum-headed Parrakeet.

I have had many opportunities of watching and closely observing the habits of these handsome little parrakeets, and am convinced that they are one and the same bird, the red-head being the mark of an advanced, if not mature plumage. In young birds, the plum-colour of the head is much mixed with green, the former colour becoming decided as the birds grow older, and this again giving way to the red head-dress. I have met with these birds in the woody ravines and recesses amongst the lower ranges of hills in the Deccan, also in the thickly-wooded garden-land near the cantonments of Ahmednuggur. In this latter spot I have often watched them in the hope of securing one of the richly-coloured red-headed birds. They fly in flocks like *Palæornis torquatus*, visiting the grain-fields, and carrying off the ears to the neighbouring trees. Their cry is not so loud and harsh as that of their larger brethren, and they may thus be distinguished when not seen. I scarcely ever saw more than two or three red-headed birds amongst a flock of plum-heads. I have not met with the nest or eggs of this species, but from the very immature plumage of young birds which I shot in January, I should say that they breed in November and December.

Family Cuculidæ. Subfamily Cuculinæ.

Genus Eudynamys.

Eudynamys maculatus. Black Cuckoo or Koweel.

Not having met with the nest and eggs of this cuckoo, I am indebted to Dr. Jerdon's catalogue for the following note on the subject:—"The koweel (as is well known in India) lays its eggs in the nest of the common crow (*C. splendens*), from which it dislodges the crows' eggs. It is said always to choose this crow's nest. On one occasion I obtained an egg from the female koweel; it was of a dirty blue colour, marked with some dusky spots."

Genus Centropus.

Centropus philippensis (Cuv.). Lark-heeled Cuckoo.

This very common cuckoo, called by many Europeans in India "the Malabar Pheasant," is a bird remarkable for its appearance, and peculiarly loud cry. Its bright chestnut wings and long tail render it conspicuous, and from the length of the latter, the name of Pheasant has doubtless been applied to it. Like others of its kind, it is fond of thickets and hedges, under the latter of which it may often be observed walking about and picking up its food, which consists of lizards, seeds and insects. Though classed in the family of the *Cuculidæ*, this bird differs from *Cuculus canorus* and *Eudynamys maculatus* in one marked respect, viz. that it does not deposit its eggs in the nest of another bird. Like the yellow-billed American cuckoo, *Coccyzus americanus* (Jenyns), it builds its own nest, but whether, as Mr. Yarrell mentions, in the case of the American bird, its egg is ever found in another bird's nest, I cannot say: I never heard of such a case.

The lark-heeled cuckoo breeds in the spring of the year, as early as January and as late as April. It builds its nest in hedges and trees; the nest is composed of grass and small twigs. The eggs, generally three in number, are of an opaque white, $1\frac{1}{2}$ inch in length by 1 inch and $\frac{2}{10}$ths in width. The exterior of the shell is of a peculiarly soft, chalky texture, which soon becomes scratched and stained.

Tribe Tenuirostres.

Family Cinnyridæ.

Cinnyris orientalis, Frankl. Purple Honeysucker.

As I am anxious to make these papers as complete as possible on the nests and eggs of the birds of Western India, I have taken the liberty of transcribing some of the observations made by Dr. Jerdon of the Madras cavalry, in cases where I have not been able to obtain information. With regard to the nest and eggs of this honey-sucker he says: "I have lately (February) seen the nest of this pretty little bird close to a house in Jaulnat. It was commenced on a thick spider's web, by attaching to it various fragments of paper, cloth, straw, grass, and other substances, till it had secured a firm hold of the twig to which the web adhered, and the nest suspended on this was then completed by adding other fragments of the same materials. The hole is at one side near the top, and has a slight projecting roof or awning over it. The female laid two eggs, of a greenish-grey tinge, spotted with dusky. The first nest it made was accidentally destroyed after two eggs had been laid, and the couple immediately commenced building another in a small tree at the other side of the door, and, as in the first instance, commenced their operations on a fragment of a spider's web. They reared two young ones from the nest."

January 9, 1855.—Dr. Gray, Vice-President, in the Chair.

On the Genus Culicivora of Swainson, and its component Species. By Philip Lutley Sclater, M.A., F.Z.S.

The genus *Culicivora* (as established by Mr. Swainson in the Zoological Journal for 1827) has the *Muscicapa stenura* of Temminck for its type, but embraces also the *Muscicapa cærulea* of Wilson and its affines. Now these birds belong in reality to two very different groups; the *M. stenura* being a *Tyrannine*, while the *M. cærulea* can hardly be placed within the limits of that family, but must be arranged either with the old-world *Muscicapines* (as in Bonaparte's Conspectus) or with the *Sylvians* (as in Gray's Genera of Birds). Dr. Cabanis in his *Ornithologische Notizen*, in Wiegmann's Archiv, has rightly separated these two forms, but has unfortunately chosen to call the *M. cærulea* and its allies *Culicivora*, and made a new name *Hapalura* for the *M. stenura*—the true *Culicivora* of Swainson. Under these circumstances *Hapalura* is a mere useless synonym of *Culicivora*, Sw., and a new name is required for the group containing *M. cærulea*, and commonly known as *Culicivora*. I therefore propose for it the term *Polioptila*, from the general grey colouring of the plumage.

The species of this genus that I am at present acquainted with are the following:—

1. Polioptila cærulea (Linn.).

Motacilla cærulea, Linn. *Muscicapa cærulea*, Wils. Am. Orn. ii. p. 164. pl. 18. fig. 5; Audub. pl. 84 ♂ & ♀.

♂ *Cæruleo-cinerea, fronte et superciliis nigris: subtus cærulescenti-alba, rectricibus extimis albis.*

♀ *Mari similis, sed linea superciliari et frontali nulla.*

Hab. United States, Texas, and Mexico.

I cannot discover how the *Culicivora mexicana*, Bp. Consp. p. 316 (of which I have examined the type in the Berlin Museum), differs from this species. It appears to me to be merely a female of the present bird.

2. Polioptila dumicola (Vieill.).

El Contra-maestre azuladillo, Azara, no. 158, unde *Sylvia dumicola*, Vieill. *C. dumicola*, d'Orb. Voy. Ois. p. 331. *C. boliviana*, Sclater, in Proc. Zool. Soc. 1852, p. 34. pl. 47.

♂ *Supra plumbea: fronte et genis nigris: subtus plumbescenti-alba, ventre et rectricibus utrinque extimis albis.*

♀ *Fronte et regione auriculari plumbeis concoloribus.*

Hab. Paraguay (Azara); Corrientes and Buenos Ayres in the Argentine Republic, and Chiquitos and Moxos in Bolivia (d'Orb.).

D'Orbigny and Lafresnaye in their Synopsis in the Magasin de Zoologie, Hartlaub in his Index to Azara, and Bonaparte in his Conspectus, have all more or less confounded the synonyms of this species with those of the next; indeed the latter author has united all the synonyms under one head, and I was thus led into the error of describing the present bird as new. It is without doubt however the Azuladillo of Azara, and consequently must bear the specific name '*dumicola*' of Vieillot. Lichtenstein's name '*bivittata*' belongs to the next species, though the above-mentioned authors have quoted it as synonymous with this.

3. Polioptila leucogastra (Max.).

Pl. Enl. 704. fig. 1, unde *Motacilla cærulea*, var. β. Gm. *Sylvia leucogastra*, Max. Beit. iii. 710. *S. bivittata*, Licht. in Mus. Berol. *C. atricapilla*, Sw. Zool. Ill. n. s. pl. 57. *C. leucogastra*, Gray's Gen. ? *C. dumicola*, Bp. Consp. p. 316.

♂ *Cinerea, pileo nigro: subtus alba, rectricibus utrinque extimis albis.*

♀ *Pileo concolore cinereo.*

Hab. Brazil; Bahia (Pr. Max.); Monte Video (Mus. Berol.); Cayenne (Buffon): New Grenada.

This species is described by Prince C. L. Bonaparte in his Conspectus as *C. dumicola*, from which it may be easily distinguished by its black head.

4. Polioptila bilineata (Licht.).

Sylvia bilineata, Licht. in Mus. Berol. *Culicivora bilineata*, Bp. Consp. p. 631.

♂ *Supra plumbea, pileo nigro: loris superciliis et corpore subtus albis: primariis anguste cinereo, secondariis latius albo marginatis: rectricibus extimis apice albis.*

♀ *Pileo concolore plumbeo : superciliis albis.*

Hab. Cartagena (Mus. Berol.).

The type-specimens in the Berlin Museum are the only examples I have seen of this species; which may be at once distinguished from all the preceding by its white superciliary stripe.

Remarks on the Arrangement of the Jacamars (Galbulidæ), with Descriptions of some New Species. By Philip Lutley Sclater, M.A., F.Z.S.

Since I wrote some articles on the *Galbulidæ*, which appeared in Sir William Jardine's Contributions to Ornithology, and the little Synopsis of the family afterwards printed apart, I have lost no opportunity of examining specimens of these birds in several museums which I have visited. In so doing I have acquired some additional information concerning them, which I now purpose bringing before the Society, together with characters of what I believe to be three hitherto unrecognized species.

Genus 1. Galbula.

1. *viridis*, Lath. Synopsis of the *Galbulidæ*, p. 2. sp. 1.

Dr. Cabanis, in his article upon these birds in Ersch and Gruber's Encyclopädie, calls the Amazon specimens true '*viridis*,' and separates the Cayenne and Guiana bird from them, under Swainson's title '*viridicauda*.' I cannot myself discover much difference between them. Prince C. L. Bonaparte quotes as a species '*quadricolor*,' Verreaux, a MS. name for which no specific characters have been published. A specimen so labelled in the British Museum is from Peru, but seems to me barely separable from *G. viridis*.

2. *rufoviridis*, Cab. Enc. d. W. u. K. vol. lii. sect. 1. p. 308. *G. maculicauda*, Synopsis, p. 2. sp. 2.

Dr. Cabanis' name has, I believe, a few months' precedence in point of date over my '*maculicauda*,' and must therefore be used for this species. As additional localities, I have now: River Tocantins, Brazil (Mr. Wallace), and Bolivia (Bridges, in Mus. Brit.).

3. *melanogenia*, Sclater. Synopsis, p. 3. sp. 3.

I have since seen other specimens of this species, both male and female, all from Central America.

4. *ruficauda*, Cuv. Synopsis, p. 3. sp. 4.

Add, as localities: Tobago (Kirk); Cumana (Dyson); Cartagena (Mus. Berol.).

These four species are, as I have already remarked (Cont. to Orn. 1852, p. 93), very closely allied to one another, but may be distinguished by the colouring of the rectrices. They are not, however, placed together in Prince C. L. Bonaparte's arrangement in his Conspectus Zygodactylorum.

5. *tombacea*, Spix (*cyanescens*, Deville).

From the Upper Amazon and eastern provinces of Peru.

6. GALBULA FUSCICAPILLA, Sclater, sp. nov.

♂ *Læte viridis ; fronte et pileo summo fuscis : nucha paululum cyanescente : mento albido : ventre crissoque intense castaneis : rectricibus extimis rufis, quatuor mediis supra viridibus dorso concoloribus.* Long. tota 8·0, alæ 3·0, caudæ 3·5.

♀ *Ventre valde dilutiore.*

Hab. In Nova Grenada, Bogota.

I have hitherto confounded this species with the *G. tombacea*, but the examination of several examples of the latter bird in the continental museums has convinced me that they are quite distinct, the *tombacea* presenting no appearance of the fuscous crown which distinguishes this species. In one of my specimens, apparently the most adult, the green descends much lower down than in others I have seen. The two outer rectrices of this bird are, as is usual in this genus, abnormally small. The first outer normal pair are rufous, tipped and externally edged with green. This green is blackish below, but above vivid as the back. The next two pair are wholly rufous. The middle four are vivid green above, and blackish-green below; the submedial pair having some rufous colouring inwardly towards the base.

7. *albirostris*, Latham. Synopsis, p. 5. sp. 6.

8. *chalcocephala*, Deville. Synopsis, p. 5. sp. 7.

I have lately seen many specimens ♂ and ♀ of this species. The male has a white bar on the throat, as in *G. albirostris*, with which it is certainly *very* closely allied. In his 'Conspectus Zygodactylorum,' Prince C. L. Bonaparte unites this species with *G. leucogastra*, with which it has nothing to do. In the 'Conspectus Anisodactylorum,' the origin of this error is attributed to an opinion of mine that they were identical (!), which however I never either expressed or entertained.

9. *cyanicollis*, Cassin. Synopsis, p. 6. sp. 8.

Specimens of this bird in the Berlin Museum,—the types of *G. cyanopogon*, Cab.,—are from Cametà, which is on the south of the Amazon, in the province of Para. The female is pale rufous below, instead of chestnut-red.

10. *leucogastra*, Vieill. Synopsis, p. 6. sp. 9.

11. *chalcothorax*, Sclater, Proc. Zool. Soc. 1854, p. 110.

From Quixos in Ecuador.

Genus 2. UROGALBA, Bp.

1. *paradisea* (Linn.). Synopsis, p. 8. sp. 11.

2. UROGALBA AMAZONUM, Sclater, sp. nov.

U. purpurascenti-nigra : alis caudaque et hujus tectricibus superioribus æneis : mento nigrescente, gutture late albo : pileo antico albescenti-fusco : rostro pedibusque nigris.

Long. tota 13·0, alæ 3·8, caudæ 6·5.

Hab. In Brasil. Boreali, Para, et fl. Amazonum.

Obs. Similis *U. paradiseæ*, sed major et pileo antico albescente fusco.

It is not without hesitation that I separate this bird from the former. I have seen many examples of it from North Brazil, and have always remarked that they differ from the Cayenne *U. paradisea* in size and in the whiteness of the forehead. Mr. Wallace brought specimens from the neighbourhood of Para, whence I believe came also my type, which I purchased in Hamburg. I may remark that there are many other corresponding species of birds in Cayenne and Brazil, of which the distinctness is generally admitted (such as *Pteroglossus aracari* and *Wiedi, Caryothraustes cayanensis* and *brasiliensis*, and *Piprites chlorion* and *chloris*), which depend upon differences similar to, or perhaps less than, those between *Urogalba paradisea* and *U. amazonum.*

Genus 3. Brachygalba, Bp.

1. *inornata*, Sclater, Synopsis, p. 7. sp. 10. *Brachygalba albiventris*, Bp. Consp. Vol. Zygodact., nec Cuv.

To the localities add: Quixos in rep. Equat. (Sir W. Jardine), and Angostura on the Orinoco (Mus. Kiliens.).

The female has the belly rufous instead of white. This species is certainly not the *albiventer* of Cuvier, that name having been applied by him to Le Vaillant's figure, Supp. II. (cited by Cuvier, insufficiently perhaps, but not incorrectly, by the number of the page, 46), and consequently a synonym of Vieillot's *leucogastra*, as placed by me in my Synopsis (see Cuvier's Règn. An. (1829) i. p. 448). I had supposed *G. albigularis* of Spix, and not this species, to be the type of *Brachygalba*, Bp., because it stood first in the list. When the creator of a genus gives neither generic characters nor type, the only rule to go by is to take the *first* species given as the type species.

2. Brachygalba melanosterna, Sclater, sp. nov.

Supra nigricanti-fusca; subtus nigra; mento albido: ventre medio albo: alis caudaque æneseentibus: rostro albo.

Hab. Goyaz in imp. Brasiliensi (Behn); Guarayos in Bolivia (d'Orb.)?

I observed a specimen of this species in the collection of Professor Behn, at Kiel. It closely resembles the preceding, but has the breast quite black and the bill white. It was brought by the owner from the province of Goyaz, in the interior of Brazil. D'Orbigny's specimen, mentioned in my Synopsis, page 7, probably also belongs to this species.

I have nothing further to say concerning *Jacamaralcyon* and *Jacamerops*. The *Galbuloides Boersi* is probably a fictitious bird. Specimens of *Galbalcyrhynchus* in the Paris Museum were brought by MM. Castelnau and Deville from Pebas, on the Upper Amazon; and one of these birds, in the collection of Herr Kalckmann of Hamburg, was procured in the neighbourhood of Pernambuco in Brazil.

Excluding therefore the *Galbuloides*, we have at present no less than twenty species of the family *Galbulidæ*, all inhabiting the tropical portions of South America. One only of these birds is found outside the Isthmus of Panama, and none occur on the western side of the Andean range. Azara includes none among the birds of Paraguay, and two only range so far south as the Brazilian provinces of Rio and S. Paolo. The true home of these birds seems to be the hot, low forests of Guiana and the Amazons, where the number of species attains its greatest development.

GALBULIDARUM TABULA GEOGRAPHICA.

	Veragua.	New Grenada.	Trinidad.	Venezuela.	Guiana.	Lower Amazon.	Rio Negro.	Rio Napo.	Upper Amazon.	East Peru.	Interior Brazil.	N.E. Brazil.	S.E. Brazil.	Bolivia.
GALBULA.														
1. *viridis*	...	...	...	...	*	*	...	...	...	*?	...	...	...	...
2. *rufoviridis*	...	...	...	...	...	...	...	...	...	...	...	*	*	*
3. *melanogenia*	*	...	...	...	...	...	...	...	...	...	...	...	...	...
4. *ruficauda*	...	...	*	*	*	...	...	...	...	...	...	...	...	...
5. *tombacea*	...	...	...	...	...	...	...	...	*	*	...	...	...	...
6. *fuscicapilla*	...	*	...	...	...	...	...	...	...	...	...	...	...	...
7. *albirostris*	...	...	...	...	*	...	*	...	...	...	...	...	...	...
8. *chalcocephala*	...	...	...	...	...	...	...	...	...	*	...	...	...	...
9. *cyanicollis*	...	...	...	...	...	*	...	...	...	...	...	*	...	...
10. *leucogastra*	...	...	...	...	*	...	*	...	...	...	...	...	...	...
11. *chalcothorax*	...	...	...	...	...	...	...	*	...	...	...	...	...	...
UROGALBA.														
12. *paradisea*	...	...	...	...	*	...	...	...	...	...	...	...	...	...
13. *amazonum*	...	...	...	...	...	*	...	...	...	...	...	...	...	...
BRACHYGALBA.														
14. *inornata*	...	...	...	*	...	...	...	*	...	...	...	...	...	...
15. *melanosterna*	...	...	...	...	...	...	...	...	...	...	*	...	...	*
JACAMARALCYON.														
16. *tridactyla*	...	...	...	...	...	...	...	...	...	...	...	...	*	...
17. *lugubris*	...	...	...	...	*	...	...	...	...	...	...	...	...	...
JACAMEROPS.														
18. *grandis*	...	...	...	...	*	...	*	...	*	*	...	...	...	...
19. *Isidori*	...	...	...	...	...	...	...	...	...	*	...	...	...	...
GALBALCYRHYNCHUS.														
20. *leucotis*	...	*	...	...	...	...	...	*	*	...	...	*?	...	...

BOTANICAL SOCIETY OF EDINBURGH.

November 8, 1855.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On the *Batrachian Ranunculi* of Britain," by C. C. Babington, M.A., F.R.S. (See Annals, vol. xvi. p. 385.)

2. "Note on *Linaria sepium*, Allman," by C. C. Babington, M.A., F.R.S. (See Annals, vol. xvi. p. 449.)

Professor Allman remarked that he found some difficulty in allowing the plant to be a hybrid, as represented by Mr. Babington, but that, from a recent examination of specimens at Bandon, he believed it to be only a variety of *L. repens*.

3. "On the Influence of Last Winter on Trees and Shrubs at Aberdeen," by G. Dickie, M.D., Professor of Natural History, Queen's College, Belfast.

4. "Notice of the Flowering of the *Victoria regia* in the Royal Botanic Garden, Glasgow," by Mr. Peter Clarke, Curator of the Garden.

5. "On the Structure of *Victoria regia*, Lindl.," by Mr. George Lawson.

The lower surface of the *Victoria* leaf is somewhat peculiar. It exhibits no stomata, but is thickly clothed with flexuous hairs, consisting of cylindrical cells, and arising each from a small round basal cell, very distinct both from the other cells of the hair and those of the epidermis, which latter are filled with diffused colouring matter, mostly red, but some blue, and a few without colour. These hairs average about the $\frac{1}{55}$th part of an inch in length, by the $\frac{1}{490}$th of an inch in breadth. There are seen scattered over the surface, in addition to the hairs, numerous round cells, precisely similar to those which form the bases of the hairs; these apparently indicate non-developed hairs. The arrangement of these cells (taking together those which form the bases of hairs and those whose hairs are abortive) is so strikingly similar to the arrangement of the stomata on the opposite surface of the leaf, as to suggest the question whether these cells are not homologous with the stomata—are, in fact, the cells from which stomata would be evolved if they were produced. This idea is strengthened by the fact that a trace of chlorophyll is seen in these cells, while it is entirely absent in the ordinary epidermal cells, but present in well-defined globules in the cells of the true stomata. Whatever be the homological relationship between the hairs and the stomata, there can be no doubt that the cells to which I have alluded represent undeveloped hairs.

6. "Notice of some of the Contents of the Museum of Œconomic Botany in the Edinburgh Botanic Garden," by Professor Balfour.

MISCELLANEOUS.

Observations on the Blistering Beetles of the Neighbourhood of Montevideo. By M. A. Courbon.

The author states that three species of blistering Cantharides are found in the neighbourhood of Montevideo,—namely the *Epicauta adspersa*, Dej. (*Lytta adspersa*, Klug), the *Epicauta cavernosa*, Reiche, and the *Causima vidua*, Dej. (*Lytta vidua*, Klug).

Of these, the first, the *Epicauta adspersa*, is superior even to the ordinary Cantharides (*Cantharis vesicatoria*) in its vesicating power, and possesses the additional advantage that its application produces no irritating action on the urinary organs, such as is usually caused by the common Cantharides. The author discovered this when treating a patient for acute hepatitis, by applying blisters upon the seat of pain; the *Epicauta adspersa* caused no inconvenience to the patient; but on one or two occasions, when blisters of the *Cantharis vesicatoria* were used, they produced the customary irritation of the urinary organs.

This species is exceedingly abundant in the immediate neighbourhood of Montevideo in the months of December, January, February and March, but especially in January and February. Its length is 13–16 millimeters ($6\frac{1}{2}$–8 lines); it is covered with minute grey scales, in the midst of which appear numerous small black points. The antennæ are black, and the feet yellow or reddish. It lives on the common Beet (*Beta vulgaris*, var. *Cicla*), and may be very easily collected, especially in the morning and evening, by taking a large sack with a few beet-leaves at the bottom of it to the places where this plant grows in abundance, cutting off the stems of the plants close to the root and shaking them into the sack. The insects may then be killed by exposing them to the vapour of vinegar, or by packing them closely in a glass vessel, closing them up hermetically, and exposing them to the heat of the sun.

The second species, the *Epicauta cavernosa*, is about the size of the preceding species, but is of a yellow colour, with three small black lines on the head, numerous small black points on the thorax, and large impressed black dots on the elytra. The legs are reddish. It is a rare species and occurs only on the *Eryngium paniculatum*, an umbelliferous plant which is very abundant on the Cerro de Montevideo. Its vesicating power is about equal to that of the common *Cantharis*.

The *Causima vidua* is a much larger species, measuring 22–27 millimeters ($\frac{7}{8}$ in. to $1\frac{1}{12}$ in.), and is entirely black, except an indistinct white border which sometimes occurs at the extremity of the elytra. It is found on two leguminous plants, *Adesmia pendula* and *A. punctata*, especially on the former; it devours the flowers. It occurs in the months of November, December and January. It is less abundant than the *Epicauta adspersa*, but may be collected in the same manner, and its vesicating power is at least equal to that of the officinal species. The author did not ascertain whether it acted upon the urinary organs.

The author adds that the vesicating power of these insects resides in all the soft internal parts, and not, as stated by M. Farines of the common Cantharides, only in the soft parts of the thorax and abdomen. He found that the internal parts of the head and thighs employed by themselves were as efficacious as those of the body, but the hard parts as usual were destitute of any action. He states that this applies also to the officinal species.—*Comptes Rendus*, Dec. 3, 1855, p. 1003.

UNUSUAL DEARTH OF ALGÆ IN 1855.

Devonport, 19th October 1855.

MY DEAR SIR,—The present year has been marked by an unusual dearth of Algæ on all the Devonshire coasts, and this I have not only had evidence of myself, but it has also been noticed by *all* my correspondents, who are rather numerous.

A great many species, which for several successive years I have been in the habit of finding whenever I sought for them, with as much certainty as I should in going into my own garden to cut a cabbage, have altogether disappeared, that is, those plants growing between the extremes of high and low water marks. This unusual occurrence from the ordinary course, after careful consideration, I am inclined to assign to atmospheric influence.

The early months of the present year, not including those which we usually assign to winter, such as March, April and May, were exceedingly cold, and frosty nights were not unfrequent even in the latter end of May. Our lowest tides here occur at the advent of the new and full moon from about twelve to one o'clock. Plants beginning to grow *between the tidal limits* were thus exposed to a very low temperature during the night; but a very different result followed at the next low water, occurring at noon, twelve hours after. Here, those plants were subjected to the influence of a vertical sun, and these alternate changes from a high to an extreme low temperature, being followed up during many successive nights and days, had the effect of destroying them altogether. I am the more convinced that my views on this subject are correct, inasmuch as I found all the missing plants by dredging in deep water, and where they could not be affected by changes in the atmosphere.

Believe me, dear Sir, very faithfully yours,

Dr. J. E. Gray. JOHN COCKS.

Observations on Echini *Perforating the Granite of Brittany.* By M. VALENCIENNES.

The attention of naturalists has always been awakened by the curious habit of many Mollusca and Zoophyta, of excavating cavities for their habitation in rocks often of great hardness and of very different natures. It was at first supposed that these perforating animals only attacked the calcareous rocks, which led several people to think that the erosion required to form the hole was assisted by the action of some acid. It has been admitted of necessity, however, that in particular cases the animals only employed mechanical means, as the Teredos and the Pholades and even the Sipunculi were found to pierce wood. Of late years naturalists have observed felspathic rocks burrowed by Mollusca. M. Caillaud of Nantes sent to the Academy specimens of granite from Pouliguen in the Bay of Croisic, perforated by Pholades. The striæ traced in the holes, corresponding with the spiny ribs of the shell of these mollusks, furnished an evident proof that the rock had been abraded by the movement communicated by the animal to the shell. Granite altered by sea-water is more readily attacked.

More recently M. Eugène Robert exhibited to the Academy a block of old red sandstone, obtained from the shore of the great Bay of Douarnenez, which was perforated with numerous holes evidently formed by the Echini which were lodged in them. Each rounded cavity is in exact proportion, both as to size and form, with the body of the Echinoderm.

M. Lory, Professor at Grenoble, and well known for his numerous and excellent works on geology, has begged me to exhibit several specimens of perforating Echini, which have taken up their abode in the granite of the Bay of Croisic, not far from Piriac. It is the same granite as that from the Pouliguen, and in the same state of alteration. This primitive rock is there perforated by Mollusca and Echinodermata for an extent of several kilometers. Those which M. Lory has just discovered are certainly of the same species as the Echini which burrow in the old red sandstone of the Bay of Douarnenez. They closely resemble the Mediterranean *Echinus*, mentioned by Lamarck under the name of *Echinus lividus*. It is one of the most abundant Echini on the coast, and in the market of Marseilles, whence Lamarck obtained his specimens. I have never heard that these individuals possessed perforating habits, and probably a careful examination of living specimens of the Echinus from the coast of Brittany may show that it belongs to a distinct species, notwithstanding its apparent identity with that of the Mediterranean. In this case it might be called *Echinus terebrans*.—*Comptes Rendus*, Nov. 5, 1855, p. 755.

NEW SPECIES OF MAMMALS AND BIRDS.

The well-known naturalist Eversmann has recently published a very interesting paper*, containing an account of some of the most recent additions to the Mammalogy and Ornithology of the Russian Empire. The species described are—

1. Vesperugo Krascheninikovii, n. sp.

V. dentes primores superiores duo interni bifidi, externi simplices minuti: auriculæ capite breviores, latæ, rotundato-subtriangulares, trago reniformi, dimidiam aurem non attingente: vellus nigrum, pilorum apicibus canis.

A new species of Bat, belonging to the section of the genus *Vesperugo* with 34 teeth—5 molars in both jaws on each side;—it is

* Noch ein kleiner Beitrag zur Mammalogie und Ornithologie des Russischen Reiches, von Dr. Eduard Eversmann; Bull. de la Société Impériale des Naturalistes de Moscou, 1853, no. iv. p. 487.

found on the Ural, and is not uncommon in Orenburg, ; it may therefore be included in the fauna of Europe.

2. Vesperugo Nilsoni, Keys. et Blas. Wirbelth. Eur. no. 88. p. xiv.

3. Vespertilio dasycnemus, Keys. et Blas. Wirbelth. Eur. no. 98. p. xvi.

Both these Bats also occur on the Ural and Southern Wolga.

4. Vanellus Aralensis, n. sp.

V. fusco-cinerascens, abdomine, cauda remigibusque secondariis candidis; primariis nigris: alarum tectricibus nigro alboque marginatis: pedibus flavis.

A new Plover, only half the size of *V. gregarius*, Pall. (*i. e. Chettusia gregaria*), to which at first sight it shows some resemblance, especially in respect of its grey colour. It is from the south Kirges-steppes, which form the northern shores of the Sea of Aral.

5. Lanius mollis, n. sp.

L. superne cinereo-vinaceus, subtus albidus (fuscescenti-undulatus) crisso hypochondriisque vinaceis: fascia oculari nigra; remigibus nigris; 4^ta^–9-^na^ basi albis: rectricibus nigris apice albis.

Dr. Eversmann gives a further accurate account of this, as of the other mammals and birds mentioned in his paper. This Lanius is described as being larger than *L. excubitor*; it was received from the South Altai, not far from the Chinese boundary on the *Tschuja*. It appears to be different from all the species of *Lanius* described by Prince Bonaparte in his excellent review of that genus in the 'Revue et Magasin de Zoologie' for 1853.

Dr. Eversmann's paper also contains some interesting remarks about the supposed varieties of *Dipus jaculus* met with on the southern steppes, which he considers form two distinct species, different from the *jaculus*,—*D. decumanus*, Licht., and *D. vexillarius*, Eversm.; also upon the distinctions between *Lanius phœnicurus*, Pallas, and the common *Lanius collurio*.—Philip Lutley Sclater.

Description of a New Bird from Guatemala, forming the type of a New Genus. By John Gould, F.R.S. etc.

Genus Malacocichla, Gould.

Gen. Char. Bill straight, shorter than the head; culmen keeled, and slightly descending from the middle to the point; tomiæ nearly straight; upper mandible slightly notched at the tip; nostrils placed in a deep depression on each side of the base of the bill; rictus destitute of vibrissæ; wings semiconcave, moderately long and slightly rounded; first quill very short, the fourth the longest; tarsi somewhat lengthened and with slight or delicate scutellations; middle and hind toes very long; tail moderately long, somewhat concave, and soft to the touch.

This form is closely allied to *Grallaria* and *Chamæza*, and would appear to unite the members of those genera to those of *Turdus*. It is very elegant, all the parts being admirably proportioned; and the colours harmoniously arranged.

MALACOCICHLA DRYAS.

Head, cheeks and ear-coverts jet-black, the feathers of the crown somewhat lengthened; back, wings and tail dark greenish-olive; centre of the throat and under surface pale buffy-yellow, blending into the olive of the upper surface on the flanks; the feathers of the breast and upper part of the abdomen tipped with olive; bill and eyelash orange-red; legs and feet orange-yellow.

Total length 7 inches; bill $\frac{7}{8}$; wing $3\frac{3}{4}$; tail $2\frac{7}{8}$; tarsi $1\frac{1}{2}$; middle toe and nail $1\frac{1}{16}$; hind-toe and nail $\frac{3}{4}$.

Hab. Guatemala.

Remark.—In size this bird is rather smaller than the European Redwing, *Turdus Iliacus.—From the Zoological Proceedings,* Nov. 28, 1854.

THE LATE MR. NEWPORT.

A plain but handsome monument, of Aberdeen granite, has recently been placed in the cemetery of Kensal Green, to the memory of the late George Newport, the eminent naturalist and physiologist. The inscription on the stone, which we give below, implies strongly, if it does not formally express, the merits of the deceased. The fact of having a public monument raised to him by those who knew him best, his friends and fellow-workers, is an eulogy of a kind which can never be called in question, though his own scientific writings constitute his best and most enduring epitaph.

INSCRIPTION.

Sacred to the Memory of GEORGE NEWPORT, F.R.S., F.L.S., F.R.C.S. &c. &c. He was born in Canterbury on the 4th day of July, 1803, and died in London on the 7th day of April, 1854. This monument was erected by Fellows of the Royal and Linnæan Societies to commemorate their regret for the loss of a much-esteemed colleague, and to testify their sense of the great services rendered by him to Science.

METEOROLOGICAL OBSERVATIONS FOR NOVEMBER 1855.*

Chiswick.—November 1. Cloudy: frosty at night. 2. Overcast and cold: heavy rain. 3. Showery. 4. Fine. 5. Clear: dense fog: very fine: rain. 6. Fine. 7. Cloudy. 8. Constant heavy rain. 9. Slight fog: fine. 10. Foggy: very fine: foggy at night. 11. Very fine: cloudy. 12. Hazy. 13. Overcast. 14. Fine: frosty at night. 15. Frosty and foggy: very fine: dense fog at night. 16. Dense fog. 17. Fine: cloudy: rain. 18. Hazy: cloudy: rain. 19. Rain. 20. Drizzly: fine. 21. Overcast: rain. 22. Drizzly: overcast: fine. 23. Cloudy. 24. Cloudy and cold: showery. 25. Cloudy: clear: sharp frost at night. 26. Very fine. 27. Overcast: slight rain. 28. Overcast: cloudy: lunar rainbow at 10 P.M. 29. Overcast: cloudy. 30. Overcast: very fine.

Mean temperature of the month	40°·84
Mean temperature of Nov. 1854	39 ·35
Mean temperature of Nov. for the last twenty-nine years ...	42 ·95
Average amount of rain in Nov.	2·347 inches.

Boston.—Nov. 1. Fine. 2. Fine: rain P.M. 3. Cloudy: rain P.M. 4. Fine: rain A.M. 5. Cloudy: rain P.M. 6. Rain A.M. 7. Cloudy. 8. Cloudy: rain A.M. and P.M. 9. Fine. 10. Cloudy. 11. Fine. 12—15. Cloudy. 16, 17. Fine. 18, 19. Cloudy: rain P.M. 20. Cloudy. 21. Cloudy: rain P.M. 22, 23. Cloudy: rain A.M. and P.M. 24. Cloudy: rain P.M. 25. Cloudy. 26. Fine. 27. Cloudy: rain P.M. 28. Cloudy: rain A.M. and P.M. 29. Cloudy: rain P.M. 30. Cloudy.

* The observations by the Rev. C. Clouston of Sandwich Manse, Orkney, have not been received.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1855. Nov.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
☾ 1.	29·704	29·667	29·36			44	27	34·5			n.	n.		....	·40	
2.	29·727	29·579	29·38			47	34	36			nw.	n.		·49	....	
3.	29·877	29·616	29·44			46	33	44			ne.	ne.		·03	·74	
4.	30·123	29·983	29·15			46	24	42			ne.	n.		·01	·14	
5.	30·180	30·161	29·77			50	32	41			w.	nw.		....	....	
6.	30·118	29·988	29·69			59	46	45·5			sw.	s.		·02	·10	
7.	29·857	29·662	29·40			55	43	49			sw.	s.		·02	·02	
8.	29·587	29·487	29·13			52	27	45·5			sw.	s.		·56	....	
● 9.	29·801	29·751	29·40			59	40	36			s.	s.		·02	·06	
10.	30·045	29·807	29·44			58	36	47			s.	s.		....	....	
11.	30·226	30·164	29·75			58	44	39			sw.	s.		....	....	
12.	30·182	30·090	29·80			50	42	45			se.	s.		....	....	
13.	30·012	29·972	29·66			48	37	45			ne.	calm		....	....	
14.	30·008	29·949	29·55			46	24	41			ne.	nw.		....	....	
15.	30·168	30·084	29·69			47	22	41			w.	wnw.		....	....	
☽ 16.	30·234	30·187	29·87			42	27	27·5			sw.	w.		....	....	
17.	30·223	30·185	29·94			47	42	30·5			ne.	nw.		....	....	
18.	30·171	30·160	29·84			47	39	46·5			ne.	e.		·06	....	
19.	30·069	30·010	29·78			47	38	42·5			e.	ene.		·05	·03	
20.	30·003	29·871	29·72			44	37	41			ne.	e.		·01	·01	
21.	29·889	29·835	29·58			43	36	40			ne.	e.		·02	....	
22.	29·828	29·784	29·43			42	27	41·5			ne.	ese.		·01	·19	
○ 23.	29·764	29·750	29·43			43	34	37			sw.	calm		....	·29	
24.	29·924	29·819	29·54			43	37	41			n.	nne.		·02	·20	
25.	30·277	30·043	29·82			43	18	39			ne.	ne.		....	·14	
26.	30·289	30·241	30·00			42	36	33			ne.	n.		....	....	
27.	30·035	29·983	29·70			47	42	39			ne.	nnw.		·01	....	
28.	30·112	30·019	29·70			47	36	43			ne.	nne.		·01	·07	
29.	30·111	30·045	29·75			45	33	41			n.	n.		....	·01	
30.	30·078	29·980	29·63			45	26	36			w.	nw.		....	·02	
Mean.	30·020	29·929	29·61			47·73	33·96	40·3						1·34	2·42	

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 98. FEBRUARY 1856.

VIII.—*Notes on the Palæozoic Bivalved Entomostraca.* No. III. *Some Species of* Leperditia. By T. Rupert Jones, F.G.S.

[With two Plates.]

[Continued from vol. xvi. p. 176.]

In Notes I. and II. ('Annals,' August and September 1855) I have described the little *Beyrichiæ* of the Upper and Lower Silurian rocks, especially of Sweden and Britain; in this paper I propose to describe other small Bivalved Entomostracan Crustaceans, larger than the former, and characteristically distinct. These are from the Silurian rocks of Scandinavia, Russia, Arctic America, and England; except one which is from the Devonian rocks of Normandy *.

Two little fossil bivalves † from the palæozoic rocks of Gothland were figured and described more than twenty years ago by Hisinger ‡, who recognized their general dissimilarity to the Conchifera, and referred them to the Entomostracan genus *Cythere*, which was the only marine bivalved form of the Subclass of the Crustacea at that time known to naturalists §.

* I have also seen lately a typical *Leperditia* from the Carboniferous Limestone of Tournay, Belgium.

† *Cytherina Balthica* and *C. phaseolus*. It is only of the former that I can here speak,—as I have not yet obtained any specimen referable to the latter. Klöden's *Cytherina phaseolus* (Verst. Mark Brandenburg, p. 102. pl. 1. fig. 10) appears to be a distinct form, of great interest. M'Coy has referred to *C. phaseolus* some Irish Silurian specimens; but Mr. Salter assures me that they do not correspond.

‡ In his 'Anteckningar i Physik och Geognosi under resor uti Sverige och Norige;' and also in his 'Lethæa Suecica.'

§ O. F. Müller's Notes in the 'Philos. Trans.' 1771, and his elaborate work on the "Entomostraca," published in 1785, and again in 1792, were still the chief sources of information on this subject.

Later researches, however, have greatly extended the list of the Entomostraca; and there are several well-known existing forms which possess a bivalved carapace or shell; such as *Cypris, Cythere, Cypridina, Limnadia, Daphnia,* and *Nebalia.* In these the carapace is vertical, and its two lateral halves or valves are either distinct in themselves and united by a more or less elaborate dorsal hingement,—or form one entire shell, doubled along the back with a flexible fold. Other Entomostraca have the carapace horizontal and flattened, or nearly so, and marked by a mesial ridge or line along its greater axis;—as *Apus* and *Limulus.* Of the above-mentioned genera, nearly all have been presented in geologic times in forms more or less closely related to the existing species.

In the case of the fossil Entomostraca, the soft parts, including the maxillary, branchial, and locomotive organs, on which the generic and sometimes the specific distinctions of the recent forms are mainly established, have quite disappeared; and the hard carapace-valves alone remain to guide us in the recognition of genera and species. It is fortunate, however, that the families, and most of the genera even, of the existing Bivalved Entomostracans * have carapaces sufficiently characteristic to enable us to co-ordinate the fossil forms by the analogies presented in the form and structure of the valves.

For the most part, the Entomostracan bivalves, both from their minute size and in their general aspect, are strikingly different from the Conchifera. Some, however, as for instance the *Estheria donaciformis* †, may readily be mistaken for ordinary bivalve shells.

One of the two little Gothland fossils above mentioned, although it resembles the Conchifera in being bivalved and in its bean-shaped form, differs from Molluscan bivalves ‡ in general appearance, and in the combination of the following characters;—the great length of the hinge-margin,—the absence of umbos,—the extreme overlapping of one valve over the other on the ventral margin,—the uniform smoothness of the surface,

* When we refer to *minute distinctions of form, hingement, and ornamentation,* we find that among the recent Bivalved Entomostraca some families and even genera have carapaces peculiar to them (*Cypridina, Nebalia, Limnadia*); whilst in other families a nearly similar carapace belongs to two genera (*Cypris* and *Candona,—Daphnia* and *Lynceus*); and on the contrary even two characteristically different carapaces occur among the species of one genus (*Cythere* and its subgenus *Bairdia*).

† Proceed. Zool. Soc. 1849, vol. ii. p. 86. Pl. Annulos. 11.

‡ With respect to the characters in which there is an approach in form, viz. a straight hinge-line and an overlapping of one valve over the other, I have been favoured with the following note by my friend Mr. Pickering:—

"On looking over the recent Conchifera, or bivalve Mollusca, I do not

—the relative thickness and the horny aspect of the valves, which are marked moreover by a small tubercle, and by a central spot, formed by a local variation in the tissue of the test.

With these characters, it is readily recognized as a Crustacean; but with regard to the place of the Gothland fossil amongst its congeners, although the several characters above enumerated are individually represented by other Bivalved Entomostraca, yet there is no genus, either existing, or yet described from the tertiary or secondary rocks, to which this fossil can be referred. The genus *Beyrichia,* of the Silurian rocks, presents some special characters in common with the fossil in question; but the two forms are unmistakeably distinct *.

In the description of some fossils from the Devonian schist and limestone of Ille et Vilaine (Brittany), M. Rouault † in 1851 recognized two new Entomostracan bivalves—a *Beyrichia* (*B. Hardouiniana* ‡, Rouault), and a form on which he founded the genus *Leperditia.* The generic characters of this Bretagne species (*L. Britannica,* Rouault) are clearly described, and are closely applicable to the Gothland fossil above referred to.

Through the kindness of Mr. J. Morris, I have had the opportunity of studying some very fine specimens of the Gothland form, as well as two valves from Néhou, which are referable

find, and indeed do not know of, any genus bearing the same characters united as in your Crustacean, namely a straight hinge-line and an overlapping ventral margin.

"The following genera show more or less one or other of these characters:—

Solemya, *Lithodomus,* *Modiola,* *Mycetopus,* *Iridina,* *Arca,* *Meleagrina,* *Perna,*	a straight hinge-line.
Avicula, inequivalve, with straight hinge-line.	
Potamomya, *Azara,* *Corbula,* *Thracia,*	an overlapping ventral margin.

"The dorsal margin of *Solemya,* with the ventral margin of *Potamomya,* would, I think, produce the form required, but such a form is unknown to me."

* *Vide antea,* vol. xvi. pp. 91 & 174.

† Bullet. Soc. Géol. France, 2 sér. vol. viii. p. 377.

‡ This species was inadvertently overlooked when I was preparing the Table of the *Beyrichiæ, antea,* vol. xvi. p. 175.

I take this opportunity of correcting an *erratum* in the Table here referred to:—*B. Wilckensiana,* and its variety *plicata,* should be placed under the heading **Corrugatæ**, instead of under **Simplices**.

perhaps to M. Rouault's species. The British Museum and the Geological Society's Museum contain some highly interesting specimens from Gothland. Mr. Salter has submitted for my examination numerous specimens of *Leperditia* from the Silurian limestones of the Arctic Regions and elsewhere; and Mr. Woodward and other friends have favoured me with several others. These materials have enabled me to prepare a notice of a few principal forms of the genus, which, though closely related, have sufficient peculiarities of the carapace to render them specifically distinct.

Class CRUSTACEA.

Subclass Entomostraca.

Order **Phyllopoda**?

Family Leperditidæ.

Genus Leperditia, Rouault, 1851. Bullet. Soc. Géol. France, 2de série, tome viii. p. 377.

Generic characters.—Animal enclosed in a vertical bivalved carapace. Carapace inequivalved; somewhat resembling a tamarind-stone and other leguminaceous seeds. Carapace-valves smooth, convex, horny in appearance, nearly oblong, longer than broad*, bean-shaped, inequilateral, posterior half broadest; dorsal border straight; ventral border nearly semicircular; anterior and posterior borders oblique above, rounded below, the valve-margin passing from each end of the hinge-line in an oblique direction downwards and outwards to about half the breadth of the valve, where it meets the curved ends of the ventral border, and so forms the more or less angular extremities of the valve, the former of which is narrower and sharper than the latter.

Valves united along their upper (dorsal) borders by a simple linear hinge; the two extremities of the hinge-border form angles with the anterior and posterior borders in each valve.

The right valve larger than the left, being broader, and overlapping completely the ventral border of the opposite valve, and to some extent its anterior and posterior borders. The overlapping ventral border of the right valve forms a thick blunt keel to the closed carapace.

Each valve is somewhat depressed towards the dorsal border; this border in the left valve is thicker than that of the right, and sometimes slightly overrides it. The ventral margin of the left valve is turned suddenly inwards, forming a thin plate project-

* The length is measured in the direction of the hinge-line,—the breadth (or height) in that from the dorsal to the ventral margin.

ing into the cavity of the carapace. The line of junction of the inverted border, or ventral plate, and the outer surface of the valve is angular, and bears a slight sulcus and moulding, against which the overlapping edge of the right valve abuts. The dorsal or the ventral profile of the closed valves is elongate acute oval; the end view of the closed valves is more or less ovate.

Rather above and in front of the centre of each valve, and on its most convex portion, nearly all the species of the genus present a slightly raised, circular or suboval swelling, having a diameter of from $\frac{1}{5}$th to $\frac{1}{4}$th of the breadth of the valve's surface. This swelling is distinguishable by a local change of colour or of surface-condition, and marks the place of a corresponding rounded pit, excavated on the interior surface of the valve so deeply as to render the tissue of the valve at the swelling somewhat diaphanous. The cast of this pit on an inner cast of the valve is strongly marked, having a greater relative height than the external swelling. The swelling has usually a reticulated appearance resulting from vascular impressions on the test: and from a slight sulcus at the margin of the pit a set of delicate canals*, tortuous and inosculating, excavated on the interior of the valve, radiate forwards, downwards, and backwards, gradually becoming fainter towards the edges of the valves.

Anterior to the central tubercle, or "lucid spot," and nearer to the dorsal margin, is a smaller, but prominent, tubercle on each valve, with a corresponding internal pit. This little tubercle (the "anterior tubercle") is usually seated on or at the edge of a slightly raised area of irregular outline; and behind it a short shallow vertical sulcus, commencing at the dorsal margin, is usually apparent.

1. *Leperditia Balthica*, Hisinger, sp. Pl. VI. figs. 1–5.

Cytherina Balthica, Hisinger, Anteckningar i Phys. o. Geol. part 5. pl. 8. fig. 2; Lethæa Suecica, p. 10, 118. pl. 1. fig. 2 *a, b*, pl. 30. fig. 1.

Dimensions of closed or of separate valves of five individuals:—

Length. (inch)	Breadth. (inch)	Thickness. (inch)	
$\frac{20}{24}$	$\frac{13}{24}$	...	Right (broad) valve.
$\frac{19}{24}$	$\frac{11}{24}$	...	Cast of left (narrow) valve.
$\frac{17}{24}$	$\frac{10}{24}$	...	Left valve.
$\frac{15}{24}$	$\frac{10}{24}$	$\frac{6}{24}$	Perfect carapace.
$\frac{12}{24}$	$\frac{7}{24}$	...	Cast of left valve.

* These are noticed also by Count Keyserling in a species from Petschora-Land.

Valves most convex at the middle and somewhat posteriorly; the posterior half of the valve broadest and boldly rounded backwards and downwards. Old individuals less tapering anteriorly, and more oblong, than younger valves. Anterior and posterior angles of the dorsal edge prominent in well-preserved specimens, the extremities of the hinge-margin being truncate, and the anterior and posterior margins of the valves obliquely rounded off from beneath them.

Ventral margin of the right valve overlapping that of the left to the extent of about $\frac{1}{5}$th the breadth of the carapace.

Dorsal margin of the left valve slightly thicker than that of the right, which latter is somewhat thickened only at its anterior third; ventral margin inverted suddenly, and marked with transverse striæ within and without.

Surface of each valve slightly depressed along a narrow area just within the margin, which forms a gently raised convex border, narrow on the dorsal edge, broader on the ventral.

Central spot and radiating canals well defined; the latter are seen, in the cast represented at fig. 4 *a*, to spring from a circular vascular impression, or sinus, surrounding the central spot or tubercle. The radiating canals have left only obscure traces on the cast* of the small specimen, fig. 5 *a*; which, however, shows the reticulated or warty appearance of the central tubercle very clearly. Anterior tubercle prominent, on an ill-defined slight elevation, which is bounded behind by a faint sulcus extending from the dorsal edge to the central tubercle.

The smaller cast, fig. 5 *a*, which I regard as representing a younger individual of this species, presents a broadish depressed margin on the anterior and ventral borders,—a feature that becomes almost obsolete in the adult specimens. It also bears a gently curved crenulated ridge, of slight elevation, crossing obliquely the postero-dorsal region of the valve;—this ridge is not traceable in the older specimen, fig. 4 *a*.

Surface smooth, shining; colour usually dark brown; two large, somewhat worn, odd valves in Mr. Morris's collection are light brown in colour; and in the largest the anterior tubercle is whitish, with a central black spot (fig. 1 *a, c*). In these two old individuals the surface exhibits traces of a fine punctation.

This species occurs in the Upper Silurian limestone of Gothland†, where it appears to be not uncommon. Hisinger gives the localities thus:—"In the Transition limestone of Gothland at Länna, near Slitehamn; also in detritus on the sea-shore: in brownish limestone in the Island Björkö, near Holmestrand,

* The surface of the cast is covered by very fine but obscure pittings, as if the inside of the valve had been marked by an ill-defined reticulation.

† For a notice of the geology and fossils of Gothland, see Quart. Journ. Geol. Soc. vol. iii. pp. 18, 30, &c.

Norway." Count Keyserling* states that this Gothland species occurs in the Silurian dolomitic limestone on the Waschkina, Petschora-Land, in company with another species (*Leperditia marginata*, Keyserl. sp.).

2. *Leperditia Arctica*, Jones. Pl. VII. figs. 1–5.

Leperditia Balthica, var. *Arctica*, Jones. Salter's Appendix to Sutherland's Journal of a Voyage in Baffin's Bay, &c., 1852, vol. ii. p. cexxi. pl. 5. fig. 13; and Quart. Journ. Geol. Soc. vol. ix. p. 314.

Dimensions of closed or of separate valves of four individuals :—

Length. (inch)	Breadth. (inch)	Thickness. (inch)	
$\frac{1}{2}$	$\frac{1}{3}$	...	Right valve.
$\frac{11}{24}$	$\frac{7}{24}$	$\frac{5}{24}$	Perfect carapace.
$\frac{8}{24}$	$\frac{5}{24}$	...	Right valve.
$\frac{8}{24}$	$\frac{5}{24}$	...	Left valve.

Valves most convex near the centre, depressed near the margins; antero- and postero-dorsal angles strongly marked; the anterior extremity acute. Central portion of the ventral border of right valve projecting downwards with an almost angular outline (giving the carapace a subtriangular shape), and overlapping the left valve to the extent of $\frac{1}{4}$th of the breadth of the carapace.

Dorsal edge of left valve much thicker than that of the right; the thickness greatest posteriorly.

Anterior and central tubercles well developed; the radiating vascular impressions form a delicate reticulation over nearly all the inner surface of the valves, and arise from a large groove or sinus surrounding the central tubercle. This circular sinus is connected by a still broader sinus with the raised area of the dorsal border of the valve. There is also another sinus embracing the under side of the anterior tubercle, and passing forward along the raised area in front of the tubercle to disappear at the antero-dorsal angle. From the lower side of this sinus fine vascular impressions originate, which freely inosculate with the others. On one specimen (fig. 1 *a*) the anterior tubercle is surrounded by a slightly raised, oval, crenulated border; and the surface of the valve immediately beneath the central tubercle distinctly exhibits by faint raised lines the course of the larger radiating canals.

Surface smooth and polished; colour light brown.

* "Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land." 4to, 1846, p. 289.

L. Arctica occurs abundantly in the Upper Silurian limestone at Cape Hotham in Assistance Bay, and Seal Island in Baring Bay; also in Griffiths and Cornwallis Islands. Specimens were brought to England by Dr. P. C. Sutherland.

This species (which at first, when Mr. Salter showed it to me in 1852, I was scarcely disposed to separate from the Gothland species) differs from *L. Balthica* in several points,—in its smaller size,—greater angularity of outline,—the greater convexity of the valves, and depression of their dorsal region,—the thickness of the dorsal edge of the left valve,—the great overlap of the right valve,—the greater delicacy and extent of the radiating canals,—and the lighter colour.

3. *Leperditia alta*, Conrad, sp. (?) Pl. VII. figs. 6 & 7.

Cytherina alta, Conrad, Report Geol. New York; Vanuxem, Geology of New York, 1842, p. 112. fig. 23, 6; Hall, Palæontology of New York, 1852, vol. ii. p. 338. pl. 78. fig. 2 *a, b, c*.

A specimen of hard, dark Upper Silurian limestone, containing numerous specimens of *Leperditia*, chiefly on a weathered plane of bedding, was brought to England from the shores of Wellington Channel* by Dr. P. C. Sutherland, and is now in the Museum of Practical Geology. The fossils are single valves, with their convex surfaces more or less exposed on the weathered surface, which also presents numbers of minute bodies, probably crustacean likewise. The valves are roughened by the irregular dissolution of their substance, and each has the most prominent spot of its convexity irregularly enamelled, as it were, by a local mineralogical condition of the altered calcareous matter of the fossil. The limestone affords a few specimens by fracture; these have smooth surfaces. The characters are as follow :—

Dimensions of separate valves of five individuals :—

Length. (inch)	Breadth. (inch)	
$\frac{5}{24}$	$\frac{3}{24}$	Left valves.
$\frac{1}{4}$	$\frac{1}{6}$	
$\frac{10}{24}$	$\frac{6}{24}$	
$\frac{9}{24}$	$\frac{6}{24}$	Right valves.
$\frac{11}{24}$	$\frac{7}{24}$	

Carapace-valves strongly convex, smooth, dark olive-brown in colour, more or less oblong, somewhat variable in outline, straight above, rounded below; extremities obliquely rounded; the dorsal angles in some much more definite than in others; posterior half broader and rounder than the anterior. Anterior

* Cape Riley or Beechey Island.

tubercle distinct, especially in the casts; central tubercle not distinct.

The anterior and posterior borders of the right valve present a slight marginal rim, especially in the younger specimens. A distinct but very narrow marginal rim is seen on the anterior, ventral, and posterior borders of some young left valves. The ventral margin of the right valve is thick and incurved, overlapping that of the opposite valve, which has its inner edge inverted at a somewhat acute angle; this inverted ventral plate is smooth.

Prof. Hall's figures, which he refers with doubt to "*C. alta*," agree in general contour with the form under notice; but the unworn surface of the latter is not papillose like the Schoharie specimens. Mr. Vanuxem's figures are wretched; but as Prof. Hall appears, after having examined specimens of the fossil indicated by Conrad and Vanuxem, to be disinclined to separate the two, it is quite possible that all may be referred to one species. Mr. Conrad * and Mr. Vanuxem quote the species as occurring in the Tentaculite limestone of the Waterlime group; Prof. Hall's specimens came from the Coralline limestone of Schoharie.

The Arctic specimens which I have here referred to *Leperditia alta*, although they differ in form less from *L. Balthica* than from *L. Arctica*, still do not present the characteristic obliquely-sub-oval outline of the former, but, the larger individuals at least, have a subglobose shape. Their marginal rim, though slight, is also a good distinctive character. In size they occasionally equal *L. Arctica*, but do not approach the magnitude of the Gothland specimens.

4. *Leperditia Britannica*, Rouault (?). Pl. VI. figs. 6 & 7.

Rouault, Bullet. Soc. Géol. France, deux. sér. 1851, vol. viii. p. 377, woodcut figs. 1, 2, 3.

Dimensions :—

Length. (inch)	Breadth. (inch)	
$\frac{11}{24}$	$\frac{7}{24}$ (about).	Bretagne specimen.
$\frac{15}{24}$	$\frac{9}{24}$	Normandy specimen : right valve.
$\frac{9}{24}$	$\frac{5}{24}$	Normandy specimen : right valve.

An odd dextral valve, apparently referable to the species indicated above, affords the following characters.

* Under the name of "*Cytherina fabulites*," Mr. Conrad has described (Philad. Acad. Nat. Sc. Proceed. vol. i. p. 332) a bivalve Entomostracan from the Trenton limestone of Mineral Point, Wisconsin, which from the description of its shape and size is probably a *Leperditia*.

Right valve nearly oblong, broadest and roundest behind; tapering and angular in front; most convex in the middle; depressed towards the margins, which are for the most part slightly raised; ventral border overlapping the opposite valve to the extent of $\frac{1}{4}$th of the breadth of the carapace; anterior tubercle distinct; central spot not defined. Surface smooth, not polished; black.

Another, but smaller, right valve (younger individual) is similar in general form, but relatively shorter and broader.

These two specimens occur on a small fragment of dark, shelly, Devonian limestone from Néhou in Normandy, which has been kindly lent me by Mr. Morris.

It appears to me probable that they belong to M. Rouault's species (which is from the Devonian rocks of Brittany), although the latter form appears to differ in the degree of convexity, and to be shorter and broader in proportion, but unfortunately neither M. Rouault's specific description nor figures supply me with all the necessary terms of comparison.

The Normandy specimen, Pl. VI. fig. 6, differs from the right valve of *L. Balthica* in its narrower and more angular outline; in the greater depression of the surface towards the margins of the valve, or more rapid slope from the centre towards the periphery; and in the greater overlap of the ventral margin.

The vertical transverse section of the closed valves of *L. Britannica*, fig. 7, is copied from M. Rouault's memoir for the sake of comparison. The ventral overlap of the larger valve is considerable, as in fig. 6 *a*; but the convexity of that valve differs in the two individuals. The inverted plate of the ventral border of the smaller valve, as shown in fig. 7, may be remarked as being of very small extent, compared with that of *L. Balthica*, and of some of the species hereafter described. In M. Rouault's fig. 1, the small valve is seen to have a dorsal protuberance, like that in *L. gibbera* (Pl. VII. fig. 9 *a*); hence, if I am right in assigning the Normandy specimens to the Bretagne species, their left valve would have the dorsal hump,—another characteristic feature distinguishing them from *L. Balthica*.

5. *Leperditia gibbera*, nov. sp. Pl. VII. figs. 8–10.

Dimensions of the separate valves of four individuals:—

Length. (inch)	Breadth. (inch)	
$\frac{9}{24}$	$\frac{5}{24}$	Left valve.
$\frac{8}{24}$	$\frac{4}{24}$	Right valve.
$\frac{1}{4}$	$\frac{1}{8}$	Right and left valves.

Valves strongly convex; almost oblong, broadest at the posterior third; extremities obliquely rounded; ventral margin gently curved; convexity greatest on the median line.

Extremities of right valve depressed and margined with a narrow flattened rim; ventral margin incurved, and but slightly overlapping the opposite valve.

Left valve thickened along the dorsal border, especially posteriorly, where it presents a smooth, oval, ridge-like protuberance, short and depressed in young specimens, but prominent and occupying even more than the middle third of the dorsal edge in old individuals. The protuberance is separated from the anterior tubercle by an oblique furrow. This dorsal protuberance is not present in the right valve at any age. The excessive thickening of the postero-dorsal portion of the left valve is also present in M. Rouault's Bretagne species*; and a tendency to this condition is indicated in *L. Arctica,* and very slightly in *L. Balthica.*

The rest of the border of the left valve is suddenly depressed into a narrow, flat, and trenchant marginal rim; the inverted ventral edge is narrow.

Anterior tubercle well marked; central tubercle indistinct. Surface of valves smooth, shining, finely pitted, and of a rich brown colour.

L. gibbera occurs in numbers in the Upper Silurian limestone of Beechey Island, in company with numbers of small bivalved Entomostraca, probably *Beyrichiæ,* among which are two varieties of *B. Klœdeni.* Specimens of the limestone have been brought to England by Capt. Sir E. Belcher, and are now in the Museum of Practical Geology.

6. *Leperditia marginata,* Keyserling, sp. Pl. VII. figs. 11–14 & 15.

Cypridina marginata, Keyserling, Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land (Geognostische Beobachtungen), 1846, p. 288. pl. 11. fig. 16.

Cypridina Balthica, Eichwald (non *Cytherina Balthica,* Hisinger), Bullet. Imp. Soc. Nat. Moscou, 1854, No. 1. p. 99. pl. 2. fig. 6.

A specimen of whitish (dolomitic) Upper Silurian limestone, containing numerous specimens of a small *Leperditia* (chiefly on a divisional plane of the rock), from the village of Saretche, in the Government of St. Petersburgh, has been kindly presented to me by Mr. T. Davidson, who received it from Prof. Kutorga of St. Petersburgh. It was labelled " *Cypridina marginata,* Key-

* Bullet. Soc. Géol. France, 2 sér. vol. viii. p. 377. fig. 1.

serl." The carapaces have mostly disappeared; but some remain in an altered crystalline state, or as a pulverulent, white, calcareous substance. The casts of the interior, and sometimes of the exterior, of the valves are very distinct; but the saccharoid crystalline character of the matrix has been ill adapted to receive the impression of any fine vascular or other markings, if such existed in the originals.

Casts of a right and a left valve are figured in Pl. VII. figs. 11, 12; and, having been able, in some instances, to observe portions of the carapace in place, as well as good casts of the outside, I am satisfied that the exteriors of the valves presented almost, if not quite, as strong a marginal rim as is seen in the casts. This I especially mention, because M. Eichwald, in describing* specimens of a similar form (possibly identical), from Esthland and Livonia, states that the outsides of the valve have no marginal sulcus and rim, and that the casts alone exhibit this character.

The St. Petersburgh specimens present the following characters:—

		(inch)		(inch)
Dimensions:—	Length	$\frac{1}{4}$	to	$\frac{7}{24}$
	Breadth	$\frac{1}{6}$	to	$\frac{5}{24}$

Carapace-valves almost equivalve, nearly oblong (subject to slight variation in outline), broadest at the posterior third, straight at the back, obliquely curved on the ventral margin, and obliquely rounded at the extremities; the convexity of the surface is nearly central. The central portion of the ventral edge of each valve is somewhat incurved; that of the right valve apparently overlapping that of the left.

The right valve is margined, except on the dorsal edge, by a well-marked sulcus, running along at a short distance from the edge, and separating off a narrow, flattened, or slightly convex border. On the left valve there is a similar marginal rim, but it dies out on the central incurved portion of the ventral margin, fig. 12 *b*.

The anterior tubercle is distinct; the central tubercle can also be easily discerned on the casts; the radiating vascular markings, however, are not apparent.

Of M. Keyserling's figures of *Leperditia marginata* (*op. cit.*), fig. 16 *d* (the smallest figure) alone corresponds exactly with the form under notice; in fig. 16*b* (*op. cit.*), and apparently in fig. 16*a*, the marginal rim (of right valve) is indicated as passing round

* Moscow Bulletin, 1854.

the ventral margin as a projecting edge*, keeping the vertical direction of the valve, instead of being a mere moulding accompanying an incurvation of the ventral border. Further, in fig. 16 *c* (*op. cit.*), there is represented an inverted edge to the right† valve (as in the *left* valve of *L. Balthica*); and Count Keyserling remarks, that, whilst the ventral plate in *L. Balthica* is marked with transverse striæ, in this species it is smooth.

The Petschora specimens vary from about $\frac{5}{24}$ to $\frac{15}{24}$ inch, and even reach nearly $1\frac{1}{4}$ inch, in length.

The anterior and the central tubercle are both referred to by M. Keyserling as being well marked in *L. marginata*, and the cast of the inside of the central tubercle is described as being beset with crowded unequal wart-like markings, and accompanied by ill-defined, tortuous, fine vein-markings, radiating backwards. The sulcus defining the marginal ledge is stated to be "slight on the surface of the valves, and deepened on the cast."

M. Eichwald‡ describes and figures a form under the denomination of "*Cypridina Balthica*," and at the same time recognizes in the casts, at least, the "margins" seen in Keyserling's species, and apparently allows the latter species to be well established on that character. The individuals of M. Eichwald's species vary in length from $\frac{1}{8}$ to $\frac{1}{6}$ inch (according to his figures); and in the text he gives "$\frac{1}{2}$ inch" as the size. They possess the anterior and central tubercles, with the muscular impression and radiating vascular markings. Excepting that the outside, according to the author, exhibits no marginal sulcus and rim, though the internal cast does, M. Eichwald's figures present no material differences from the smaller form of M. Keyserling's species. Neither the figures, however, nor the description, afford all the necessary details for satisfactory comparison with known species.

The specimens here referred to are from "the upper beds of the greywacke limestone" of Esthland and Livonia; and, according to M. Eichwald (*op. cit.*), another similar form, but with a row of punctiform pits on the border of the valve [query, on a depressed marginal border?], and without any apparent central spot and radiating vessels, occurs in the dolomitic limestone near Gatschina, on the river Oredesch§.

* It is described as "more or less clearly running along all the oval outline of the valve and ending at the hinge-angles."

† As this inversion on the *right* valve is contrary to what obtains in other species of the genus, perhaps this figure has been reversed on the plate.

‡ Bulletin Imp. Soc. Nat. Moscou, 1854, part 1. p. 99. pl. 2. figs. 7 & 8.

§ M. Eichwald also figures and describes a narrower and slightly arched form ("*Cypridina minuta*," *loc. cit.* fig. 6), from the Brandschiefer of Erras and the vicinity of Talkhof.

In Plate VII. fig. 14, I have figured a very interesting specimen, which apparently is referable to the larger form of Count Keyserling's species (*loc. cit.* fig. 6 *a* to *c*). It is in a white (dolomitic) Silurian limestone, brought by Sir John Richardson from Pine Island Lake* on the English or Great River, a few miles north of Cumberland House (about lat. 54°, long. 104°), and is now in the British Museum.

The fossil represents in relief the interior of a single left carapace-valve, and appears to have been a cast which, subsequently to the removal of the valve itself, has been smoothly recoated to a certain extent with a thin covering, similar in colour to the matrix, but less crystalline. In some aspects, the edge of the cast being partially non-continuous with the matrix, the fossil has an appearance of representing the valve itself,—which is not the case.

It is $\frac{3}{4}$ inch in length and $\frac{1}{2}\frac{1}{4}$ inch in breadth; similar to some specimens of *L. Balthica* in its obliquely suboval outline and well-defined dorsal angles; the surface is strongly convex, sloping gradually posteriorly, but suddenly depressed on the anterior and ventral margins to meet a well-defined flat marginal rim, which ends at the extremities of the dorsal border.

Anterior tubercle very distinct, surrounded by an irregular depression; central tubercle large, but not elevated; radiating vascular markings not apparent; an oblique shallow furrow, passing from the depression behind the anterior and above the central tubercle to the most projecting portion of the posterior portion of the valve, cuts off a somewhat raised area along the postero-dorsal region.

If there be any inverted plate within the ventral border (like that represented in Keyserling's fig. 16 *c*, *op. cit.*), it is concealed by the matrix.

I follow M. Keyserling in placing two such apparently dissimilar forms as figs. 11–14 under one specific appellation, because my own materials for observation are very limited, and it is possible that the Petschora-Land specimens have afforded the necessary links for connecting the two by specimens of different stages of growth.

If the smaller form (figs. 11, 12) be the young of the larger one, we have a carapace with a merely moulded and incurved ventral edge in its young form developing a strongly bordered margin with an inverted ventral plate (according to Keyserling, *op. cit.*) in its older state! If, on the contrary, as I am inclined to suspect, the smaller form be an adult, it is necessarily distinct,

* Journal of a Boat-Voyage through Rupert's Land, &c. 2 vols. 8vo. London, 1851 (vol. i. p. 75).

and does not come within the typical group of *Leperditia*, and should be removed to a subgenus at least.

It should be remarked that *L. marginata*, as represented by figs. 11–14 (and M. Keyserling's figures), differs from *L. Balthica*, and the other species above mentioned, in having the greatest convexity on the anterior and inferior region of the valve, rather than on the central portion.

Fig. 15 represents a cast in sandstone ($\times$ 2 diam.), from the Tilestones (Downton sandstone) of Kington in Herefordshire, of a *Leperditia* apparently belonging to the species under notice. It is associated with casts of small *Lingulæ*. Another specimen, consisting of a cast of the left valve, in the same sandstone, exhibits similar characters.

These individuals measure $\frac{7}{24}$ inch in length, and $\frac{1}{6}$ inch in breadth; they are rather more angular anteriorly than figs. 11 & 12; they present only obscure traces of a marginal rim; and their dorsal edge is not quite straight, but very slightly raised at the centre. Otherwise the general form is similar in the English and Russian specimens.

The anterior and central tubercles in the Kington specimens are distinctly seen, and have the same relative position and proportions as in the St. Petersburgh specimens.

With all the slight differences observable, considering the indifferent state of the casts, I do not think that the Kington specimens can be referred to any other than the Russian species.

This is the first noticed occurrence of *Leperditia* in British rocks*. The specimens are in the Museum of Practical Geology; and I am indebted to Mr. Salter for having kindly drawn my attention to them.

7. *Leperditia Solvensis*, nov. sp. Pl. VII. fig. 16.

Length $\frac{1}{8}$ inch; breadth $\frac{1}{14}$ inch.

The impression of the outside of a small valve (an artificial cast of which is represented, magnified 2 diameters, by fig. 16) on a fragment of Lower Silurian schist from South Wales has been kindly communicated to me by Mr. Salter. It is from the Llandeilo flags (lowest portion) of Upper Solva, Solva Harbour, St. David's; and is now in the Museum of Practical Geology.

The valve was slightly convex†, narrow oblong in shape, nar-

* Count Keyserling, in his remarks on the *L. marginata* of Petschora-Land, expressed his astonishment that the Upper Silurian rocks of England had not yet yielded this species; as it has at last made its appearance, we may hope that it will soon be represented by numerous specimens in the cabinets of the indefatigable collectors in Siluria.

† The degree of convexity of the valve cannot be exactly ascertained, as

rower at one end than at the other, straight at the back, rounded at the ends, gently curved below. Excepting at the dorsal edge, there is a well-defined, flattened, marginal rim. The tubercles are not apparent.

This fossil approaches very nearly in outline to *L. gibbera*, and in some of its characters to *L. marginata*; but its small size, slight convexity, narrowness of shape, and large proportion of marginal rim separate it from these species.

Observations on the Genus.

I must first observe that Prof. Quekett, having microscopically examined portions of the carapace-valves of *Leperditia Arctica*, informs me that they exhibit most distinctly characteristic crustacean structure.

In seeking for the family alliances of this palæozoic genus, we find some of the characters of its carapace among the existing bivalved Entomostraca, both of the Phyllopod and Lophyropod groups; but others of its peculiarities are not yet traced. It is not well represented by any known recent form, but partakes of the characters of several.

Shape.—The carapaces and carapace-valves figured in Plates VI. & VII. present a general uniformity of shape, in the sub-oval outline on three of their edges and the straightness of their upper or dorsal border. They all possess the antero-dorsal tubercle, and most of them show some evidence of the central spot or tubercle. The ventral edge of the left valve is suddenly inflected to a greater or less extent in all excepting those referred to *L. marginata* and *L. Solvensis*. In the smaller form of the one (Pl. VII. fig. 12) there is a decided modification of the inflection alluded to;—in the latter, and in our large form of *L. marginata*, the evidence on this point is imperfect.

The mode in which the two valves close one on the other, by a strong overlap and an inflected flange, is peculiar to the typical *Leperditia*.

With respect to the form of the valves among other bivalved Entomostraca, fossil and recent, an approach to the outline-shape of *Leperditia* is not uncommon; but, except among the *Beyrichiæ*, few species are definitely characterized by this exact shape, with its dorsal angles and ventral curvature *. Those that approach most nearly in this outline of the carapace-valve are the *Limnadidæ* † and (with the exception of being notched) some of the *Cypridininæ*.

its convex portion has been somewhat crumpled by pressure; in other respects the original form appears to be well preserved.

* *Cypridina Isabella* is one of the few examples of this shape (here modified by an infero-anterior notch) in other genera.

† Especially in the young state.

Central spot.—There is another point of resemblance between *Leperditia* and the *Limnadidæ*, namely the great central spot with its vascular markings (Pl. VI. fig. 1 *c*; Pl. VII. fig. 4 *d*). In *Leperditia* there appears to be only one circular canal; in *Isaura* (*Estheria*) *cycladoides* there are three (Joly*), as there are also in *Lymnetis*, as shown by Grube†. These concentric vascular impressions on the inside of the carapace are present also in other Entomostraca, as for instance, on the lateral halves of the carapace in *Apus*‡ and *Lepidurus*§.

The reticulated centre of this spot (which leaves the low warty tubercle on the casts of the fossil valves) is the place of attachment for the great adductor muscle of the animal‖ (Joly, Grube).

The radiating canals, originating at the central tubercle, are found in *Lymnetis* (Grube, *loc. cit.*) as well as in *Leperditia*.

The concentric, radiating, and reticulate markings are probably referable to the course of blood-vessels and sinuses. The carapace of many of these little Crustaceans appears to be extremely sanguiferous, and an important adjunct to the usual respiratory organs.

The central spot of *Leperditia* and the *Limnadidæ* is represented in the *Cypridininæ*, *Cyprinæ*, and *Cytherinæ* by a group of variously arranged minute lucid spots, occupying an analogous position on the valve; and, in the first-named family at least, I believe the lucid spots certainly to mark the place of muscular attachment.

Eye-spot.—The anterior tubercle may with probability be regarded as indicating the place of the eye¶,—or possibly even as the external part of that organ; but, excepting some allied palæozoic forms, there are no other bivalved Entomostracans having the eye indicated by a tubercle on the carapace, and few have the eye placed so high up in the antero-dorsal region.

In the *Cyprinæ* and *Cytherinæ* the eye is single (coalesced), and close up to the anterior hinge. Some at least of the *Cypridininæ*, in which group the eyes are separate and transversely distant one from another, have the eyes lower down in the an-

* Annal. Sc. Nat. 1842, nouv. sér. vol. xvii. p. 293 &c. pl. 7–9.

† Bemerkungen über die Phyllopoden, &c., von Dr. A. E. Grube; Archiv für Naturgeschichte, 1853, p. 109. pl. 7. fig. 22.

‡ Baird's Natural History of the British Entomostraca (Ray Soc.), 1850.

§ Baird, Zool. Soc. Illust. Proceed. 1850. Annulosa, pl. 17.

‖ This central tubercle in the fossil Entomostraca has been often mistaken by palæontologists for an eye-spot. Eichwald (*loc. cit. supra*) supposes it in *Leperditia* to be the seat of the ovary, and the associated radiations to be ovarian vessels: this is quite untenable; the eggs are found in the postero-dorsal region of the recent bivalved Entomostraca.

¶ Count Keyserling (*loc. cit. supra*) describes this tubercle in *L. marginata* and *L. Balthica* as the "eye-tubercle."

tero-dorsal region,—just above and in front of the muscle and central spot*. This last is the position of the eye-tubercles in *Leperditia*.

In the *Limnadidæ* the eyes are quite differently situated. They are closely approximate, and are placed (as in the *Daphnidæ*) low down on the beaked head (or cephalic rostral buckler) of the animal; and hence they are sometimes even protruded from between the anterior margins of the valves in *Estheria*.

The eye-spots or anterior tubercles of *Leperditia*, being near the dorsal edges of its carapace, have an analogous position to that of the eyes on either side of the mesial line of the horizontal carapace in the *Apodidæ*,—or rather, being somewhat further apart (measuring across the hinge-line of the valves), those of *Corycæus* and *Caligus*.

Conclusion.—The points of resemblance between the carapace of members of the recent families of Entomostraca and that of *Leperditia* may be indicated as follows:—

Resemblance in—	*Limnadidæ*.	*Cypridininæ*.	*Apodidæ*.
Outline	+	*	−
Central spot for muscular attachment	+	+	−
Vascular markings (sinuses)	+	−	+
Vascular markings (radiating)	+	−	−
Situation of the eyes	−	+	*
Eye-tubercles	−	−	+

The above remarks may be of use not only in showing the difficulty that exists in co-ordinating this fossil genus (so far as the remains of the carapace will help us) with its known allies, but also to some extent in illustrating another example "of the combination in extinct animals of characters separately manifested in existing species."

In concluding this notice of the relations of *Leperditia*, I would observe that the successive changes in the developmental growth of individuals remind us of the gradations of structure observable among allied species; and, as among the *Limnadidæ*, young individuals† present not a bivalved, but an horizontal carapace, like that of *Apus*, so the carapace of an Apodoid ideally folded in two along its mesial line, with its two halves drawn together by a transverse muscle, would well represent in most of its important characters the carapace of a *Leperditia*; for the eye-spots would be nearly in the relative position required, and the central muscle-spot would be associated with vascular mark-

* For instance, *Cypridina Zealandica*.

† *Estheria* and *Lymnetis*, less than a week old: (Joly, Grube).

ings. Nor would the valves, thus ideally constructed, be without considerable resemblance in outline to the *Leperditia* valves. Moreover, the vertical dorsal sulcus, which is scarcely apparent in the typical *Leperditia*, though strongly marked in another section of the group, and present also in *Beyrichiæ*, would find its homologue in the nuchal furrow of the folded Apodoid.

Burmeister*, in his review of the classification of the fossil Entomostraca, observed that Hisinger's two Gothland species (together with Klöden's *C. phaseolus*) should be regarded as belonging to a group distinct from the *Cytheres*. He proposed to retain the generic term *Cytherina* † for them, and to found on them a distinct family (*Cytherinidæ*) of the *Phyllopoda*; referring to *Estheria* as a closely allied genus. Keyserling and Eichwald quote *L. Balthica* as a "Cypridina."

There can be little doubt that *Leperditia* and its allies are sufficiently distinct from the known Entomostracan groups to constitute a separate family, as Burmeister recommended. The *Leperditidæ* (as I propose to term this group), comprising *Leperditia, Beyrichia,* and some other forms not yet described, may be regarded as most probably coming within the pale of the *Phyllopoda*.

EXPLANATION OF PLATES VI. AND VII.

Plate VI.

[The figures (excepting fig. 1 *c*) represent the specimens magnified two diameters.]

Fig. 1. *Leperditia Balthica*: *a*, right valve; *b*, the same, anterior extremity; *c*, the same, central spot and anterior tubercle, highly magnified. —From Mr. Morris's Cabinet.

Fig. 2. *Leperditia Balthica*: *a*, left valve; *b*, the same, anterior extremity. [This specimen being somewhat worn, does not well show the sharp angle of the ventral edge.]—From Mr. Morris's Cabinet.

Fig. 3. *Leperditia Balthica*: *a*, perfect carapace, showing the right valve; *b*, the same, showing the left valve; *c*, the same, showing the dorsal aspect; *d*, the same, showing the ventral aspect; *e*, the same, showing the anterior extremity.—Mr. Morris's Cabinet.

Fig. 4. *Leperditia Balthica*: *a*, cast of the interior of a left valve, showing the anterior and central tubercles, and the radiating vascular markings; *b*, the same, ventral aspect; *c*, the same, showing the anterior extremity. The dotted lines represent an ideal section of the carapace.—Museum of the Geological Society.

Fig. 5. *Leperditia Balthica*: *a*, cast of the interior of a left valve of a

* Organiz. d. Trilob. pp. 57 & 63. (Ray edit. pp. 49 & 55.)

† The name "Cytherina" was substituted by Lamarck for Müller's *Cythere*, and has been used by numerous writers in the same sense. Although "Cythere" has been restored to its original use, and the word "Cytherina" is adrift, still, from the frequent misuse of the latter term, it is not eligible as a generic appellation. Dana has lately used the term "Cytherinæ" to represent a subfamily.

smaller individual; anterior and central tubercles distinct, but radiating vessels only apparent towards the ventral border; *b*, the same, ventral aspect, with a part of the inverted edge remaining attached; *c*, the same, dorsal aspect.—Museum of the Geological Society.

Fig. 6. *Leperditia Britannica*? : *a*, right valve; *b*, the same, ventral aspect; *c*, the same, anterior aspect. The dotted line indicates the supposed outline of the opposite valve.—Mr. Morris's Cabinet.

Fig. 7. *Leperditia Britannica*, transverse vertical section of the carapace, after Rouault (Bull. Soc. Géol. Fr. 2 sér. vol. viii. p. 378. fig. 3).

Plate VII.

[The figures represent the specimens magnified two diameters, excepting figs. 4 *d* and 5, which are more highly magnified.]

Fig. 1 *a*. *Leperditia Arctica*, right valve; central and anterior tubercles well developed, the latter ornamented with an oval crenulated border. —Museum of Practical Geology.

Fig. 1 *b*. *Leperditia Arctica*, right valve, anterior extremity.—Museum of Practical Geology.

Fig. 2. *Leperditia Arctica*: *a*, left valve; *b*, the same, anterior extremity. —Museum of Practical Geology.

Fig. 3. *Leperditia Arctica*: *a*, perfect carapace, showing the right valve; *b*, the same, showing the left valve; where the carapace is broken, the radiating vessel-markings are seen; *c*, the same, dorsal aspect; *d*, the same, ventral aspect; *e*, the same, anterior aspect. —Museum of Practical Geology.

Fig. 4. *Leperditia Arctica*: *a*, cast of the interior of a left valve; *b*, the same, ventral aspect; *c*, the same, anterior aspect; the dotted line indicates the outline of the opposite valve in section; *d*, enlarged view of the cast of the central tubercle; *e*, fragment of the same left valve, showing the inner aspect of the "central tubercle," or "lucid spot," and the vascular markings, together with a portion of the inverted edge of the same valve; the lower fragment is a portion of the overlapping edge of the right valve. —Museum of Practical Geology.

Fig. 5. *Leperditia Arctica*: diagram showing the relations of the overlapping and overlapped ventral edges of the valves.

Fig. 6. *Leperditia alta*? : *a*, right valve, with weather-worn surface; *b*, the same, ventral aspect; *c*, the same, anterior aspect.—Museum of Practical Geology.

Fig. 7. *Leperditia alta*? : *a*, left valve (young), with weather-worn surface; *b*, the same, ventral aspect; *c*, the same, anterior aspect.—Museum of Practical Geology.

Fig. 8. *Leperditia gibbera*: *a*, right valve, shell nearly all worn (or rather dissolved) away; *b*, the same, ventral aspect; *c*, the same, anterior aspect.—Geological Society's Museum.

Fig. 9. *Leperditia gibbera*: *a*, left valve, surface well preserved; *b*, the same, ventral aspect; *c*, the same, anterior aspect.—Museum of Practical Geology.

Fig. 10. *Leperditia gibbera*, outline profile of the anterior aspect of the carapace.

Fig. 11. *Leperditia marginata*? (young?): *a*, cast of right valve; *b*, the same, ventral aspect; *c*, the same, anterior aspect.

Fig. 12. *Leperditia marginata*? (young?): *a*, cast of left valve; *b*, the same, ventral aspect; *c*, the same, anterior aspect.

Fig. 13. *Leperditia marginata*? (young?), outline of the anterior aspect of the two valves united.
Fig. 14. *Leperditia marginata*? (adult): *a*, cast of left valve; *b*, the same, dorsal aspect; *c*, the same, ventral aspect; *d*, anterior aspect.—British Museum.
Fig. 15. *Leperditia marginata*?, cast of right valve.—Museum of Practical Geology.
Fig. 16. *Leperditia Solvensis*, artificial cast of impression of right valve.—Museum of Practical Geology.

IX.—*Further Observations on the Development of Gonidia* (?) *from the Cell-contents of the* Characeæ, *and on the Circulation of the Mucus-substance of the Cell.* By H. J. Carter, Esq., Assistant Surgeon H.C.S., Bombay.

[With two Plates.]

Since my first "Observations on the Development of Gonidia (?) from the Cell-contents of the Characeæ," &c.* were arranged, and which I then stated were not so "extended and complete" as they would have been had more leisure been at my disposal, I have obtained much more precise information on the subject. The inquiry was then new to me, and the only author to my knowledge who had engaged in it was Professor Pringsheim, who met with a similar formation in *Spirogyra*, &c.†, and had assumed, as the simplest way of accounting for it, that the ciliated bodies produced in this way were "propagative cells of the *Spirogyræ* capable of development." In the "*Postscript*" to my "Observations," however, I expressed a different opinion, having at first, with Professor Pringsheim, been under the impression that a development of such "cells" under such circumstances could only belong to the plant in which it took place, and therefore I called them "gonidia." But subsequent observations favoured the view that they did not belong to *Nitella*, and therefore that they should have been called "monads;" viewing "monads" in the same relation to Infusorial that "gonidia" bear to future Algoid developments. That there is a great resemblance between gonidia and monads, and that there may be instances where their subsequent forms alone can determine which appellation should be used for them, in the sense mentioned, may be easily conceived, and the present is one to the beginner; but whether or not it should be so to the experienced observer, I will not now stop to discuss.

Like all unfinished investigations, my first communication

* Ann. and Mag. Nat. Hist. vol. xvi. No. 91. p. 1, 1855.
† *Id.* vol. xi. No. 64. p. 294, 1853.

will remain uninteresting until its subject is made more comprehensive, and it is on this account that I offer the following additional observations, which, together with figures of all that requires illustration in this, as well as in my former paper, will furnish a key to what I have already described, and enable the reader to correct for himself any false inferences which my remarks may have caused from my imperfect knowledge of a development, which at first appears more likely to be vegetable than animal, and though subsequently proved to be the contrary, is after all situated in that part of the scale of living beings with which we are least acquainted, and where many of the organisms so much resemble the lower orders of both vegetable and animal kingdoms, that on one day they are on this side the line of separation and another day on that, as discovery turns their balance in favour of one or the other of these great divisions of organic life.

With such introductory remarks let us proceed then to the different parts of the subject which require further elucidation.

It will be seen (at p. 6, *Obs. cit.**), that the "gonidia," which we shall henceforth call "monads," lost their cilium respectively and passed into polymorphic, reptant cells, each of which contained a contracting vesicle; in fact, into Rhizopoda; and here we must leave them for the present, considering them as *Amœbæ,* which might or might not have had an ulterior development.

Now we find by what Pringsheim has stated, that he not only observed a similar development in the cells of *Spirogyra*, but also in *Œdogonium, Cladophora fracta,* and in the young plants of *Nitella syncarpa*; to which I may here add the extent of my own experience in this matter, viz. that such developments are common in *Chara* and *Nitella*, *Cladophora* and *Spirogyra*; occasionally in *Hydrodictyon*; in *Closterium acerosum* and *Cosmarium* among the Desmidiæ, but never in the Diatomaceæ †; common in *Euglena* and in the dead bodies of Furcularian Rotifera. The same or similar developments probably take place throughout the whole of the freshwater Algæ and in many of the Infusoria, but I have only noticed them up to the present time in the organisms mentioned. Again, wherever I have seen them, they have appeared to me to have arisen from germs implanted in the Algæ or Infusoria in which they have occurred; and the organisms which have come from them have been *Amœbæ, Astasiæ,* or colourless flexible *Oscillatoriæ* (?). I am not certain that

* After this, the page alone of these "Observations" will be mentioned.

† The *Asteridia* of the Rev. W. Smith however appear to belong here, and that naturalist has seen them "occasionally in the Diatomaceæ." (Quart. Journ. Microscop. Sc. vol. i. p. 69.)

Pleotia should not be added to these, but until further observation proves this, I must leave it under doubt. May not the "spirozoids" also or "spermatospheres" of Itzigsohn belong to these developments? Their being developed in *Spirogyræ*, from globules of endochrome which become pale, lose their colour, and end in becoming "greyish-white," at least, gives them a strong resemblance. How the germs which produce these developments exist in the cells of Algæ without apparently affecting their vitality, or causing a suspension of their functions, is difficult to conceive; but that they do so, is proved by the presence at least of one kind generally, if not always, in the plants of Characeæ after they have attained a certain size, and to that we must now chiefly direct our attention.

My first observations on this development were made on the internodes of a very small species of *Nitella*, but latterly they have been made on the internodes of a very large one; some of the oldest of which average six inches in length by one twenty-fourth of an inch in breadth. Hence they were well adapted generally for experiments on this Alga*.

Let us now direct our attention to what takes place when one of these, about three or four inches in length, is so suspended, that about an inch of the free end may rest upon a slide of glass, in a little water, while a portion of the latter also is cut off with a lancet, and the rest covered with another piece of glass for observation.

1st. The *axial fluid* rushes forth and renders the *cell-wall* more or less flaccid.

2nd. The *mucus-layer* in part comes forth, and with it also portions of the *green layer*.

3rd. After a short time the expelled mucus, which is apparently separated into masses, but is nevertheless more or less

* There are two species of *Nitella* in the island of Bombay, the smallest of which I have already described, and the following is a description of the large one, or one in question:—

Plant long and straggling, of a deep green colour, with short branches, crowded towards the top. Oldest internodes 5–6 inches long, some fluted (from collapse?) where the endochrome has disappeared and left them of brown colour; terminal internodes shortened and crowded, comparatively. Verticils consisting of five short branches, each composed of 2–3 long cells applied end to end, the last terminated by a spine, five minute spines round each joint, and 10–12 or more round the base of each verticil; long branches rising between the short branches of the verticil. Organs of fructification cast together in the axil of the verticil or singly at the joints of the short branches. *Globule* spherical, of a brownish-green colour; *nucule* conical, at first white, then black. *General characters*:— Great length, dark-green colour, large organs of fructification and large size of plant generally. Grows in the tank of Nagaum in the island of Bombay.

connected by minute threads of its own material, is drawn back into the internode almost as quickly as it was ejected.

4th. By now moistening that part of the internode which is suspended, the mucus is again made to rush forth, and this backward-and-forward movement may be kept up for some time by alternately moistening and allowing the internode to get dry; or, by keeping the internode constantly moist, the whole of the mucus-contents may at once be discharged.

Here there is evidently a rapid endosmosis, and it would appear that the mucus-contents, which are within the *green layer*, are not expelled so much by the contraction of the latter, as I had inferred (p. 18), but depend for their exit upon the passage of water through *both* the *cell-wall* and the *green layer*; while the "spasmodic" retraction of the mucus mentioned in the same paragraph must be chiefly attributed to the drying up of the cell-wall, and consequent imbibition through the truncated end of the internode.

Green layer.—The structure of this has already been described, and the "green disk" was stated to consist of a transparent capsule or cell, within which is a green, flat disk or nucleus, of nearly equal diameter, presenting three or more granules in its composition. It is to the latter now that I chiefly wish to call attention. In these granules I had only been able to obtain a faint trace of starch by iodine, and therefore I left the question of their composition open, although I might have inferred from analogy that they were starch-grains. Subsequent observation has now proved to me that they are the rudiments of starch-grains, and that in some instances where the starch has been fully formed, they have increased to such an extent as to occupy the whole of the transparent capsule (Pl. VIII. fig. 5). Thus packed together of different sizes, they assume the rounded, subangular shapes of all similar bodies developed in a circumscribed space; at the same time they appear to have been formed at the expense of the green disk, whose substance is much wasted or has entirely disappeared.

Hence they are generated in the protoplasm of the cell; for if the green disk be exposed to the action of æther when the granules are very small, the colour of the nucleus disappears, but its form remains; while at a still earlier period it also appears to contain a nucleolus or cytoblast. Under what circumstances the granules come into existence I am ignorant; but that they have nothing to do with the cytoblast may be inferred from their appearance in the Diatomaceæ (*Navicula fulva*, &c.) outside the cell of the cytoblast or nucleus, and in the cavity or body of the frustule, which, up to the time of their appearance together with that of the oil-globules, is perfectly transparent.

Mucus-layer.—It has been already stated that when this rushes out it is found to be composed of a granuliferous mucus, globular vesicles, circular disks, and irregularly shaped opake, yellowish bodies. The disks, which are circular in the small *Nitella*, are elliptical and elongate in the large one; and the irregularly shaped bodies, which have no particular figure in the small *Nitella*, are, for the most part, agariciform and patulous in the larger species. The same differences obtain also in *Chara verticillata* (Pl. VIII. figs. 7–16).

Although many of the globular vesicles present no nucleus, and many appear to be altogether void of granular contents, yet most present either a single nucleus or a plurality of such nuclei; and some which are very large contain a number of smaller nucleated vesicles like themselves; but the typical form of the globular vesicle consists of a transparent cell-wall filled with a granuliferous mucus, the grosser parts of which are more or less collected round the nucleus, which is fixed to or imbedded in its cell-wall (fig. 14); the nucleus being, in fact, equivalent to the "circular disk" (fig. 8); and where we see a plurality of them in a globular vesicle (fig. 16), it may be inferred that they are developed there, and that the subsequent bursting of the vesicle thus allows them to become free and scattered in such abundance as they are observed to be throughout the mucus-layer. Another remarkable character of this delicate vesicle is, that it is endowed with the power of motion, inasmuch as many may be seen on their first issuing to rotate upon their axes, and to undulate or prolong their cell-wall in different directions, while the granules of the mucus internally are in constant vibratory or molecular movement, like those of *Spirogyra* (produced perhaps by the irritability of the mucus); while the mucus itself *en masse* is continually moving to this side or that, and drawing all the granules which are imbedded in the moving portion in the same direction. Hence, with the exception of the contracting vesicle and a far more delicate texture, we have a cell corresponding in every respect to that of *Amœba* and *Spongilla*.

It will be remembered also, that in my description of *Spongilla* * it is stated, that the intercellular mucus which binds the cells together has a polymorphic power, like that of the cells themselves; and this appears to be the case, but in a much more limited degree, with the granuliferous mucus of *Nitella*, which, at the time of its issuing from the internode, in masses, undergoes a slow but appreciable change of form; and either throws out threads which adhere to the glass, or exhibits in these threads a distinct retractile movement when the latter separate

* Ann. and Mag. Nat. Hist. vol. iv. p. 36, 1849.

from their points of attachment. It is perhaps more to the breaking of these than to the "bursting of the vesicles" mentioned (p. 19), that the "jerking" movements seen every now and then in this mucus are to be attributed; at the same time, the severation of these threads thus uniting the masses of mucus may still be a vital act.

The "irregularly shaped bodies" (fig. 11), which are agariciform in the mucus of the large *Nitella* and *Chara verticillata* (figs. 12, 13), next claim our attention. They are of an opake, yellowish colour, and bear a strong resemblance to starch as well as to fixed oil. It is stated (p. 4) that iodine only turns them of a "deep brown amber colour;" but since that, I have frequently found it produce in some a deep claret, almost amounting to purple tint, with portions here and there which were quite blue. When pressed however, under these circumstances, between two pieces of glass, part of their substance has, in addition, assumed a fatty consistence, of a brown amber colour. What are these bodies then; and whether do they belong to the globular vesicles or to the mucus of *Nitella*, or are they developed in both; and what is their origin? These are questions for our consideration which we shall now pursue. From the apparently promiscuous formation of starch and fixed oil in the nucule of *Nitella*, and from the formation of starch-grains, and, probably as often, fixed oil-globules in the protoplasm of the "green disk," it does not appear unreasonable to conceive that similar formations may take place in the mucus-layer (which is also the protoplasm) of the internode. But I have lately found that starch is plentifully developed in *Spongilla* towards the end of the season, when it is about to be left uncovered by the water, and that not only are large starch-grains to be observed, apparently in nothing but the intercellular substance, but that many of the cells also exhibit traces of starch among their greenish granular contents; and some spherical cells appear to contain nothing else but a translucent amyliferous fluid; while there is no trace of starch to be found in any part of the capsule or its contents, nor in the newly developed *Spongilla*. With organisms then thus far alike in their products as *Nitella* and *Spongilla*, and the presence of an organism so much like *Spongilla* in the internode of the former, how to decide which produces these partly amyloid, partly fatty, agariciform bodies that abound in the mucus of *Nitella*, is a question which had better be postponed until we come to the development of the latter. In the meanwhile, with reference to their origination, I can state no more than I have done with respect to the origin of the starch-grains in the green disks, and the starch-grains and oil-globules which occur together promiscuously in the Diatomaceæ and in other vegetable cells, viz. that they first make their appearance in the cavity and substance of the protoplasm; which latter is Cruger's view*.

In the small species of *Nitella*, these irregular bodies were almost as frequently found appended to, or in the walls of, a globular vesicle, in the manner of the circular disk or nucleus itself (fig. 15); frequently seen in plurality as well as singly within large globular vesicles in both species of *Nitella*, imbedded in their internal mucus; and it often, though by no means always, appeared to me, that the circular disk or nucleus passed into the irregular body. This seems a not unlikely origin for them, and would explain their situation when appended to a vesicle, loose in the granular mucus, or in plurality in the large vesicles; more particularly, as has before been stated, from these being the only positions in which the circular or elliptical disks (nuclei) do appear. At the same time, many may have had their origin in the mucus itself, just as the starch-grains of the green disk, perhaps in germs, and this would account for the minute ones; but whatever may be their origin, or whether they be a development of *Nitella* on the globular vesicles, they form part of the contents of the internode, and disappear in the course of the passage of the cell-contents into the so-called "gonidial cells," and the subsequent development of the monads.

With vesicles so nearly allied to *Amœba* and *Spongilla*, it also seems not improbable that they should take in substances of nutrition after a similar manner; that is, apparently through their cell-wall; and although in some cases the irregular bodies may be developed in the nuclei of daughter-vesicles which have not left the parent, yet in others they may have been taken in by vesicles in the way to which I have alluded, viz. for the sake of food. Hence we frequently see one imbedded in the internal granuliferous mucus of a vesicle, and not unfrequently undergoing, to a certain extent, that rotatory motion which is presented by portions of food just introduced into the abdominal mucus of *Vorticella*, *Paramecium aurelia*, &c. But perhaps the most remarkable instance of this occurs with the green disks, more or less of which become displaced and insulated when the end of the internode is truncated, and thus appear to be caught up by the globular vesicles immediately the two come into contact (fig. 17). Donnè first called attention to this, terming the globular vesicles "grosses gouttes huileuses ou albumineuses," and his observation was confirmed by Dutrochet†. The

* Ann. and Mag. Nat. Hist. vol. xv. p. 317. See also Mohl's papers translated by Henfrey, with observations by the latter, *idem*, pp. 321–416.

† Ann. des Sc. Nat. Bot. vol. x. p. 348, 1838.

circulation of the mucus-layer itself is hardly more remarkable than the rapidity with which the green disks are whirled round upon their short axis horizontally or vertically, when they get into the abdominal mucus of one of these vesicles. If this explanation of it meet with disbelief, I can only repeat in its support, that the irregular bodies are similarly affected when they get into this position, though not to such a degree of rapidity, probably from their greater weight and ragged form (fig. 18), and that neither these nor the green disks exhibit this phænomenon when lying outside the vesicles; while the rotation of food, when it gets into the abdominal mucus, is a common occurrence in many of the Infusoria, especially in *Vorticella*, *Paramecium*, &c.

We now come to an important point of elucidation; viz. if the globular vesicle can enclose the green disks so rapidly when a few only of the latter are displaced, they should be able to enclose a far greater number when the whole of the *green layer* is broken up (figs. 19, 20). Hence it becomes much more likely that this should take place when the so-called "gonidial cells" are formed in the internode (fig. 21), than that portions of the loose mucus, as I had before supposed (p. 7), should wrap up certain numbers of the green disks respectively in their substance, and then pass into closed, transparent sacs or cell-walls. Led on from fact to fact, then, to this conclusion, we now see that the so-called "gonidial sac" is not a new formation, but a pre-existing "globular vesicle," which, when filled with green disks, is in an efficient state, as regards nourishment, to multiply itself by segmentation (fig. 22). That segmentation is the way in which the litter of monads is produced, would appear, first, from the cell-wall losing all power of motion, and apparently life (fig. 20); then the formation sometimes (probably always) of a secondary more delicate cell or coat within (fig. 21); afterwards a separation *en masse* of the granules and mucus from the brown or nutritive matter, now become effete (fig. 23); and, lastly, by the division of this into the litter of monads (figs. 24, 25). Whereas, in the propagation by ovules in the Amœbous cells, all foreign matter appears to be thrown off, and the ovules fully formed and separate previous to encystment and incubation. After the monads, formerly called "gonidia," have been developed, the inner cell disappears, and the outer one giving way from decay (?), they escape into the water (figs. 26, 27).

It is not always that this process can be so distinctly seen, because the brown matter seems sometimes to be so mixed up with the granules and mucus, that the monads appear to come directly out of the former, without a previous separation of the latter.

The production of the young Water-net, or *Hydrodictyon*, is not unlike this. Here a single gonidium grows into a long tubular cell, during which its internal surface becomes lined with a mucus-layer charged with chlorophyll-granules and starch-grains; this layer, when fully developed, divides up into gonidia, which, by mere change of position (Braun), force themselves into a new Water-net, or separate altogether, and pass out through a rent in the parent gonidium, now become a long cylindrical cell; at this moment also the existence of another more delicate cell, between the outer one and the mucus-layer, is demonstrated, in which the passage of the gonidia is momentarily arrested. Here, then, the chief apparent difference between this process of development or multiplication and that of the globular cell of the mucus-layer of *Nitella* is the introduction of foreign material for the support of the mass during the time it is undergoing division in the latter, and the preparation of it in the cell itself for this process in the former. Here also the cell-wall of the gonidium passes into the cell-wall of the mother-cell in *Hydrodictyon*, which corresponds to the so-called "gonidial cell" of *Nitella*, and is not a new secretion; while the internal delicate membrane which holds the gonidia in *Hydrodictyon* corresponds to the delicate cell-membrane which immediately surrounds the monads in *Nitella*; and the monads, as well as the gonidia of *Hydrodictyon*, appear to gain their proper covering from the contents of the secondary cysts, which coverings in time become respectively the mother-sacs of future litters. We shall also see by and by, that the same thing takes place in the segmentation of *Paramecia*.

The passage of the green disks *in situ* into monads or polymorphic cells, mentioned p. 8, is now easily understood; since, if the germ producing the first globular vesicle can get through the cell-wall of the internode without causing a suspension of its functions, a germ from it might easily get from the *mucus-layer* into the green disk of the *green layer*; and there, living upon the protein nucleus and green chlorophyll, take the place of the latter in the transparent cell, which, finally decaying, would allow the monad or monads thus produced to get into the cavity of the internode.

Viewing, then, the globular vesicles as an infusorial development, all difficulty in accounting for the changes which they occasion in the cells of the *Characeæ* disappears, and all changes which take place in these vesicles themselves become easily understood.

But we have yet to discover whether these vesicles existed *ab origine* in the mucus of the internode, and, if not, how and under what form they were introduced.

Probably the best way of pursuing this part of the subject is to commence with the development of the new plant from the nucule, by which we shall see under what form the mucus first appears.

The nucule of *Chara verticillata* (fig. 35 *a*), which is more or less ovate, consists of three coats, viz. an external or cellular, a middle or laminar, and an internal or delicate one, within which is enclosed a quantity of starch and oil, together with a little mucus.

The external coat (*b, b*) is composed of five long cells, twisted twice round the middle coat, side by side, so as to form a spiral plane, ending at the apex in a group of ten cells, the last of which are pointed; this group has been called the coronet. They all, and in every respect, answer in structure, &c. to the description given of the internode of *Nitella* in my first paper.

The middle coat (*e, e*), which represents in relief and depression the spiral lines impressed upon it by the cellular one, consists of several very thin laminæ, structureless, homogeneous in composition, and of a dark brown colour by transmitted, but black by reflected light.

The internal coat (*d, d*) is a fine delicate colourless membrane, which frequently adheres very strongly to the middle coat, and so much resembles the laminæ in the latter, that the whole together present a structure similar to that of the thickened cells in old filaments of *Conferva glomerata*. When treated with iodine alone, this, as well as the middle coat, assumes a reddish-brown colour; but when sulphuric acid is added, the internal coat (as well as the next layer to it, which ought perhaps to be considered a part of it) turns blue, while the middle coat remains unaltered.

The starch and oil are in pellicled smooth grains, of a subround, subangular, elliptical or compressed form. These grains are larger in the centre than at the circumference, where they become almost molecular, and are mixed up with a layer of mucus, which supports the whole in an ovoid form.

This external mucus may be the preserved protoplasm, and there may be a cytoblast also ready to assist in the formation of the first cell; as in *Spirogyra*, where both protoplasm and cytoblast appear immediately the contents of the resting-spore burst forth to form the new cell.

Such is the composition of the *nucule*, in the contents of which I have never seen anything like the "globular vesicles" of the mucus-layer; not even where the germinating matter has perished, and the nucule has remained for several weeks afterwards exposed to the decomposing action of the water. Neither have I even seen anything like the globular vesicle, or monad developed from it, in the cells of the filaments producing the antherozoids of the *globule*.

We have now to examine the development of the first few cells of the new plant successively, in order that we may trace the development of the mucus-layer.

In the Characeæ, as in *Cladophora*, but not as in *Spirogyra*, the coat immediately covering the grumous contents of the spore in one case and the nucule in the other, appear to be prolonged into the cell-wall of the new plant. I infer this from the cell-wall of the first internode being so firmly attached to the inner coat of the nucule that it cannot be separated from it without rupture, since the black colour of the middle coat prevents our seeing how the continuation is effected after the manner of *Cladophora*, where the old cell and the spore-capsule are equally transparent. By a prolongation of the internal coat into the new cell-wall, I mean that the former becomes soldered to the latter, as the latter is secreted or formed by the protoplasm of the nucule.

Having come to this conclusion, we will now follow the extension of the new plant to the sixth cell, exclusive of the cavity of the nucule. At this period we shall find it about one-fiftieth of an inch in length, and the circulation or full development of the mucus-layer only established in the cell next the nucule, which we shall designate the first, and so on to the terminal one, which will be the sixth.

Beginning then from the sixth, or youngest cell, and tracing the development backwards, or towards the nucule, we shall find the following appearances:—

In the terminal or sixth cell, which is not fully formed, nothing is seen within the cell-wall but a mass of small spherical hyaline vesicles of different sizes, and the barely perceptible rudiments of the green disks (fig. 36). In the fifth the number of vesicles are diminished, by some being larger than the rest, especially two in the centre, and the rudiments of the green disks more distinct. In the fourth the two large vesicles (spaces?) have united into one, and many of the smaller ones have broken down into, or have been replaced by mucus; the rudiments of the green disks are more evident. In the third the same changes are seen, but still more advanced; while in the second the central space is much larger, though irregular in form; the mucus increased in quantity, apparently at the expense of the hyaline vesicles, which are now very few; and the whole beginning to move gradually round the cell. In the first the circulation is established; no hyaline vesicles are seen in the mucus, though already it presents some of the "irregularly shaped bodies," and the green disks are found.

Thus we see that the mucus-layer appears originally to be formed by cells of extreme tenuity, and that even the first cell which presents a circulation may have the irregular, agariciform bodies in it.

Now the same thing takes place in the roots (fig. 37), which are given off in a circlet from the first internode or junction of the first cell with the cavity of the nucule (fig. 35 *e*), and at this period far exceed the plant in length and amount of development. They however present these exceptions, viz. that they are as transparent as glass, from having no green disks, and for some time bear a large cytoblast in their extremity (*f*), which however, as the root elongates, adheres to one side (*g*), and there appears to undergo fissiparation and throw out a new circlet of roots (*h*), while the old root ends some distance beyond this in a *cul de sac* without further development.

Thus we have the green cells of the plant at first, as well as the roots, so transparent, that the delicate hyaline vesicles which precede the formation of the mucus-layer can be distinctly seen through them; while afterwards, when the mucus is fully formed and in circulation in both, and an equal degree of transparency still remains in either, no vesicles whatever can be seen, nor anything like the nuclei belonging to the "globular vesicles;" though, as before stated, a variable number of the irregular bodies may already be present.

Hence we may fairly infer two things, viz. first, that the globular vesicles at least do not exist *ab origine* in the mucus-layer; and, secondly, that the irregular-shaped or agariciform bodies may be formed in it independently of the presence of the globular vesicles.

As to the external source of the globular vesicles, it does not seem improbable, now that we know them to be so like Rhizopoda in almost every respect, and to produce monads which pass into small amœbous cells, that they should originally come from germs of their family; particularly as all the freshwater species dwell upon the freshwater Algæ, are chiefly dependent on the mucus of their cells for food, and are always found in greater or lesser numbers creeping over their tender shoots, or present at the formation of the resting-spores, when the cell-membrane is so soft that it can be most easily penetrated.

If we saw an *Arcella* or *Difflugia* developed from one of these monads which pass into an amœbous form, we should have no doubt about the matter; nor ought we to have much, I think, if we can find one Alga developing itself in another under similar circumstances.

For instance, we will take *Œdogonium* germinating in the midst of the living cells of a filament of *Oscillatoria* (*princeps*, Kg.).

Happening one day to be examining the spores of *Cladophora*, with which *Conferva*, *Œdogonium*, and this *Oscillatoria* had been mixed and kept in a glass for eight or ten months, for the sake of observing the development of the former, I noticed that in several of the filaments of the *Oscillatoria* there were green cells developing themselves, so much so as to thrust aside the cells of the *Oscillatoria*, and break through the thickened sheath of the old filament, after which they passed into a filament like that of *Œdogonium*; but not being sure of the family of the Alga, I waited for the determination of this, until chance favoured me with the view of a filament not only extending along the sheath of one of the *Oscillatoriæ* mentioned, but also bearing in addition the peculiar spore of *Œdogonium*. Although in many of these instances the cells of the *Oscillatoria* were dead, yet in several the cells of *Œdogonium* were growing in the midst of the living cells, and bursting through the sheath where the latter, from its transparency and general appearance, bore no signs of previous injury (Pl. IX. fig. 15).

Now here, neither the spore of *Œdogonium* nor its sporule or gonidium can be supposed to have entered the sheath of the *Oscillatoria*, as they, from their size, would probably have caused such an injury of the sheath as would have led to the death or rupture of the filament at this part. Hence we may infer, that these cells arose from germs of extreme minuteness, which nevertheless had the power of penetrating the Oscillarian sheath. May not the "globular vesicles" of the mucus-layer of *Nitella* have been derived from germs of Rhizopoda equally small, but endowed with a similar power? Many small species of *Œdogonia*, like Rhizopoda, have a great tendency to dwell on the outside of the filamentous Algæ; old filaments of *Cladophora* are frequently covered with *Œdogonium*, and it seems not improbable that the minute germs of both Rhizopoda and *Œdogonium* may have a like parasitic tendency, as well as power to penetrate into their interior.

Lastly, we have to consider how the germ, when so small, can possess such power of penetration; a proposition which is easily solved when we remember that almost every observation we make on structural alteration in vitalized parts presents us with an instance of bodies travelling from one part to another, or, in other words, effecting change of position by a solution of the material which obstructs their progress.

As, however, it is desirable to support this by a case in point, or one as nearly allied as possible, I will cite a development belonging to the class under consideration, which takes place in the cells and resting-spores of *Spirogyra*.

Just after the conjugation of *Spirogyra*, a number of spherical cells filled with minute refractive granules frequently make their appearance within the mucus-layer of the cell, and when the former shrinks from the sides of the latter, these spherical cells become wrapped up in it (fig. 9 *a*). In this position, if their granular contents, which the sequel will show to be germs, were to be liberated into the cell of *Spirogyra* through the bursting of their parent-cells, they would in all probability perish, for the parent-cells have apparently already subsisted, and brought their progeny to the state of germs, on the nutrient contents of the cell of *Spirogyra* in which they have become developed. But to provide for this, these spherical cells have each the power, not only of developing a blind tube, which by the process of solution to which I have adverted can pass through the cell-wall of the *Spirogyra* for the exterior liberation of their germs, but also to tubulate with each other if necessary, when the contents of all the cells together may be thus liberated by one or more tubes only, as the case may require (fig. 9 *b*); and often they will send one through the septum of the cell into the resting-spore of the next cell, which being full of nutritious matter, immediately furnishes food for the whole brood (fig. 10 *e*). Hence if a blind tube of a small cell of this kind can make its way through these comparatively hard membranes by simple solution, for it can hardly be supposed that it does so by any mechanical power, the smallest germ may be able to enter the cell or sheath of a filamentous Alga after the same manner. That the granules of these spherical cells, which are of different sizes, and, motionless at first, become locomotive, swarm about the cell, and then pass out of the tubular prolongations, has been proved to me by ocular demonstration (fig. 9 *b'*).

Thus I think sufficient evidence has been brought forward to show, that the globular vesicle of the mucus-layer or protoplasm in the cells of the Characeæ is a parasite, probably of a rhizopodous nature, apparently introduced after the development of the young plant, and not impossibly under the form of a germ, and after the manner of the instances last mentioned.

I have yet however to add a few observations on developments of a similar kind in the cells, not only of *Spirogyra*, but in the body of an infusorium, viz. in *Euglena*.

During conjugation, the *Spirogyræ* are particularly infested with these parasites, if such they may be termed, and the rapidity with which they make their appearance at this period would lead to the conclusion that the germs from which they originate must have pre-existed in the cells in which they appear, as in the Characeæ; that is to say, without interfering with their functions. Be this as it may, the peculiar tubulating cell just mentioned is very commonly seen in *Spirogyra* at this time (figs.

9, 10); and not only in *Spirogyra*, but also in the dead bodies of some of the Furcularian Rotifera (fig. 16). To what infusorium this cell belongs I am ignorant; but from having seen it associated with *Astasiæ* under circumstances indicative of one being the product of the other, and more particularly from finding young *Astasiæ* developed in the cells of *Spirogyra* to a great extent where the tubulating cell-development was equally prevalent (fig. 9), with no mother-cells present in the cell of *Spirogyra* containing the young *Astasiæ* to thus account for their origin (fig. 9 *d*), I have supposed that they might have come from the germs contained in the tubulating cells, which germs have been conveyed into the cells of *Spirogyra* in the way above described (fig. 10). However, whether the tubulating cells are connected with *Astasia* or not, young *Astasiæ* are also developed within the cells of *Spirogyra* to a great extent (fig. 9 *d*); and although they at first have almost as much polymorphism as an *Amœba*, still they retain their cilium, and after a while assume the form and movements peculiar to *Astasia* (fig. 9 *d'*). I might here mention, that on one occasion I saw a *large Amœba* with a long cilium, at one time assuming the form of *Astasia*, and at another that of *Amœba*, which thus gives us the link between these two infusoria. The cilium however had not the power of the filament of *Astasia*, though it occasionally became terminal.

Besides these developments in the cells of *Spirogyra*, there is the one described by Professor Pringsheim*, and frequently a development of long, slender, colourless filaments, which have a writhing movement like that of an injured earth-worm. Some of these filaments present numerous granules in their sheath, and a faint appearance of cell-division; and I think that I have seen such filaments coiled up in mother-cells within the *Spirogyra*-cell. The same kind of filaments occasionally appear in *Closterium acerosum*, when its contents are passing into dissolution; but long before the chlorophyll has changed colour, or putrefaction has commenced. To enumerate all the developments of this kind, however, which take place in the filamentous Algæ is not my present object, and the only other development of the kind that I need allude to here is that which frequently occurs in *Euglena*.

This is also of a Rhizopodous character, and at first I thought it might be merely another form of *Euglena*, as *Acineta* is but another form of *Vorticella*; but subsequent observations convinced me that this was not the case. I was led to notice this development by an apparent metamorphosis of the cell-contents of

* Ann. & Mag. of Nat. Hist. vol. xi. p. 210, 1853.

some fixed and capsuled *Euglenæ* (which I had had under observation) into granuliferous *Amœbæ* of a pinkish colour within the old cell of *Euglena* itself (fig. 14); and the presence of several such *Amœbæ* creeping about the watch-glass, while many of the cells of the *Euglenæ* (*viridis*?) were empty, or only contained a little red effete matter, left no doubt in my mind as to the origin of both colour and infusorium.

It was also observed in some instances, where the contents of the *Euglena* had passed into an Amœbous mass, that the latter underwent a kind of segmentation, so that several (perhaps eight) small *Amœbæ* were developed instead of one large one. All this became confirmed on another occasion, when watching some large *Euglenæ* of a purse-like or ovate form (*Crumenula*, Dujar.?), wherein the peculiar embryonic cells of the species (fig. 11 *a*, *b*) (for each species has its peculiar-shaped cell of this kind, and they are all composed like those of *Spongilla*, viz. of a transparent compressed capsule, and a faint yellowish translucent nucleus of nearly equal size) had been developed. Expecting daily while under observation to see the embryonic cells liberated by the rupture of the parent-cell, I noticed on one occasion that several of the latter had become surrounded respectively by a delicate granuliferous *Amœba*, and from that moment I knew that all further progress of the embryonic cells must cease, for the *Amœbæ* appear to destroy every living organism which they enclose. However, in a few days the *Amœbæ* had left the *Euglenæ*, but the rich green colour of the latter had faded; indeed there was hardly any colour at all left, and the embryonic cells, with which they were originally filled, began to diminish in number, and give place, at the same time, to a uniform granular matter, which soon segmented itself into another development of six or eight globular masses, much larger than the embryonic cells (fig. 12). Such a process at first seemed to be proper to the *Euglenæ*, as the contents of one and all successively became thus affected; but presently the spiral coats of the *Euglenæ* respectively gave way, and the globular masses being liberated, began to creep about under the form of *Actinophrys* (fig. 13 *a*, *b*). It then seemed evident that the germs of an *Amœba* had been introduced, and that they had become developed in the cell of the *Euglena* at the expense of its embryonic cells; but whether or not they had been introduced while enveloped in the *Amœbæ* mentioned, there are no facts to decide.

This apparent metamorphosis of the cell-contents of *Euglena* into Rhizopoda is not only mentioned for the purpose of instancing another of the developments under consideration, but also for preventing others from being misled, as I was myself at first, into considering this as an *alternating* form of *Euglena*. I have since almost satisfied myself that *Euglena* conjugates, and that the cells which I have termed embryonic pass into *Euglenæ*. But had these cells not been present, there would still have been room for doubt, inasmuch as a development of the same kind takes place in some *Amœbæ*, apparently in connexion with the nucleus alone, with which *Euglena* also is provided (fig. 11); at the same time that we know the *Amœbæ* to produce embryonic cells like *Spongilla*, which cells again are like those of *Euglena*. Some *Amœbæ* at least then, propagating by germs or gemmæ, according as the granules are set free singly or in masses, as well as by embryonic cells, it might be questioned whether *Euglena* does not also possess these two processes. Again, when we know from Stein, as before mentioned, that *Vorticellæ* pass into *Acinetæ*, and *Acinetæ* produce full-formed *Vorticellæ*—and I have seen some *Amœbæ* also produce full-formed *Vorticellæ*—it becomes necessary to ascertain among these changes, what are parasitic or foreign developments, and what are merely *alternating* forms of the same species,—inquiries which are extremely intricate and perplexing, but which must be prosecuted thoroughly before we shall be able to adjust these matters, or arrive at a true history of the vital œconomy of both Infusoria and Algæ.

With reference to the development of the "ciliated sacs" mentioned at p. 14, I have since ascertained, that the variety of forms which they assumed depended upon their having been forced from their cysts before they were fully developed; for I have since not only had an opportunity of examining them when just liberated from the latter in the natural way, but of watching for a long time two individuals of large size and full development, which I found free among some filaments of *Cladophora*. Having thus called attention to this development, I will describe the infusorium which appears to be the source of it. It is a *Paramecium* closely allied to *Nassula*, and, from the likeness of the oral orifice to the human ear, I propose for it the name of "*Otostoma*."

Otostoma, H. J. C. (new species) (Pl. IX. figs. 6, 7, 8).

Body ovoid, of a light brown colour, covered with longitudinal lines of cilia (figs. 7, 8). Mouth ear-shaped, in a depression situated about the junction of the anterior with the middle third of the infusorium (fig. 7 *a*); buccal cavity broad, short, curved downwards, and a little upon itself outwards, plicated longitudinally in parallel lines (fig. 6 *a*). Anus terminal; gland or nucleus long, fusiform (fig. 7 *c*), situated between the buccal cavity and the contracting vesicles (fig. 7 *d*, *d*), which are double, and connected with a set of vessels something like those of *Paramecium aurelia**.

The individuals which become encysted in the internode of *Nitella* I have never been able to see clearly, on account of their rapid movements and gorged state with the green disks (fig. 1); but the depression indicating the position of the mouth can be seen, and two contracting vesicles. After the segmentation, which stops at 2, 4, or 8, and full development of the new brood has taken place, the green matter, now become brown, is thrown off as effete (figs. 3, 5), like that of the "globular vesicles" after the monads appear, and the cysts giving way, the new infusoria come forth, presenting the arrangement of cilia, form of nucleus, and colour of *Otostoma* (fig. 5); but there is only one contracting vesicle at this time, and the mouth is not so rigidly fixed or defined as in *Otostoma*, probably from the tender age of the new animalcule.

During the process of segmentation, the external and internal cysts at first appear to be newly secreted, and the old ciliated integument to be divided up into coats for the new litter; but this does not correspond with what has been before stated, where the old coat seems to be metamorphosed into a cyst-covering for the new litter, and another delicate cyst secreted within this (figs. 2, 3); while the internal substance then divides itself up into 2, 4, or 8 sacs, as the case may be, and each division developes a new ciliated coat for itself (figs. 3, 4).

The presence of a few monads, which probably formed part of the contents of the internode before they were gorged by the infusorium, and retained their life by getting between the cysts (fig. 3 *b*, *b*), favours the view that the external cyst was the originally ciliated coat of the parent infusorium.

Lastly, I have to give an explanation of the locomotive power afforded to the fragments of the spiral bands of "*Zygnema*" mentioned at p. 16, which I now feel convinced did not derive this power from their own mucus, but from having been enclosed within the bodies of delicate *Amœbæ*, which afterwards crept about under the radiated form of *Actinophrys*.

Circulation.

It has been shown above, that rhizopodous cells abound in the mucus-layer of the old internode of *Nitella*, but at a very early period do not appear in the internodes or roots of the young plant. Hence it becomes necessary to adduce further

* In a future communication, I propose describing this "system of vessels," which are excretory at the contracting vesicle; when I shall also recur to the description of *Otostoma* more particularly.

proofs of the mucus-layer, minus the rhizopodous cells, possessing the "inherent power of mobility" mentioned at p. 18, which was then assigned to it, chiefly upon the inference that the mucus of the mucus-layer furnished the cell-wall of the so-called "gonidial cells," and that the polymorphic and locomotive power of the latter at the commencement was indicative of the same power existing in the mucus in its amorphous, plasmic state. That such a deduction would be inadmissible if the development was to be considered infusorial, I stated in my "Postscript" (p. 22); and now that the so-called "gonidial cells" have been shown to be the globular vesicles of the mucus-layer, and of a rhizopodous nature, the fallacy of such an inference is much more evident. But I also observed, that there were still "sufficient reasons left" for my considering the rotatory motion of the mucus-layer due to an independent contractility.

I have now to give further proof of this; but, unfortunately, in doing so I must confine myself to what the mucus-layer exhibits while within the internodes and roots of the young plant, supported by what it may be inferred to possess from analogous motions exhibited by the mucus-layer of other allied organisms; for the cells and the roots of the young plant, at that time when alone we have the power of determining that there are no rhizopodous cells in them, furnish too small a quantity of mucus for our watching it in the manner so easily effected when issuing from the large internode.

To pursue this inquiry, then, we have first to satisfy ourselves that the motions in *Nitella* and its allied organisms are in homologous structures, and then to see how many kinds of motion this structure presents.

Of their being in homologous structures there can be no doubt, because the mucus-layer in all is the protoplasm of the cell; and they are of two kinds, viz. one of general irritability, and the other of polymorphic and locomotive power.

The first kind, or that of general irritability, is manifested by the trembling movement of the granules which are imbedded in the mucus-layer itself, more than by that of the moving agent or mucus, which can hardly be seen, from its transparency. This motion of the granules, which is similar to that termed "molecular," is observed in the mucus-layer of the spine-cells of *Nitella* in which no circulation has ever existed, and in that of the internodes when the circulation is temporarily arrested. It is also seen in *Cladophora*, and particularly in *Spirogyra*; in the Desmidiæ (*Closterium*, &c.); in the Diatomaceæ (*Navicula*, &c.), and in the mucus of the cell of *Spongilla*, &c.

The second kind, or that of polymorphism and locomotion, includes the rotatory movement seen in the cells of many aquatic plants besides the Characeæ, in which the whole of the mucus-layer changes place. In *Serpicula verticillata* (Roxb.), the green disks are imbedded in the mucus-layer promiscuously, and are carried round the cell with it; and in *Tradescantia* the cytoblast *also* goes round with the mucus-layer. To this perhaps might be added the polymorphism of the granular mucus occasionally witnessed on the septa between the cells of *Spirogyra* (p. 19), unless this also be owing to the presence of a rhizopodous organism.

There is yet however another kind of motion, which has been observed in *Closterium Lunula*, and some other Desmidiæ; and this, according to the Rev. S. G. Osborne's observations, confirmed by Mr. Jabez Hogg*, is owing to cilia situated on the surface of the mucus-layer. By their action, which appears to be very irregular, and is certainly very perplexing, the brown corpuscles are urged backwards and forwards, or circulated more or less round the frond. The same kind of motion is witnessed in similar corpuscles in *Spirogyra*, which, coming next to *Closterium* in point of organization, may be found to be provided with similar organs. There is no analogy, however, between the circulation of these corpuscles and the rotatory movement of the mucus-layer of *Nitella*, nor between it and the circulation of the axial fluid of the latter and its particles. To assume that the mucus-layer of the internode of *Nitella* is urged on by cilia, would be to assume that the cilia are not on the surface of the mucus-layer, as in *Closterium*, but on the inner surface of the green layer; and then, in the roots, that they are on the inner surface of the cell-wall, for there is no green layer there,—which would be absurd. Again, we can see that the particles contained in the axial fluid are impelled by the irregular surface of the mucus-layer, and this seems quite enough to account for this circulation.

As regards the general irritability of the mucus-layer, this by itself is of course no proof of locomotive power, but occurring in homologous structures, it allies them in point of property as well as structure, and therefore affords additional reason for admitting the phænomena observed in one as confirmative or explanatory of those which are observed in another organism of the same or similar nature. Hence, if we have evidence of a locomotive power in the mucus-layer of the cells of *Spirogyra*, and the object to be gained by it, as well as evidence of the same power in the mucus-layer of the internode of *Nitella*, though the object be *not* manifest, our conclusion, that the latter is

* Quart. Journ. Microscop. Soc. vol. xi. p. 234, 1854.

owing to an innate contractility, and not to any foreign organism or any other moving power, is much more satisfactory than if it were unsupported by the movement of the mucus-layer in *Spirogyra*, where its nature is obvious from the object gained by it.

I allude to the movements which take place in *Spirogyra* during conjugation, when the mucus-layer, retracting from the cell-wall of one filament, carries its contents through the tube of intercommunication, across to the cell of the opposite filament.

To refresh the memory of the reader, I might here briefly sum up what takes place on this occasion. The first step on the part of the mucus or protoplasmic layer is to soften a small portion of the cell-wall; it then presses upon this so as to force it forwards into a tubular prolongation to meet a similar one from the opposite filament; the two mucus-layers dissolve the partition which interrupts their union; the mucus-layer of one cell then retracts from its cell-wall, gathers up the spiral bands and cytoblast, and mingling with its fellow at the junction of the tubular prolongations, passes over into the opposite cell with the return of the latter, and there amalgamating with it thoroughly, becomes capsuled and passes into a spherical or elliptical spore, as the case may be. Now here there is no addition of material to cause the mucus-layer to grow and protrude from its cell like a bud or young shoot,—it is an act performed by the mucus-layer alone, and that too almost faster than the hour-hand travels round the dial of a watch; indeed, it is performed so quickly in *Closterium Ehrenbergii*, where a similar process takes place, that according to the Rev. W. Smith, who has watched it, the discharge of the endochrome and formation of the sporangia are accomplished with such rapidity, that this may be seen to take place in the field of the microscope, "the whole operation not occupying more than a few minutes*."

Again, in *Œdogonium flavescens* (Kg.), I was lately fortunate enough to see the contents of one of the cells wrapped up in their protoplasmic sac, actually leave the cell, form into a spore, and whirl off in the manner of zoospores generally. The cell-wall bore no appearance of spore-dilatation, though the density of the gonimic contents indicated that it would sooner or later have done so; it was a terminal one, and the septum of the free end had probably been broken when the other part of the filament had been torn from it in preparing the mass for microscopical examination. As the last part of the cell-contents left their old cavity distinct locomotion was seen in the mass, and when the whole had become extricated, several twitchings of the pro-

* Ann. and Mag. Nat. Hist. vol. v. p. 8, 1850.

toplasm, apparently of adjustment, took place. It then assumed a globular and afterwards an ovoid shape, when the small end becoming transparent and throwing out a wreath of active cilia, it bounded off and was soon undistinguishable from other spores of the same kind which were present in equally active motion. At the moment of its exit I observed a delicate membrane at some distance around it which disappeared (by bursting?) immediately the cilia began to play.

Having thus brought forward incontestable proof of locomotive power in structures homologous with the mucus-layer of the cell in the Characeæ, I shall now only add another instance of the kind mentioned (p. 19), where a *partial* movement of the mucus-layer, again in *Chara verticillata*, afforded direct evidence of its possessing the independent power of contractility in question. This occurred in a very young plant where the roots were nearly an inch long, though not more than the 500th of an inch broad, and, as before stated, as transparent as glass. While tracing one of these, in which the circulation appeared to have ceased, I came to a part where there was a slight movement of the mucus-layer, which increased up to a certain point, and then as gradually subsided again. It was a thickened portion, but apparently composed of nothing more than transparent mucus charged with a number of granules. It was moving towards the extremity of the root, and was seen to pass through that part of the latter which was kept in the field of the microscope for the purpose, leaving all the mucus as still behind it as that which was beyond the moving portion. To conceive after this that the mucus-layer of the Characeæ is endowed with a locomotive power, seems not difficult, if we cannot conclude that by this power also it moves round the internode.

Since the above was written, I have read the following passages in Cohn's 'Natural History of *Protococcus pluvialis*' (1850), translated by Busk for the Ray Society (*loc. cit.* p. 532, 1853), and they so accord with my own conclusions on the subject, that I cannot do better than insert them here, as a termination to an argument in favour of the moving power of the mucus-layer or protoplasmic cell of the Characeæ, instituted for the purpose of conveying a similar impression :—

"From these considerations it would therefore appear, as certain as it can be made by an empirical deduction from the premises in such a subject, that the protoplasm of botanists and the contractile substance and sarcode of zoologists, if not identical, are at all events in the highest degree analogous formations.

"Whence, the distinctions between animals and plants viewed in the above light must be thus understood : that in the latter the contractile substance, as the primordial utricle, is enclosed within a rigid ligneous membrane, which permits only an internal motion, evidenced in the phænomena of circulation and rotation; while in the former it is not thus enclosed. The protoplasm in the form of the primordial sac is, as it were, the animal element in the plant in which it is *confined*, being *free* only in the animal kingdom."

Casual Notes on the Characeæ.

Circulation.—I have repeated the experiments of Amici, Dutrochet and others by ligaturing the internode of the large *Nitella* at several places with similar results. The circulation has hardly been arrested; but to succeed well in this, an old internode must be taken. On one occasion an inch of one of these long internodes was cut out of the centre with a blunt pair of scissors and placed on a glass slide in a little water, and under a piece of glass about the same width; the water therefore but just covered its extremities; in this portion the circulation continued in opposite directions (for fortunately one of the white lines or "lines of repose" was uppermost) for ten minutes by the watch; the larger bodies ceasing to circulate first, and lastly the molecules.

Tenacity of life.—The internodes which I ligatured perished after a few days; indeed this is the common fate of the Characeæ; but the nodes retain their vitality, and the small internodes also. Single, isolated cells and small internodes, which can hardly be seen with the naked eye, frequently retain their green colour, and keep up a continued rotation of their mucus-layer for eight and ten months after they have been separated from every part, dead and living, belonging to the parent plant; but they do not appear to increase in size in the least. Those little shoots which spring from the cells of the nodes (the bulbels probably of Montagne*) would probably grow into new plants if favourably situated for nourishment, as the nodes commonly throw out roots as well as shoots, when the other parts of the plant are threatened with destruction.

Endosmosis.—The rapidity with which water passes through the cell-wall of the internode, as shown by the experiment detailed at the commencement of this paper, indicates the amount of fluid that might pass from one internode to another through contact even of their extremities; and hence how the nutritious fluid formed in the roots might also find its way from the roots to the extremities of the plant.

Germination.—The nucules of *Chara verticillata* which were placed in water on the 21st of March germinated at the end of

* Ann. des Sc. Nat. Bot. 3 sér. t. xviii. p. 65.

twenty-six days; those placed in water on the 2nd of May after sixteen days: of fifty nucules placed in water on the 1st of September none have germinated up to the present time (November 15th). At first the young plants appeared in the form of *Nitella*, but not having grown beyond three-quarters of an inch in length, they did not pass into that of *Chara*. Thus, *Chara* begins in the lower form of *Nitella*; and the oldest internodes of the large *Nitella*, where the endochrome has disappeared, are fluted like the stem of *Chara*, but not celled like it. Out of the first set of nucules (viz. thirteen) four only germinated, and one of these threw out two plants, but both did not grow with equal rapidity, one remaining abortive or stationary.

Bombay, 15th November 1855.

EXPLANATION OF PLATES VIII. AND IX.

PLATE VIII.

Fig. 1. Portion of an internode of *Nitella*, showing the arrangement of the "green disks" in the "green layer;" also (*a*) one of the white lines or "lines of repose"*.

Fig. 2. Transverse section of ditto, showing (*a*) the "green layer;" (*b*, *b*) internal border of "mucus-layer;" (*c*, *c*) "lines of repose."

Fig. 3. Portion of the green layer showing its structure; also the chlorophyll-mucus of the "green disk" and its transparent cell.

Fig. 4. Cavity of "green disk" divided into compartments with a granule in each.

Fig. 5. Ditto nearly filled with starch-grains, the chlorophyll having almost disappeared.

Fig. 6. Starch-grains of ditto, separate.

Fig. 7. Portion of the "mucus-layer" as it issues from the internode, containing the "globular vesicles," "circular disks," irregular bodies and granules.

Fig. 8. "Circular disk" of small *Nitella*, with molecular-formed nucleus contracted into an oval shape. 9. Ditto from mucus-layer of *Chara verticillata*. 10. Ditto from mucus-layer of large *Nitella*.

Fig. 11. Irregular body from mucus-layer of small *Nitella*. 12. Ditto agariciform, from *Chara verticillata* and large *Nitella*, inferior view. 13. Ditto ditto, superior view.

Fig. 14. "Globular vesicle" with circular disk or nucleus *in situ*, surrounded by granuliferous mucus.

Fig. 15. Ditto with an "irregular body" in the position of the circular disk or nucleus.

Fig. 16. Globular vesicle containing a plurality of circular disks.

Fig. 17. "Globular vesicle" of large *Nitella* with disk or nucleus *in situ*, surrounded by granuliferous mucus, in which are imbedded two

* All these figures should be viewed as diagrams delineated after nature as far as circumstances would permit; and should any discrepancy be found between them and the text, the reader is requested to be guided by the latter.

"green disks;" as they are situated when seen to undergo rotatory motion.

Fig. 18. "Globular vesicle" of large *Nitella*, containing agariciform "irregular body." 18′. Ditto of small *Nitella*, containing in addition to its nucleus an irregular body imbedded in its granuliferous mucus; as it is situated when seen to undergo partial rotatory motion.

Fig. 19. Portion of internode of *Nitella*, showing the breaking up of the green layer preparatory to grouping of the green disks.

Fig. 20. Ditto, with green disks grouped or enclosed in the "globular vesicles."

Fig. 21. Groups which have assumed a spherical form: (*a*) globular vesicle or so-called "gonidial cell" stiffened and clarified, yet capable of projecting ambulatory processes (see fig. 23 *a*); (*b*) secondary coat circumscribing granuliferous mucus, green disk, &c.

Fig. 22. "Globular vesicle" showing internal granuliferous mucus circumscribed by secondary coat, mass of green disks, and "circular disk."

This form is often seen without the mucus in a perished, half-developed state, when the "circular disk" is always particularly evident; thus with the other elements of the cell at once indicating its identity with the "globular vesicle" and rhizopodous nature.

Fig. 23. "Globular vesicle" showing secondary coat, granuliferous mucus, and mass of green disks all now separated; (*a*, *a*) stiffened ambulatory processes.

Fig. 24. Ditto, with granuliferous mucus presenting a mulberry form of segmentation. Cell about 1–300th of an inch in diameter.

Fig. 25. Ditto, lateral view.

Fig. 26. Ditto, after separation of the segments into monads, and disappearance of the secondary coat.

Fig. 27. Ditto, bursting and giving exit to the monads, green disks, &c., and other effete matter contracted into a small brown nucleus.

Fig. 28. Small "globular vesicle" with "irregular body" in the position of the nucleus, developing one monad only. Cell or vesicle 1–2150th of an inch; monad 1–4300th of an inch in diameter.

Figs. 29, 30, 31. Monads of the globular vesicles or cells assuming different forms. All about 1–4800th of an inch in diameter when globular.

Figs. 32, 33, 34. The same after a few days' growth; now about 1–2150th of an inch in diameter, assuming the forms of *Amœba* and *Actinophrys*; with contracting vesicle.

Fig. 35. Vertical section of a young plant of *Chara verticillata*, with nucule still attached. (*a*) nucule: (*b*) external cellular coat; (*c*) middle or laminated black coat; (*d*) internal delicate coat; (*e*) circlet of roots springing from cells of first node; (*f*) second position of cytoblast, viz. at the termination of the granuliferous mucus which fills the extremity of the root; (*g*) third position of the cytoblast, viz. when attached to the side of the root at some distance from the granuliferous mucus of the extremity; (*h*) circlet of roots arising from the cytoblast so situated. The small figures, 1 to 6, indicate cells of the stem in successive stages of development; showing that the formation of the "mucus-layer" is preceded by the presence of a mass of hyaline, spherical vesicles of different sizes, which at first fill the young cell.

Fig. 36. Last three cells (viz. 4, 5, 6) of fig. 35, more magnified.

Fig. 37. One of the new root-buds of (*h*), fig. 35, magnified, to show that the mucus-layer of the root also is preceded by the presence of hyaline vesicles, as well as that of the cell of the stem; shows also first position of the cytoblast, viz. at the free end of the root-bud.

Plate IX.

Fig. 1. Dark green spherical cyst appearing in the internodes of *Nitella* at the commencement of decomposition (see p. 14, *loc. cit.*), of different sizes, but the largest about 100th of an inch in diameter; the green colour arising from distension with the green disks and other contents of the internode.

Fig. 2. Ditto after the formation of a secondary cyst circumscribing these contents.

Fig. 3. Ditto, with the contents of the secondary cyst divided into four ciliated sacs: (*a*) effete matter or green disks thrown off; (*b, b*) monads between the two cysts.

Fig. 4. Ditto, with the contents of the secondary cyst divided into two sacs only, which are ciliated, and contain respectively a portion of the green disks in their interior.

Fig. 5. Ciliated sac fully developed, now assuming the form of *Otostoma*.

Fig. 6. *Otostoma* (H. J. C.) about 100th of an inch long: (*a*) lateral view of plicated buccal cavity; (*b*) spherical vesicles of different sizes, which together with mucus fill up the abdominal cavity; (*b*) one of these vesicles magnified, containing five smaller ones situated on one side and filled with a brown yellow fluid.

Fig. 7. Ditto: (*a*) oral orifice, ear-shaped; (*c*) fusiform organ; (*d, d*) contracting vesicles; (*e*) pellets of green food, which, when present, with the mucus and spherical vesicles mentioned in fig. 6, fill the abdominal cavity; (*f*) anal orifice.

Fig. 8. Ditto, showing arrangement of cilia over the surface.

Fig. 9. Portion of a filament of *Spirogyra* just after conjugation, showing (*a*) a cell containing a development of spherical cells filled with yellowish refractive granules; (*b*) a cell containing a development of tubulating cells also filled with yellowish refractive germs or granules; (*b'*) exit of the latter; (*c*) a spore destroyed by the same development; (*d*) a cell in which a litter of monads has been developed, having in addition to polymorphism a single cilium attached to them respectively, and hence frequently assuming the form of young *Astasiæ*; (*d'*) the same monads after having left the cell. Monads about 1–2150th of an inch in diameter.

Fig. 10. Two cells of a filament of *Spirogyra*, showing (*b*) a spore destroyed by the tubulating cell; (*c*) one of the tubes leading through the septum of the cell to insert itself into the sound spore of the next cell.

Fig. 11. *Euglena* (*Crumenula*, Dujar. (?)) filled with embryonic cells (?), also showing the nucleus and its cell, and the "red spot" or body attached to its proper cell: (*a*) vertical view of embryonic cell; (*b*) lateral view of ditto.

Fig. 12. Ditto, with embryonic cells and general contents much deranged; also presenting faint traces of segmentation of another development.

Fig. 13. Ditto, with a few only of the embryonic cells left; the green colouring matter gone, and the whole contents of the *Euglena* yielding to the development of eight or ten spherical cells filled with minute granules of equal size; (*a, b*) the same spherical cells after exit, assuming respectively the forms of *Amœba* and *Actinophrys*.

Fig. 14. Old cell of *Euglena viridis* presenting one large granuliferous *Amœba* instead of several small ones; a portion of effete matter left in the cell, and the *Amœba* throwing its processes through its crevices.

Fig. 15. Portion of a filament of *Oscillatoria* (*princeps*, Kg. (?)), in which a development of some germs of *Œdogonium* having taken place in the midst of the cells of the *Oscillatoria*, they are bursting through its sheath.

Fig. 16. Furcularian rotiferous animalcule in which the tubulating cell has become developed: (*a*) dilated round form assumed by the extremity of the tube before bursting.

X.—*Amended Description of the Genus* Scaphula, Benson, *a freshwater form of the* Arcacea; *with characters of a new species from Tenasserim.* By W. H. Benson, Esq.

Since the year 1825, when the little bivalve Arcaceous shell, *Scaphula Celox*, described in the 'Journal of the Calcutta Asiatic Society' for 1836, occurred to me in the rejectamenta of the River Jumna in Bundelkhund, no species has been added to the genus. In the past year a rich collection of land and freshwater shells, containing many new species, was made in the British provinces of Burmah, from the frontier above Prome on the Irawadi to Mergui, by Mr. W. Theobald, jun., who has obligingly submitted them to my examination. Among them I find a very distinct species of *Scaphula*, with the epidermis strongly developed, and the hinges joined by the ligament, as was the case with one of my specimens of *S. Celox*, which exhibited vestiges of a light epidermis. A conjecture has been hazarded by an English naturalist, probably from the view of the specimens presented to the Zoological Society in 1834, that the shell was a subfossil extinct form. The present discovery must set that opinion completely at rest. Besides the specimens of *S. Celox* from the Jumna, some were subsequently procured from the bed of its tributary, the River Cane, at Banda, and in 1835 I observed the species in a collection of shells made in the vicinity of the Khassya Hills to the east of Bengal.

The new form was found in some abundance in the Tenasserim River, and we may now hope that other species will yet be found in Burmah, and in the countries extending to Cochin China, as they become gradually open to the naturalist.

Scaphula was first made known in the 'Zoological Journal' for 1834. In 1840 Swainson applied the same name to a form of the *Olivacea*, having overlooked the previous employment of the term as a generic designation. The more perfect state of the Tenasserim species, and the variation of characters, will permit of a more correct diagnosis of the genus than was possible from the typical species, specimens of which are exceedingly rare. No conchologist has collected in Bundelkhund since the period of my residence in that province, and a search which I made for specimens of the shell, during a hurried visit to Banda in 1844, proved fruitless.

Scaphula, Benson. Zool. Journ. 1834, vol. v. p. 464–5.

Testa æquivalvis, valde inæquilateralis, subtrapeziformis, carina valida ab umbonibus distantibus usque ad marginem posteriorem et basalem extendente; cardo rectilinearis, medio tenuis, ad extremitates sulcidentatas latior, dentibus anterioribus 4, crenulatis, minutis obliquis, posterioribus lamellatis, parallelibus, intus oblique descendentibus, 4 ad 6, primo obliquis, demum transversis, raro bifurcatis, munita; ligamentum exterius, rhombiforme, inter umbones situm; epidermis tenuis vel crasse lamelloso-rugosa; musculi adductoris impressio antica unica, posteriores duæ subdistantes quorum inferior oblongo-quadrata; pallii impressio integra.

The genus is at once distinguished from its nearest allies, *Arca* and *Cucullæa*, by the hinge being linear and edentate in the middle and for the greatest part of its length, and by the form and position of the teeth at the extremities; the laminar posterior ones, which are sometimes ramose, running obsoletely and obliquely into the interior of the shell. The two distinct adductor muscular impressions, and the squareness of the lower one on the posterior side in both species, are peculiar features supporting the claims of the type to generic distinction.

Scaphula Pinna, n. s.

Testa elongato-triangulari, subtrapeziformi, extus sub epidermide albida, intus cærulescente, antice angusta, extremitate subacute angulata, arcuatim descendente, postice subalata, expansa, extremitate superne arcuata, infra rectangulari; carina acuta, compressa; pagina postica majori subremote, antica confertim concentrice sulcata, utrinque radiatim striatula; epidermide fusco-nigra, crasse rugoso-lamellata, marginem nigrescentem excedente; musculi anterioris impressione ovato-rotundata, posterioribus duabus, superiori subcardinali elongata, angusta, inferiori elongato-quadrata.

Long. 11, alt. 5, crass. 6 mill.

Habitat in flumine Tenasserim.

The River Tenasserim has a course through nearly three degrees of latitude, between the coast ranges and the high interior chain which forms the British boundary towards Siam, before it turns suddenly towards its embouchure at Mergui.

The appearance of a slight iridescence on the bluish enamel of the interior in this species, is due, when visible, solely to weathering, and is evidently not the normal state of the surface. At first sight the shell might be taken for a species of *Modiola*, and by its discoverer was supposed to be a species of *Dreissena*. It was not until the hinge had been submitted to the lens that its true characters were ascertained.

A description of the typical species may here be subjoined in an amended form.

Scaphula Celox, Benson. Journ. As. Soc. Calc. vol. v. p. 750

Testa elongato-trapeziformi, albida, marginibus (superiori et inferiori) parallelibus, antice rotundata, postice oblique truncata; carina vix compressa; pagina antica, multo majori, costulis exiguis radiatis munita, postica lævi; epidermide tenui cornea induta; musculi anterioris impressione ovata, posterioris inferiori elongato-quadrata.

Long. 12, alt. 5, crass. 8 mill.

Habitat in fluminibus Jumna et Cane, necnon in rivo quodam Bengaliæ citra Gangem.

In one specimen, from the River Cane, the keel has a disposition to be double, with an intervening furrow. This is apparently only an accidental variation.

Cheltenham, 10th January 1856.

XI. — *Description of* Tanystoma tubiferum, *a Burmese form related to the Genus* Anostoma *of* Lamarck. By W. H. Benson, Esq.

The only Eastern shell hitherto made known which bears any relation to the Brazilian genus *Anostoma*, is the little species discovered by the late Capt. Boys in Rajpootana, designated by me as *A. Boysii*. It was separated by Pfeiffer under the generic name of *Boysia*, and soon after by Albers as *Hypostoma*. A singular Anostomatous shell, still more minute than *Boysia*, was found by Mr. W. Theobald on the banks of the Irawadi. Its open umbilicus, differing from the closed rimate volution of the known types, and especially the curious solute and protracted last whorl and trumpet-mouthed aperture (which is dentate, as in the ancient genus *Anostoma*), render it desirable to characterize the shell as a new type of form, under the name of *Tanystoma*, which may be considered as generic or sectional according to the views of systematists, some of whom do not admit the claim of *Boysia* to generic separation.

Tanystoma, nobis.

Testa convoluta, conoidea; umbilicus apertus; anfractus ultimus solutus, protractus, sursum tortus, aperturam dentatam alte tollens; peristoma horizontale, expansum.

T. tubiferum, nobis.

Testa depresso-conoidea, radiato-striata, cornea, sutura excavata, spira breviter conoidea, apice obtusiusculo; anfractibus 3, convexis, ultimo tubam protractam, sursum tortam, altiorem quam apice, efformante, ad periphæriam valide et obtuse carinato, superne baltea tumida, a periphæria sulco profundo separata, munito, subtus convexo, margine umbilici aperti perspectivi angulato, angulo usque ad aperturam extendente; apertura horizontali, sursum spectante, 6–7-dentata, dentibus lamelliformibus duabus parietalibus, supera validiori duplicata, inferiori minore profunda, 1 columellari mediocri, 4 palatalibus, quarum superiori duplicata tertiaque majoribus; peristomate libero, valde expanso, reflexiusculo.

Diam. major 4, min. 3, axis 2 mill.

Habitat ad Thyet-Mio prope ripas fluminis Irawadi Burmanici, saxis calcareis adhærens.

This interesting shell was found by Mr. Theobald to be very local, but not uncommon at the spot indicated—about six miles south of the frontier station. It was not met with lower down the river at Prome, nor elsewhere.

Cyclophorus fulguratus, Pfr., was found from Thyet-Mio to Rangoon; and a gigantic *Megalomastoma*, of the type of *M. Chrysallis*, Pfeiffer, resembling in size and figure *Pupina grandis* of Forbes, near Moulmein, verifying the opinion communicated to Dr. Pfeiffer, that the true habitat of those two species was probably Ava, and not Arva, a river in Columbia, as conjectured by that author from the illiterate orthography of the name furnished to him.

Five new species of Gray's genus *Alycæus* occurred, two of which are related to the Himalayan *A. strangulatus*, H., and *A. gibbus* of Cochin China. There are also two new forms of *Pterocyclos*, two of *Pupina*, besides a third from Sylhet, a new *Leptopoma*, an *Otopoma* (?), and two or three new *Cyclophori*. Two new minute *Hydrocenæ*, closely allied to my Khassya *Cycl. sarritum*, with the operculum, enable me to fix the place of that species, as well as of *C. tersum*, mihi, and probably of *C. Milium*, both of which Pfeiffer, in a letter dated some months ago, conjectured to belong to *Hydrocena*. *Cyclotus* and *Diplommatina*, which are Indian forms, are not represented in the collection.

In new Helices the collection is very rich: one form in particular is curious, from its resemblance to the North American *H. hirsuta*, Say.

Mr. Theobald's personal researches in the Punjab and Sikkim have also added new forms from the Salt Range and Darjiling.

Cheltenham, 12th January 1856.

XII.—*On* Pleurodictyum problematicum. By William King, Professor of Mineralogy and Geology in Queen's College, Galway, Corresponding Member of the Natural History and Medical Society of Dresden, &c.

[With a Plate.]

A few weeks since I selected, from the extensive sale collection of Dr. Krantz of Bonn, several fine specimens of the *Pleurodictyum problematicum* of Goldfuss, from the Upper Devonian sandstone of Daun in the Eifel. Previously, I had not examined any examples of this singular fossil: all the information I then possessed respecting it was derived from some published figures and descriptions by Goldfuss, Phillips, and Lyell; and I had an impression that the vermiform appendage, occurring within it, was generally considered to be a foreign body.

Pleurodictyum problematicum, as it usually occurs, may in general terms be described as an oval or nearly circular discoid body, having one surface free and the other firmly adhering to a portion of the matrix in which it occurs. If observed attentively, it will be seen to consist of a number of closely packed, more or less inclined subpolygonal cones, with their apex or small end corresponding to the free surface, and their base attached to the matrix: the cones are at a slight distance from one another, but connected by means of a number of short thread-like processes crossing the vacant interspaces. Within the central area of the free surface a sigmoid or S-shaped vermiform appendage is seen lying among the interspaces, and having both terminations passing down to the opposite or adhering surface.

Sir Charles Lyell has given a tolerably correct view, natural size, of the free surface of this fossil in his excellent Manual, p. 429, 5th edit. The same surface is represented, twice the natural size, in Pl. X. fig. 1, so as to exhibit the different parts more obviously.

The fossil, as just described, is a cast; it will therefore be evident, that the cones are casts of subpolygonal cells,—the vacant interspaces, their walls,—and the short thread-like processes crossing the same, casts of tubular openings or foramina in the cell-walls. It will also be obvious, that the free surface exhibits the aggregated bases of the cells; and it necessarily follows, that the opposite or adhering surface is that to which the cell-apertures are turned. It will now be understood why *Pleurodictyum problematicum* is usually considered a coral.

Respecting the vermiform appendage, Lyell, Milne-Edwards and Haime consider it to be the remains of a *Serpula*, or a *serpuliform body*, and that our fossil is attached to it: on the contrary, Phillips describes the appendage in question as "a vermicular cast in the tubule of some mollusk (?) which has perforated the coral*."

The "coral" itself struck Phillips as having considerable resemblance to his *Favosites megastoma* and *F. tenuisepta*†, species which De Koninck places in his genus *Michelinia*. Milne-Edwards and Haime include it in *Poritidæ*, a family of their division Zoantharia perforata‡. But Dr. Roemer of Breslau objects to this collocation, and appears to have no doubt whatever of its close relation to *Michelinia*, particularly the species *M. favosa*§.

Notwithstanding there may be different shades of opinion among palæontologists respecting the nature of *Pleurodictyum*, they all seem to agree in regarding it as a coral, and in considering the vermiform appendage as having no organic connexion with it. At this stage of the present paper I feel it necessary to announce, that I totally dissent from the views just given: I cannot think that the fossil itself is a coral, properly so called; nor can I reconcile myself to any other opinion than that the vermiform appendage is a structure constituting an integral portion of its organization.

Before stating my views, however, I purpose giving a somewhat detailed description of our fossil; and in doing so I think it best to describe its different parts in their original state, and not as casts.

Pleurodictyum problematicum is externally a nearly circular concavo-convex discoid body, the under surface or base being concave. It seldom exceeds an inch and a quarter in diameter and about three-eighths of an inch in thickness. Its upper surface slopes off regularly to the margin, which is thin. These

* Vide "Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somersetshire," p. 209.

† Palæozoic Fossils, p. 20.

‡ Vide reference to these authors in a subsequent part of this paper.

§ Dr. Roemer's views are advanced in the last edition of Bronn's 'Lethæa Geognostica.' I have not been able to consult the details of my friend's views, as given in this work; but he gave me an outline of them during a joyous day we had together last September among the Stringocephaluses, Megalodons, &c. at Paffrath. I hope he may be induced to give an English dress to his views on *Pleurodictyum* in the 'Annals.'

characters give a vertical section of it a somewhat crescentic shape, as may be seen by a reference to Plate X. fig. 2.

Internally it consists of a number of short, rather wide, subpolygonal cells, with generally four sides, subradially and alternately arranged, and arising from a thin, nearly circular basal plate thickest in the centre and slightly wrinkled concentrically. According to Edwards and Haime this part is covered with epitheca. By means of the basal plate, a Pleurodictyum attached itself to some foreign body,—at Daun, generally to the convex valve of a Chonetes; but in process of growth it spread beyond the margins of the shell. Impressions of this part often exhibit subradial and anastomosing lines, which are nothing more than marks of the cell-walls arising from its thinness. An impression of the basal plate with its subradial and anastomosing lines, and a cast of the Chonetes valve to which it was attached, are represented in Pl. X. fig. 3.

The cells, of which there appear to be between sixty and seventy in a full-sized specimen, are nearly upright in the central portion, exterior to which they become more and more inclined towards the margin, where they are horizontal or nearly so (vide Pl. X. figs. 2 & 8). This modification gives rise to a peculiarity of form requiring to be noticed: the central cells * stand on a true base; but those situated outside of them lose it gradually by one of their side walls (the outermost) becoming insensibly converted into a base;—the marginal cells, in short, repose completely on one of their side walls (vide Pl. X. fig. 2). All the cells, except those in the centre, have their mouth directed towards the margin.

The cell-bases are usually somewhat rhombic or oval, with the longitudinal axis directed from the centre to the margin of the fossil (vide Pl. X. fig. 1); and they are generally $\frac{1}{4}$th of an inch in length, and $\frac{3}{16}$ths in width.

All, except the marginal cells, have the inner surface of their base marked with a central prominence, which becomes converted into a median ridge in the submarginal cells. The prominences and ridges have produced those large depressions seen on casts of the cell-bases (vide Pl. X. figs. 1 & 4).

The cells are marked interiorly with a number of fine longitudinal costules (generally five or six on each of the four walls), which are *spinulose* on and near the base, and *plain on the sides*, where their linear arrangement is most decided. On the base the costules are nearly obsolete; but their spinules are strongly

* It will simplify my description by designating the cells confined within the area occupied by the vermiform appendage—*central cells*,—those on the margin—*marginal cells*,—and those between both of the latter—*submarginal cells*.

developed, particularly on each side of the prominence or median ridge. The plain costules are most prominent near the margins of the cells, giving the latter a sulcated character. Although, from their being nearly obsolete on the base of the cells, it is difficult to trace the costules on this part, yet there are sufficient indications to show that they radiate from the central prominence or median ridge and pass up the walls. The intervening furrows are plain, except at the inferior half of the cells and the marginal portion of the base, where they are punctured: on casts they appear like granulated lines. The spinules have produced those pricked holes exhibited on casts of the cell-bases (vide Pl. X. figs. 1 & 4).

The walls of the cells vary from $\frac{1}{16}$th to $\frac{1}{8}$th of an inch in thickness, the thickest portion being at the base. Besides the character last described, they are perforated completely through or foraminated, usually at intervals of about $\frac{1}{16}$th of an inch. In general the perforations or foramina, which are arranged somewhat longitudinally (vide Pl. X. figs. 5 & 6), pass direct through the substance of the cell-walls, except at or near their base, where they are long, curved, and sometimes anastomosed (vide Pl. X. figs. 4 &c.). In their foraminated character the cell-walls offer a striking resemblance to those of *Favosites* and *Michelinia*.

Interpolated or young cells are occasionally seen springing from all points of the outermost walls of old submarginal cells: when not in contact with the basal plate they are of a conical form, and their pointed base terminates usually in two foramina which diverge and pass into the adjoining cell or cells (vide Pl. X. figs. 2 & 7).

All the cells, except those in the centre, grew out horizontally for awhile; but as soon as new cells external to them were developed, their aperture became turned up, giving a geniculated form to their outward outline, as represented in Pl. X. figs. 2 & 8. This peculiarity of growth occasionally gave rise to a considerable interspace between the mouths of old adjacent cells. It is in this interspace that their interpolated or young *submarginal* cells, noticed in the last paragraph, originated. The development of the latter did not cause the fossil to increase in height, as might be supposed; for in no instance have I observed them to rise above the old cells. The increase of *Pleurodictyum* was by horizontal growth, mainly due to young cells originating on its margin: in their earliest stage, even when scarcely $\frac{1}{8}$th of an inch in length, these young marginal cells are foraminately connected with older ones, and their pointed or inferior end is also often seen terminating in two diverging foramina, as obtains in their submarginal analogues.

Within the central area, there winds tortuously through the substance of the cell-walls the vermiform appendage already noticed. In thickness it sometimes equals the width of the cell-bases. The best way of examining this structure is on a cast of the under surface of the fossil, similar to that represented in Pl. X. fig. 1, where it may be seen in the centre following a course resembling the letter S through the interspaces separating the casts of the cells. Neither of its terminations is seen on the surface under consideration, as both are continued with a slight outward curve down to the opposite or adherent surface, completing as it were the form of the letter, but having the tails bent on one and the same side of its plane. Another mode of describing this appendage may be adopted by restoring the fossil in imagination, and placing its *upper* surface before the eye. Commencing at one of its terminations, which is situated about midway between the margin and the centre, it may be traced passing down among the cells with a sinuous curve to the basal plate, across the central part of which it makes a sigmoid flexure; it next passes with another sinuous curve to the surface, reappearing at about the middle of the side opposite to where it entered. The *course* of the appendage is often difficult to trace; but I have no doubt that the one just described, allowing for some slight deviations, will be found to be approximately correct. I cannot positively state that I have made out the form of its terminations, though one of them, in a specimen before me, has some appearance of being constricted just immediately before it appears at the surface: with this exception, the thickness of the appendage, throughout its entire length, appears to be remarkably uniform. I also observe that its thickness bears a comparative proportion to the size of the fossil, the largest specimens having the thickest appendage.

A remarkable circumstance respecting the course of this structure remains to be noticed. In half the number of specimens before me, it is folded, where in contact with the basal plate, in the *written form* of an *s*; but in the other half, the letter, as it were, is exactly reversed. In the specimens represented under Pl. X. figs. 1 & 4, it may be said to be normally folded; whereas in Lyell's figure referred to it is inversely folded.

Connected with the statement that the appendage passes through the substance of the cell-walls, I may add, that it never passes through the cells themselves: those adjacent are shortened and variously altered in shape to suit its form, as may be seen represented in Pl. X. figs. 2 & 9. This is also the case with the foramina; for their thread-like casts, when adjacent to the appendage, never appear as if passing into it, except in what are obviously accidental cases; they are always to be seen curving over, by, or below it. Both modifications are exhibited in Pl. X. figs. 1, 2, 4 & 9.

With respect to the cell-apertures, as exhibited on the upper or convex surface, I have endeavoured by grinding down a few casts, from their basal or concave surface, to exhibit them. The specimens at my service for this purpose are, however, so few, that I have been compelled to represent a gutta-percha impression taken from a very indifferent one (vide Pl. X. fig. 10). The apertures it will be seen are somewhat circular and subpolygonal; and the central portion contains the apertures of several small cells, the size of which is attributable to the vermiform appendage lying beneath them, thereby preventing their full development. I failed in discovering the terminations of the appendage in this specimen; but judging from others, I am disposed to place them near the marks * *.

Pleurodictyum having been generally considered a coral, it may be expected that I should examine the grounds on which this opinion is founded; but I contend, that it is quite unnecessary for me to enter on such a step: all I have to perform is to prove that the vermiform appendage is integral to the fossil. It may also be observed, that even before the generally received view can be discussed, the appendage must first be proved to be a foreign body. Were it not for the vermiform appendage, I should at once subscribe to the opinion that our fossil was a coral;—the only question with me would be, as to what division of the class Corallaria it belonged.

I am quite willing, however, to institute a comparison between *Pleurodictyum* and those corals with which it has been associated, a step which may be of some service in working out the question shortly to be discussed.

The family *Poritidæ*, in which MM. Edwards and Haime place our fossil, is composed of genera, having, with a few tertiary and jurassic exceptions*, all its representatives living in our present seas. The agreement between it and the genera alluded to consists in the foraminated character of the cell-walls and the absence of horizontal plates: but there is an important difference prevailing; as in the group named a well-developed septal apparatus (consisting of vertical plates) exists, which is absent in the fossil†.

* Milne-Edwards and Jules Haime, since the Introduction to their Monograph of British Fossil Corals was written, have added a new genus to the family *Poritidæ* under the name *Protaræa*. It is typified with Hall's Silurian *Porites vetusta*. This species and another (*Protaræa Verneuili*) occur in the Silurian beds of North America.

† Mr. Rupert Jones has kindly supplied me with a copy of Edwards and Haime's diagnosis of *Pleurodictyum* since much of this paper was written. As I differ from these able Invertebratologists respecting the homology of

As regards *Michelinia* (a genus of the family *Favositidæ*), with which Roemer has collocated *Pleurodictyum*, all its species have long tubular corallites, which, although agreeing with our fossil in being foraminated and longitudinally lineated at their margin, are filled up, except at top, with numerous transverse irregular curving plates, giving them quite a vesicular structure*. There is not the least trace of any transverse plates in *Pleurodictyum*.

Thus admitting for a moment that our fossil is a coral, it could not be placed either in *Poritidæ*† or *Favositidæ*, as defined by Edwards and Haime; nor could it, strictly speaking, be placed in either of the more comprehensive groups named Zoantharia perforata and Zoantharia tabulata, to which these families respectively belong; it could only be considered as an aberrant form of either one or the other.

The resemblances just made out are, however, of considerable value; for they strongly manifest the side which certain affinities of *Pleurodictyum* lean to. These affinities in my opinion belong to parts subordinate to others only occurring in animals higher than the Zoanthairs; I am therefore led to consider them as merely of secondary importance. Hence I may be allowed to

certain parts of this fossil, I have thought it necessary to give a copy of their description:—"Polypier subdiscoïde, soit libre, soit fixé sur un corps serpuliforme ou sur une coquille, à plateau inférieur recouvert d'une épithèque forte et présentant quelques plis concentriques; polypiérites courts, prismatiques, irradiant en un court faisceau et se terminant sur une surface légèrement convexe; calices polygonaux, un peu inégaux; trous de la muraille petits et irréguliers, assez peu nombreux; les murailles un peu larges. *De 20 à 28 cloisons formées par des poutrelles grêles qui avancent jusqu'au centre de la chambre des polypiérites;* largeur des calices de 3 à 5 millimètres. Ces polypiers n'ont ordinairement que 3 ou 4 centimètres de diamètre total."—Vide "Monographie des Polypiers fossiles des terrains paléozoïques," inserted in the Archives du Muséum, tom. v. p. 210, 1851. The passage I have italicized evidently refers to the fine longitudinal costules (spinulose and plain) intervening between the furrows (punctured and plain) previously described in the text (p. 133). But, with all due deference to the opinion of MM. Edwards and Haime, I am strongly disposed to consider the so-called "cloisons" as simply homologous with the granulations, spinules and echinated costules seen on the septa of many Zoanthairs.

* I am much indebted to my friend George Tate, Esq., of Alnwick, for placing in my hands his specimens of *Michelinia* to enable me to make myself acquainted with the character of this interesting genus.

† MM. Edwards and Haime place *Pleurodictyum* next to *Protaræa* in *Poritidæ*. In their "Monographie des Poritides," published in the Annales des Sciences Naturelles, 3 sér. t. xvi. p. 48, referring to their earlier Monograph in the 'Archives,' they state—"et nous nous bornerons à répéter ici qu'elle diffère seulement des *Litharæa* par une épithèque plus développée, des murailles plus épaisses et des cloisons plus poutrellaires." *Litharæa*, another genus of the family *Poritidæ*, is typified with the *Astrea Websteri* of Bowerbank,—an eocene fossil described and represented in their Monograph of the British Fossil Corals, p. 38. pl. 7. fig. 1.

state, that our fossil possesses strong collateral affinities with the order Zoantharia.

The question now comes on for discussion, as to what position *Pleurodictyum* occupied in the Invertebrate division of the animal kingdom? As intimated in the early part of this paper, I dissent entirely from the opinion which regards it as a member of the class Corallaria. My own opinion is entirely based on the presence of the vermiform appendage, which I consider a true organic constituent of the fossil; it therefore behoves me to establish its claims to be considered in this light.

According to Lyell and Milne-Edwards, *Pleurodictyum* attached itself to the vermiform appendage, *i. e.* the "*Serpula*" of the former, and the "*serpuliform body*" of the latter; but this opinion is totally inadmissible from the appendage *being always internal*. Recurring to Phillips's view, that it is "a vermicular cast in the tubule of some mollusk (?) which had perforated the coral," it may be observed, in the first place, that as I have not seen specimens from every known locality*, it would be improper of me to assert that *Pleurodictyum* never occurs without the appendage; but this I am prepared to state, that, with a few exceptions, every specimen I have examined from Daun possesses it:—in making this assertion I speak advisedly, because possibly some parties may dispute it. I perceive the appendage in the smallest as well as the largest specimens; and in some of the exceptional cases noted, I can see the vacant space which it originally occupied. I am therefore led to conclude, that whenever the appendage is absent it has either fallen out, or been removed by some accident.

The vermiform appendage in all the specimens that have passed under my notice is always folded, as before described, somewhat like the letter S, having its central portion resting on the basal plate, and its extremities passing up to opposite sides, between the margin and centre, of the upper surface. This constancy of form and position it is impossible to conceive could have prevailed had the appendage been a perforating body†. Again, this structure is never seen otherwise than passing

* It is of extensive geographical range, occurring at West Ogwell and Torquay in Devonshire, Néhou in France, Coblentz and other places on the Rhine, Daun in the Eifel, Aleje in Spain, Goslar in the Hartz, and Jefferson County in the State of Indiana, North America. In all these localities, *Pleurodictyum* occurs in the Devonian system; but, according to Sir R. Murchison, M. Richter has lately described a new species under the name *P. Lonsdalei* from the Silurian beds of Saalfeld (vide Quart. Journ. of the Geol. Soc. vol. ix. p. 413). Perhaps Milne-Edwards's *Spongarium* may be the basal plate of a fossil having some relation to *Pleurodictyum*?

† The two specimens represented under figures 1 & 4. Pl. X. are almost a fac-simile of each other as regards both form and position.

through the substance of the cell-walls: in no case can I perceive any appearance as if it had passed through the cells themselves; nor have I ever seen anything to show that it cut, as it were, any of the foramina*: on the contrary, the cells have been built around, or adjacent to, the appendage; and the foramina have been carried over or under it.

These facts I regard as completely proving that the original of the vermiform appendage was an *ab initio* structure—a true integral organ of *Pleurodictyum*.

From the absence of all evidence to the contrary, it cannot be concluded that the appendage was enclosed in a sheath, like that of some shell-bearing borers †: it must be the cast of a fleshy tube included in, and protected only by, the substance of the cell-walls.

The reader will now be prepared for the statement, that I consider the vermiform appendage as the cast of a tubular chamber which enclosed the intestinal canal of *Pleurodictyum*.

But an intestinal canal necessitates the existence of a mouth and an anus. No coral, however, possesses more than one orifice to its digestive cavity. *Pleurodictyum* therefore cannot belong to any division of the class Corallaria: it must be assumed as belonging to a higher type in the scale of animal organization.

Considering certain primary groups of the Invertebrata possessing an oral and an anal orifice—for example, Tunicata, Mollusca and Bryozoaria—if all their existing and extinct representatives be examined, we shall fail in observing any to be strictly available for *Pleurodictyum*. This being the case, our only alternative is to have recourse to its collateral affinities, which, as already seen, lean to Zoantharia. Reflecting on this order, it may be asked—of the classes named, having two orifices, which one has the closest relation to it? Obviously Bryozoaria ‡. But in no cell-bearing forms of this class, such as *Lepralia*, *Eschara*, &c., is there one to be found consisting of large cells with a vermiform appendage: all of them have their solid parts consisting

* The vermiform appendage having increased in size as the fossil became enlarged, thereby encroaching on the adjacent cells, it must not be supposed that cases exhibiting the foramina broken through do not occur. It may be observed, however, that although I have seen thread-like casts of the foramina almost, if not completely, touching the appendage, I have never perceived any appearance as if they had been cut by a boring animal.

† The cases of close proximity alluded to in the above note completely dispel the idea that the appendage originally possessed a shelly sheath, as some have conjectured.

‡ It may be readily imagined that the class Tunicata occurred to me as a group to which *Pleurodictyum* might belong; but as its collateral affinities lean rather to Mollusca than to the Zoanthic corals, I felt myself compelled to abandon the idea.

of innumerable minute cells, each being inhabited by a single Bryozoon. If it were possible for the intestinal canal of every animal in a *Lepralia* to be preserved, a vermiform appendage ought to occur in every cell.

We have now arrived at the great difficulty which besets us in considering our fossil to belong to the class Bryozoaria; for as there is only one appendage to all its cells, it is evident that each one cannot have been tenanted by a single Bryozoon. But let us again consider the Zoanthic affinities of *Pleurodictyum*. Why may it not have been inhabited by a Bryozoic form organized after the Zoanthic type? In short, why may not its occupant have been a Zoanthoid Bryozoon? According to this view, *Pleurodictyum*, although consisting of a number of cells, belonged to a simple individual; and it necessarily follows that its cells, instead of being aggregated corallites, were merely chambers corresponding with the interseptal spaces or *loculi* characteristic of the lamelliferous corals, particularly those in which these parts are formed by confluent plates, as in most species of *Stephanophyllia*. The cells were probably receptacles for the generative organs; and they possibly indicate the existence of a number of concentric circles of tentacles similar to those surrounding the orifice of an ordinary Actinia.

In *Pleurodictyum*, the varying number of cells or chambers, which is altogether dependent on its size, is not opposed to the suggestion just made; since the tentacles in *Actinia* and some allied genera are well known to increase in number as the polyp increases in size.

It would be unwise to specialize too much in an hypothetical restoration of the animal that belonged to our fossil; but I cannot refrain from hazarding the conjecture that the chambers were surmounted by the stomach. It is highly improbable that the vermiform appendage comprised both the stomach and intestine, like the alimentary apparatus in *Echinidæ*, in which, it must be understood, the large visceral cavity allows full room for the necessary dilatation of the gastric portion; because in the fossil the whole appendage was so hemmed in by the substance of the cell-walls as to render impossible an increase of any portion of it by repletion, supposing any such portion served as a stomach. I am therefore led to consider the vermiform appendage as being the cast of a tubular chamber which enclosed *only* the intestinal canal, a view which, it will be observed, is in exact accordance with my conjecture as to the cells being inferior in position to the stomach. Perhaps the constriction I noticed at one of the terminations of the appendage indicates the commencement of the rectum.

In conclusion, it remains for me to observe, that if the view herein taken of the position of *Pleurodictyum* in the animal kingdom be correct, this fossil will necessarily represent a type, which, although not known as living, is one that there is no difficulty in conceiving to have existed; since it forms exactly the link that seems to be wanted to connect the true Corals with the class Bryozoaria.

Belmont near Galway, Jan. 9, 1856.

EXPLANATION OF PLATE X.

Pleurodictyum problematicum.

Fig. 1. View of basal or under surface of a cast, twice the natural size, having the basal plate and nearly one-half of the cells removed (the latter from the lower portion of figure). One of the extremities or tails of the vermiform appendage is consequently exposed, curving down among the cells to the opposite (upper or adhering) surface: the other extremity also passes down to the same surface, but becomes concealed among the cells.

Fig. 2. Longitudinal section through the centre, partly restored, showing casts of central (upright), submarginal (inclined) and marginal (horizontal) cells; also young cells with their pointed base attached to the outer side of old ones. The appendage (of which a cross section is exposed) is seen beneath one of the cells, which is modified (shortened) to make room for it. The base of the central cells exhibits the furrow or depression resulting from the central prominence or median ridge thereon. The dark portion at bottom exhibits the space originally occupied by the basal plate.

Fig. 3. Impression of the basal plate, twice the natural size, exhibiting marks of the cell-bases, and the shell-valve (cast of *Chonetes*) to which it adhered. The anastomosing lines are rather too strongly marked.

Fig. 4. Representation, thrice the natural size, of a portion of central area of basal surface, exhibiting the appendage with one of its extremities (the left) passing gradually down among the cells (or rather up) to the opposite (upper) surface. This specimen, which is different from that under fig. 1, exhibits casts of the foramina at the cell-bases, where they are "long, curved, and sometimes anastomosed;" but always avoiding the appendage: it also exhibits the depressions (produced by the central prominence or median ridge), and the pricked holes (produced by the spinules belonging to the adjoining obsolete costules) on casts of the cell-bases (central and submarginal).

Fig. 5. Cast of a marginal cell showing its (outer) sides and rhombic base, with their punctured furrows and plain marginal sulcations (or intervening costules).

N.B. This figure ought to have been three times its size to exhibit clearly all the characters belonging to the interior of the cells. The spinulose costules (not present on this cell) are only seen on the base of the central and submarginal cells.

Fig. 6. Cast of a submarginal cell showing its inner sides marked with casts of foramina linearly arranged.

Fig. 7. Casts of submarginal cells exhibiting young interpolated ditto with their pointed base terminating in "two foramina, which diverge and pass into the adjoining cell or cells."

Fig. 8. Side view of casts of marginal cells. This figure exhibits two young cells originating on the outer side of an old one, causing its aperture to be turned up, thereby giving its outward outline a geniculated form. The small cell to the right reposes completely on one of its sides.

Fig. 9. Side view of two cells, modified owing to the propinquity of the appendage, of which a cross section is represented.

Fig. 10. Gutta-percha impression, twice the natural size, of the upper surface, showing the somewhat circular and subpolygonal form of the cell-apertures. The marks * * indicate the probable situation of the terminations of the vermiform appendage.

XIII.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[With a Plate.]

[Continued from p. 42.]

Pulmonifera.

The leaf-like appendages of *Phyllodoce lamelligera,* which expose to the action of the aërating medium a true chylaqueous fluid, differ very little in intimate structure from the branchial laminæ of the Crab, the purpose of which is to distribute for respiration a current of blood, properly so called. But the tracheæ of Insects have no parallel amongst the respiratory systems of the Invertebrata. Compared with the respiratory organs of the water-breathing Articulata, these tracheæ constitute, in a complete sense, an apparatus invented *de novo.* Insects, with reference to the relations of this system, cannot therefore be said to be to the water-breathing Annulose and Articulated animals what the Pulmoniferous Gasteropods are to the water-breathing Mollusca. In the latter cases nevertheless, the aquatic and atmospheric systems are strikingly diverse.

In the instance of the air-respiring Crustaceans no change of structure whatever occurs in the respiratory system. The branchiæ of the terrestrial Isopoda are precisely the same in every detail of minute structure as those of the aquatic genera. The inference arises at once: these Crustaceans are merely modified water-breathers! But when an animal is to be formed whose medium of life shall *permanently* be the atmosphere, a design in the construction of the breathing system is adopted involving express provisions, which stand at marked variance from every variety of the water-breathing machinery. It is accordingly observed that the contrast between 'the lung' of Pulmoniferous, and the branchia of the Branchiferous Gasteropods is almost as striking and irreconcileable as that which separates the trachea of the Insect from the breathing plume of the Annelid or the gill of the Crab. In the midst of the aquatic Articulata, the air-breathing Insect arises on the scene; in the midst of the aquatic Mollusca, the pulmonated Gasteropods are formed. The object being one and the same, namely to produce an air-breathing animal, the artificer being still within the limits of the Invertebrate subkingdom, the question is most natural, Are the means in the two cases also the same by which the one and the same end is sought to be attained? —No! they are most wonderfully and extraordinarily dissimilar. The tracheæ of the Insect pervade the entire substance of the body of the animal. The 'lung' of the Snail is a mere bag, inflated as if by some rude and fallible artist, under the skin of the back. The former charms the eye as it discovers the mingling of the infinitely perfect with the infinitely minute. The latter shocks the mind with disappointment as it views the characters of a contrivance at once coarse, clumsy, and inadequate. But is it so in reality, or is it so only because imperfectly understood, and because it is measured by a wrong and unfair standard? Is not such an apparatus, simple as it is, quite enough to sustain the sluggish vitality of these slow-moving and sleepy animals? And is not the *end in view* accomplished quite as perfectly as it is in the case of Insects, though by a machinery of incomparably greater apparent intricacy? These questions will well prepare the mind for the investigation of the actual details.

All the terrestrial and the majority of the freshwater Gasteropod Mollusks breathe air. They are provided with a pulmonary cavity or sac, whose walls are networked with vessels by which the blood is exposed to the aërating element. No form of branchiæ exists. The animals which present this organization are all provided with distinct heads and furnished with tentacula and organs of sight. They walk by the aid of a well-developed creeping disc. One large division of the land snails is supplied with an operculated shell; the rest are inoperculate and sometimes shell-less. The Pulmonifera are closely related to the plant-eating sea snails (Holostomata) through the Cyclomata, and to the Nudibranchs by *Onchidium*. As a group, the land snails are inferior to the sea snails, on account of the comparative imperfection of their senses, and the union of the functions of both sexes in each individual.

The typical inoperculate Pulmonifera vary in appearance and habits, but agree essentially in structure. The respiratory orifice is small and valve-like, to prevent too rapid desiccation in the land species, and to guard against the injurious entry of water in the aquatic tribes*. Hence they have been called *Adelo-pneumona* (or concealed-lunged) by Dr. Gray; the Operculata, by antithesis, being named the *Phanero-pneumona* or open-lunged.

The Onchidiadæ are sea slugs, breathing by means of a pulmonary cavity, but living immediately in contact with marine conditions. According to the dissections of Mr. Hancock, the "lung is placed in this group at the posterior extremity of the body, and has consequently the heart in front of it."

Respiration in the Limacidæ is accomplished by means of a cavity seated on the back near the neck, and covered by the disc (Pl. XI. fig. 1). It opens on the right by a valvular sphincteric orifice, which is endowed with an active power of widely dilating and of closely contracting (*e*). In this family the rectum does not traverse the respiratory chamber; it lies external to, and below its right boundary. The anal orifice therefore is separate from that of the respiratory; it is seen immediately below the latter. This is a fact of structural disparity between the Limacidæ and the Helicidæ. In the latter the intestine is a prominent object in the breathing-chamber, and the vent is confounded with the pulmonary orifice. The position of the generative outlet is variable.

The following description is founded upon numerous dissections of the common Slugs. The breathing-sac presents in all the species the same anatomical characters. It is best studied by fixing the animal with two strong pins, transfixing the body in front near the head and behind near the tail in a cork-bottom dissecting dish. One blade of a strong, blunt-pointed sharp scissors should be inserted into the pulmonary orifice. The point should now be carried round the boundaries of the chamber, the disc being cut as the instrument travels round. Such a section (fig. 1) will enable the lid of the cavity or the respiratory disc (*b*) to be so perfectly raised as to leave the entire space underneath quite uninjured. A part corresponding with the pericardium (*c*) will however be found to be adherent to this roof; it should be snipped with the scissors. The roof, in the substance of which is lodged the rudimentary shell, should now be reflected and pinned down (as shown in figs. 1 & 2). From the central space of the cavity a second membrane (fig. 1 *c*) will require to be raised. This is much more vascular than the former integumentary covering (*b*), and constitutes really a part of the respiratory surface. This structure serves also as peri-

* See the excellent Manual on Recent and Fossil Shells, by S. P. Woodward.

cardium. It overcovers the heart, and embraces the large curved gland, in the centre of the area bounded by which the heart (Pl. XI. fig. 1 *d*) is situated. A perfect view of this pulsatile body is thus obtained. It beats slowly, about 30 or 35 times in a minute; less frequently probably in an unmutilated animal. It consists of an auricle which is situated under or below the ventricle. The ventricle is not a linear continuation of the auricle, separated only by a constriction as it is in the Helicidæ, but a separate organ receiving the auricle by a laterally placed auriculo-ventricular orifice. It will be seen that the large blood-channels (fig. 1 *g*) which are distributed over the floor of the cavity, and which in nature are of an opake white colour, converge upon the auricle, and that the aorta (*h*) rising boldly up from the ventricle as a vigorous vessel of considerable calibre, pierces the base of the chamber and disappears, travelling backwards among the viscera.

Now of the Limacidæ it cannot with truth be said that they are either Proso-branchiate or Opistho-branchiate. The heart here is certainly not placed either before or behind the respiratory organ, but in its true centre. The ovoid space circumscribed by the gland (c', c'), and roofed down by the pericardium, has only one opening through which the air can effect its ingress and egress. This opening corresponds to the point at which the line of the gland is interrupted. In some species it is placed at a point on the left side remote from the external orifice (*e*), in others behind; in others again it has an anterior position. That portion of the cavity which is without the gland, and between it and the outer boundary of the disc (*f*, *f*), forms a circle, so that the air may course around the cavity from right to left or reversely, according to the tendency of the muscular action by which it is impelled. The movements of breathing are far less manifest in the slug than in the snail. In the slug the pulmonary orifice slowly opens, and the bag is emptied by the slow expulsion of the air. The act of inhalation is performed in a similarly slow manner. The orifice now firmly closes, and remains closed until the next act of expiration, which may occur irregularly in ten minutes or a quarter of an hour.

Two points in the history of the respiratory cavity of the Limacidæ demand special attention. First, the structure and distribution of the vessels, and secondly, the character of the membrane or covering by which the cavity is lined. As a rule, it may be stated that the pulmonary vessels are distributed in the Limacidæ over the floor of the chamber, in the Helicidæ over the roof. In the former the mucous gland is considerably larger than in the latter. The heart of *Limax* lies, like the pulmonary network, on the bottom of the cavity; that of *Helix*, like its pulmonary *rete,* is located in the roof. These are features of striking dissimilarity.

The pulmonary vessels (*a*) of *Limax* are not, as in *Helix*, gathered into one large trunk, debouching in the auricle. They consist of several trunks, the cylinders of which are so superficially situated as to stand in prominent relief above the main plane of the cavity. This peculiar appearance results from the rigid calcareous walls of the vessels. It seems, according to the author's dissections, as if two or three veins in *Limax* opened into the auricle, but it is not easy to determine their exact number. The peculiar tenacious mucus secreted by the gland (c', c') which surrounds the heart (*d*) is poured out into the respiratory cavity. But although this is the case, it does not interfere with the function of the surface over which it is diffused. It does not become *adherent* to the latter. This mucus is capable of enclosing globules of air, and of becoming frothy. In this state it is frequently extruded from the pulmonary orifice. The study of these glands and their structure is for the present postponed, since they share in no way in the process of respiration.

Cuvier and the older anatomists supposed, when they observed the *white colour* of the vessels in the Limacidæ, that the phænomenon was due to the *milky* character of the blood by which they were filled. This is an error. The white colour results from the mixture of fat and chalk which abounds in the substance of the walls of the vessels, imparting to them a peculiar character and extraordinary thickness; such thickness as renders it extremely difficult to understand how they are not thereby disqualified for the office which they are designed to discharge. The larger vessels (fig. 1 *g*) stand upon a more superficial plane than the smaller ones. This disposition gives a *cellulated* appearance to the surface (fig. 2), like that of the inside of the frog's lung. It is an arrangement which, more completely than a smooth surface, detains the air in contact with the blood. But though a *tendency* to the cellular form is displayed by the pulmonary membrane, it must be understood that it is not *organized* after that fashion, as is the case with the lung of the frog.

The pulmonary vessels in the Pulmonated Gasteropods form but one sheet, that is, the blood traverses the area of aërating surface only *once.* The blood-currents converge upon the respiratory chamber from all parts of the body. Large trunks (fig. 2) may be seen at the sides of the cavity before, behind, and at the sides. These trunks are individually walled vessels; they are true pulmonary arteries. They subdivide into smaller vessels, and these break again into a network constituting the real lung of the animal. Near the position of the heart, they begin to reunite, large trunks becoming visible, which end in the auricle. The larger trunks are visible to the naked eye; the smallest require all the skill of the microscopist for their examination. The coats of the more visible white trunks are rendered colourless under the joint agency of dilute muriatic acid and æther: neither reagent alone will remove the white colour. The acid will dissolve the lime and leave the fat: the æther will remove the fat and leave the lime. The fat and the lime are contained in *cells*, and intimately mixed. The lime exists in the form of amorphous granules; it does not *crystallize* even in the rudimentary shell contained in the roof, but from the conical masses which adhere into groups in some places, it is evident that a tendency to crystallize is manifested.

It seemed to the author a point of extreme interest to determine whether the lime and fat which render the outline of these vessels, especially in the common Black Slug, so conspicuous, were incorporated in the substance of the vascular walls, and in what manner, or whether they were lodged in a tissue occupying the intervals between the vessels. These questions immediately arose. It appeared so utterly without precedent that vessels, destined to aërate the blood, the smallest, the most subdivided, the most thin-walled, the most naked of all the vessels of the body, in every other animal, vertebrate and invertebrate, should in the instance of the Limacidæ be encumbered with such thick, even inorganic, rigid parietes!

The physiologist is embarrassed in attributing to a machinery, by comparison so coarse and clumsy, a function so subtle and refined as that of breathing. But is it not presumptuous to pronounce a verdict of imperfection upon any of the works of Nature? Is it not possible that faultless skill and matchless adaptation of instrument to purpose, may yet reveal itself beneath the apparent characters of an organ which at present may appear rude and ill-contrived? It is more probable that Nature should be perfect than that her critic should be so.

A transverse section of one of the larger vessels will render it at once evident that each trunk is lined *internally* by a smooth non-calcified membrane, and that the lime-particles are deposited *only in the substance of the external coats.* The presence of this inorganic substance destroys the power of the vessels to contract upon their contents. The blood is circulated therefore through the pulmonary membrane by some other force than that usually due to the elasticity of the vessels. Although the fact is of difficult proof by direct demonstration, it is almost certain that the *exterior* of each vessel is also lined by a non-calcified membrane. It must be so, because active vibratile cilia unquestionably exist in various parts of the pulmonary cavity in every species of *Limax**.

If the internal and external coats of the vessels assume thus the characters of two concentric non-calcified cylinders, it follows that the mineralized layer must occupy the intervening space, representing the middle coat. This is probably the truth. But whether the external membrane and the lining of the cavity be separate structures or not, it is indisputable that the vessels are enveloped in a thick calcareous sheath. It is obvious, therefore, that the respiratory gases respectively leaving and entering the blood must traverse this dense septum,—a peculiarity quite without a parallel in the whole history of the organs of respiration. In the higher animals the pulmonary vessels in all classes are brought so near the aërating surface, that anatomists of eminence are not wanting who assert that such vessels are not covered by any kind of epithelium whatever. If then all structures interposed between the blood and the air are thus studiously reduced to the utmost extreme of tenuity in the higher animals, how is it that in these highly organized Gasteropods the respiratory vessels should not only be encumbered by thick coats, but by those of an inorganic nature?

Either in these animals respiration is reduced to a minimum, or these calcareous coats not only do not interfere with, but literally facilitate the interdiffusion of the gases. Although this idea presupposes a mechanism quite unique in the history of the breathing organs of animals, it involves nothing which contradicts the laws of endosmosis. The mineral which is deposited in the coats of the vessels is the carbonate of lime. It is impossible that such a substance could exert any chemical affinity either for oxygen or carbonic acid. The lime-particles are so loosely strewn together that they are separated by spacious interstices. Such a septum would present no obstacle to the diffusion of gases. In fact the endosmotic conditions of the beautiful experiment devised by Prof. Graham, in which he coated a coarse sheet of brown paper with a thin film of collodion, are precisely imitated in the vessels of the Slug. Prof. Graham found that the organic film so placed did not in the least degree diminish the rate of diffusion at which gases pass through a sheet of brown paper.

It is quite certain then that the vessels of the lung-sacs of the Limacidæ are *encircled* by the calcareous coats. The lime is not

* I invite especial attention to this point, because hitherto all anatomists have denied the existence of ciliated epithelium in the interior of the pulmonary chamber of air-breathing Gasteropoda. I have proved the fact of its presence beyond doubt, and by repeated observations.

deposited in *lines*, as the cilia are disposed along the branchial leaves of the Lamellibranchiate Mollusks, leaving a non-ciliated interval to which the active process of respiration is chiefly limited. The gases *must* consequently traverse the entire substance of the calcareous and membranous coats. The interstices between the calcareous particles might on this view be considered as each representing *a cell*, in which a small volume of air is held stationarily in intimate contact with the blood, and beyond the disturbing control of the ever-moving and varying parietes of the general cavity; and in which, as in the air-cells of Mammals, the interchange of the gases is a *continuous*, not an interrupted, process. But these permeable calcareous coats, while they divide the oxygen into myriads of infinitesimal portions, bringing it thus in a state of extreme subdivision into contact with the blood, act also like other porous bodies upon gases, by *condensing* their volumes. The power thus exerted increases the diffusiveness of the gases, and consequently augments the measure in a given time of the function of the part, because it virtually accelerates the interchange of the gases. The *ultimate* vessels of the abdominal organs are furnished with soft non-calcareous coats. The lime in these parts of the body is present only on the larger trunks. This substance is suppressed, therefore, in those organs in which its presence would interfere with the nutritive and secernent office of the minute vessels. Being present on those of the lung, the inference is unavoidable, that in this situation at least it does not obstruct the function of the organ. It seems on the clearest grounds that the mechanical subdivision of the air in a respiratory organ may be made to supersede the necessity for the subdivision of the blood by the formation of a *rete mirabile.* To this end in the Limacidæ a contrivance of singular simplicity is adopted: the air is made to rush in steady but infinitely divided currents in the direction of the blood. This is enough to secure the intended result. The blood accordingly flows in channels of comparatively large diameters. Coarse trunks separated by wide intervals, they contrast most strikingly with the elaborately formed parallel capillaries of the gills of all the branchiferous orders of Gasteropods, in which the blood-stream is reduced to the utmost minuteness.

On no other interpretation of the anatomical facts by which the pulmonary sac of the air-breathing Gasteropods is distinguished, is the reproach of rudeness and coarseness of construction to be removed. On this interpretation the rudeness is turned into subtlety and the coarseness into refinement, and the physiologist may cite indeed an organ which at first only shocked the short-seeing mind with a sense of disappointment, as only another illustration of the illimitable fertility of resource by which every part of every living mechanism is distinguished. It is only by such a contrivance that the *necessary surface* for the aërating process can be realized; for compare the area of this lung-sac with the extraordinarily multiplied superficies secured by the laminose arrangement of the gills in the branchiferous orders, and how considerably the latter will be found to exceed the former! In comparing a gill with a lung, even in the same class of animals, and organized on the same type, it is necessary to remember that in the former case the oxygen, dissolved in water, is brought up to the blood under certain opposing circumstances, and that a compensation is offered in the divided state of the blood, while in the latter a similar amount of work may be done with large vessels and coarse streams, in consequence of the unmixed and direct manner in which the active element is applied to the vital fluid.

The pulmonary chamber of the Helicidæ is distinguished by several anatomical particulars from that of the Limacidæ. In the Snail (fig. 3) the rectum (*a*) enters the precincts of the chamber, and the heart (*b*), mucus-gland (*g*), and pulmonary vessels (*d*) are seated on the *roof* (*h*) of the cavity. In the Slug, as already detailedly explained, the rectum is external to the chamber, and the heart, gland, and pulmonary *rete* are placed at the bottom of the cavity.

Helix aspersa (figs. 3, 4 & 5) is the best, because the most familiar, example of the family of the Helicidæ. In it, as compared with *Limax*, a marked deviation is observed in the position of the mucus-gland. That of *Helix* presents the appearance of a soft oval mass (fig. 3 *g*) situated to the right of the heart when *in situ*; it is considerably less developed than it is in *Limax*. This proximity of place to the heart has probably some meaning which is not yet understood. But in structure the gland is the same in the two families. The auricle (*c*) and ventricle (*b*) of the heart in *Helix* are placed on the same axis; they are separated only by a slight constriction. In *Limax* the divisions of the centre of the circulation are placed on different axes, and more individualized. In this latter genus it is planted in the centre of the respiratory plexus, and also in that of the cavity. In *Helix* it is situated at the posterior boundary of the chamber.

The roof in this shelled genus is a flexible membrane (fig. 3 *b*, and figs. 4 & 5 *c*). It is fixed posteriorly to a sort of diaphragm (fig. 3 *i*) which imperfectly divides the thorax from the abdomen (*j*). In the substance of the roof is lodged a stratum of muscles which contract and relax synchronously with the expiratory collapsing and inspiratory expanding of the cavity. These respiratory movements are very markedly defined in the animal of *Helix* removed carefully from its shell (figs. 4 & 6). The fixed position afforded by the ligament which ties the body to the columella, yields important service in the mechanical acts of respiration.

The soft abdominal segment (fig. 3 *j*) of the body is covered by a continuation of the mantle. In this situation the membrane is thinner, smoother and more delicate. *It is quite adherent everywhere to the subjacent organs.* There are no vacuoles either between it and the invested viscera, or between the viscera themselves. During retraction the foot may be concealed completely in the cavity of the thoracic moiety of the animal. This explains why it is that the viscera (brain, œsophagus, portions of reproductive and chylopoietic viscera, &c.) are so loosely packed in this region, and why it is that large spaces filled with fluid lie intermediately. Such vacuoles are more spacious in the Helicidæ than in the Limacidæ, because in the former the head and foot are more retractile than in the latter. The anterior surface or front of the operculum is perforated on the right side by a large, valvular, irritable sphincteric orifice (figs. 4 & 5 *a*, *a*). In the edge of the mantle directly above this orifice is observed a deep notch (fig. 4 *e*), which, when the animal is tightly coiled up into itself, fits over the orifice. By this simple contrivance, under all circumstances, the patency of the communication between the breathing-chamber and the external air is secured. So important is this point, that, both during hybernation and when the animal remains long attached to a dry calcareous stone in arid seasons, the membranous epiphragm which is then formed from the mucus supplied by the mucus-gland, is valvularly perforated at a point corresponding to the respiratory orifice. Respiration therefore, though sometimes greatly reduced in amount, at no time during the life of the animal completely ceases.

The pulmonary plexus, which in *Helix* is restricted to the roof of the cavity (fig. 3 *h*), presents a much more regular and symmetrical arrangement of the vessels than that of *Limax*. In *Helix* a main vessel (*d*, *d*) runs obliquely from left to right along the vault of the cavity; it terminates by dilating into the auricle (*c*); it commences at the anterior border (*d'*) in branches which converge upon it with great regularity of course. The lateral trunks are similarly regular. In some places the ultimate vessels can be traced with the naked eye: they are best viewed as opake objects, by cutting off the entire roof and placing it, vessels uppermost, between two slips of glass, and then examining with a two-inch or an inch object-glass. It will be observed that the primary or large trunks (fig. 6 *a*, *a*, *a*) run, on the whole, in parallel directions, enclosing interspaces of pretty uniform diameters; and that the secondary branches (*b*, *b*) proceed from the primary also in a determinate manner, separated by tolerably uniform distances, and running in tolerably orderly directions, so that they leave between them spaces which manifest a tendency to symmetry of outline and regularity of areæ.

The ultimate vessels (fig. 6 *c*, *c*) undoubtedly obey a similar method of distribution. If a spot be taken for inspection in which they are densely present, the vessels will be found to lie in parallel columns (as represented in Pl. XI. fig. 6, which has been drawn with great care from the actual object). In other places, especially towards the circumferences of the roof, they exhibit a more sparse and less regular distribution. If such portions of this vascular membrane were folded in the "ridge and gutter" fashion, taking care that the secondary vessels coincided with the borders of the folds, a *branchia* would be formed whose structure would conform with the *laminose* principle. It may conversely be said, that the lung of the air-breathing Gasteropod is nothing but the branchia of the water-breathing Gasteropod, having the laminæ of the gill so unfolded as to form a straight sheet. This comparison is really not too far-sought. In both instances the ultimate vessels present a uniform cylindrical character, seldom intercommunicating: such a comparison, however, is quite untenable in the case of *Limax* (fig. 2). Here the plexus is arboriform and irregular, circumscribing areæ of various sizes and figures. Like that of *Limax*, the lining of this cavity in *Helix* is undoubtedly ciliated at various parts. It is only possible to detect the presence of cilia along the lines of the larger vessels, and here and there in creases in their vicinities.

From the author's observations, it is probable that the spaces between the larger vessels, and coinciding with the capillary areæ, are devoid of *ciliated* epithelium. Nor is it easy to separate the layer of epithelium by which these parts are covered, from the elements of which the coats of the vessels themselves are composed.

In *Helix* the coats of the pulmonary vessels (fig. 3 *h*) are considerably less calcified, less white in appearance, and more flexible than those of *Limax*. They afford, therefore, a more favourable opportunity for determining their minute structure.

The same surprise may be expressed with respect to this lung-sac as with respect to that of *Limax*, viz. that so limited a vascular area presenting vessels so coarsely subdivided, should suffice, in so bulky an animal, to supply the demands of the respiratory function. While all other animals, even those inferior to these Mollusks in serial standard, are furnished with organs which involve prodigious superficies for action, how is it, it may again be asked, that in these superiorly endowed Gasteropods so rudely constructed an apparatus, so carelessly formed an organ should be enabled adequately to discharge a function so imperious?

Can there be any peculiarity in the structure of the vessels? As the calcareous layer is less developed here than in *Limax*, it is obvious that the presence of this layer is not an indispensable constituent of the organ. The pulmonary vessels in the Snail exhibit a structure which cannot well be proved to exist in the Slug. Their coats bulge out in a cellular-like manner. This occurs all round the circumference of each vessel, most distinctly in the smallest. It is impossible to determine whether the convexities on the exterior correspond with concavities on the interior of the vessels. But, by inference from the character of the outside, it seems almost certain that such an arrangement does really exist. If it does, it is not difficult to understand how considerably it is calculated to augment the surface of contact between the blood and the air. Though such cellulated parietes might mechanically slacken the speed of the current, the function of the part cannot fail to be considerably raised in amount.

Lymneadæ.—"These freshwater pulmoniferous snails constitute a very natural family, the animals of all bearing a great similarity to each other, and being similarly organized. All have short, broad snouts, and two tentacula of considerable size, either triangular or subulate in shape, with eyes placed at their inner bases." (Forbes and Hanley.) Little has been done by anatomists to elucidate the structure of this interesting family. In several features they approximate closely to the Helicidæ. The most striking character is the siphon-like tube into which the respiratory orifice is prolonged. This siphon (fig. 7 *a*) is capable of being considerably extended beyond the edge of the mantle (*b*). When the animal is floating reversely near the surface of the water, it may be seen from time to time to be slowly pushed above the surface into the air. At this moment, and through it, the effete contents of the respiratory cavity are emitted, and a supply of oxygen is drawn in. So wonderfully sensitive and discriminative is this little organ, that it opens only when it peeps into the atmosphere. Water never enters into the pulmonary chamber of *Lymneus*. The same observation applies to *Planorbis*.

But in these water-snails the breathing-chamber (fig. 7 *c*) is more actively ciliated than in the terrestrial families. Not because they breathe at any time on the aquatic principle, but probably because the whole tissues in these water-inhabiting genera are less calcified, and therefore more favourable to the development of cilia. It must, however, be supposed from these statements that the breathing-chamber is lined with a continuous layer of ciliated epithelium. It is detectible only on certain parts which chiefly correspond with the lines of the large trunks. The Limneids differ from the Helicidæ in being furnished with a richly ciliated epithelium on the *exterior* of the respiratory cavity. In young specimens vibratile cilia may be detected over the entire abdominal portion of the body. In the old, however, it disappears from this region, and is replaced by a non-ciliated variety.

In *Planorbis* the distribution of cilia is more limited. It is detectible on the siphon and margins of the thoracic cavity. With care it is possible to lay open or to remove the roof of this cavity in a large specimen of *Lymneus,* fixed by pins whilst floating in water. The roof delicately cut away is placed between two slips of glass and examined as an opake object. The larger vessels present a general arrangement analogous to that formerly described in *Helix.* A large central trunk runs obliquely from the left anterior to the right posterior angle of the cavity (fig. 7 *d*). It is the main venous channel which terminates in the auricle (*e*). The lateral or secondary trunks converge upon the line of this vessel from all sides. It is scarcely possible, in consequence of the absence of lime from the coats of the vessels, to trace the distribution of the ultimate channels. From glimpses obtained here and there, it is however most probable that they observe a parallel mode of division such as that already represented in the Helicidæ. The heart differs from that of *Helix.* The ventricle stands at an angle on the auricle. The axes of these two divisions meeting at the auriculo-ventricular orifice would form nearly a right angle. The gland (*f*) occupies a position to the left of the heart; it resembles that of *Helix*; it is an oval flocculent mass. To the right of the heart, the rectal intestine (*g*) enters within the precincts of the respiratory cavity; it traverses the chamber along its floor, and terminates in the siphon (*a*).

The breathing-chamber in the Lymneadæ exceeds that of all other air-breathing Gasteropods in size relatively to that of the body. The surface for the outlaying of the pulmonary plexus exhibits a greater relative area. The pulmonary sac of *Planorbis* is probably organized after the model of that of *Lymneus.* It is formed however on too small a scale to admit of a direct and satisfactory examination. The siphon is extensile like that of *Lymneus,* and like that of the latter genus, the cavity communicates externally by means of the siphon alone.

[To be continued.]

XIV.—*On the Marine Testacea of the Piedmontese Coast.* By J. Gwyn Jeffreys, Esq., F.R.S.

[With a Plate.]

The conchology of the British islands having been nearly exhausted by the excellent work of the late Professor Edward Forbes and Mr. Hanley, I had no wish to glean the small handful that remained in that field; and I therefore determined to spend part of my "long vacation" in exploring another district, in which my former labours and experience might prove useful to me. My original intention was to visit Sardinia, the fauna of which island is but little known, although its scenery and antiquities, as well as the habits of its people, have been so well described, and invested with so much interest, by the book of my friend Mr. Tyndale; but this intention was frustrated by a regulation which I was informed on my arrival in Italy had been recently made for putting all sea-borne travellers from the mainland in quarantine for five days, by reason of the prevalence of cholera at Genoa and Leghorn. This would have effectually marred the prosecution of my design; and I therefore, but with reluctance, gave it up. Another plan which I had formed as an alternative before leaving England, was to explore that part of the Riviera which lies between Genoa and Portofino on the east. This I subsequently carried out, and extended by excursions in the same direction to Sestri di Levante and Spezia, thus including about sixty miles of sea-coast; and ultimately, through the assistance of the Chevalier Verany (the well-known author of one of the most finished *livres de luxe* which ever emanated from a scientific pen—his work on the Mediterranean Cuttles), I made myself acquainted with the testaceous mollusca or shell-fish of the whole of the Piedmontese sea-board, extending from 43° 40′ to 44° 25′ of north latitude between Nice and Genoa, and from 7° 10′ to 10° of east longitude between Nice and Lerici. It is, with the exception of the Gulf of Venice, the most northerly section of the Mediterranean, and is situate in nearly the same parallel of latitude as the lower part of the Bay of Biscay.

I believe I was the first who ever "dredged" this part of the Mediterranean; and as a short account of the adventure may be useful or interesting to other naturalists, I trust I may be excused in prefixing it to the more scientific portion of this communication.

To transport dredges, sieves, and other conchological apparatus across the continent, and afterwards to work in a small felucca, with the aid of Italian boatmen who never saw a dredge or a conchologist before, and whose *patois* it was very difficult to understand, is quite a different affair from having, like my friend Mr. M'Andrew, a well-found yacht with a crew of trained and semi-conchological seamen; to say nothing of the heat, dirt, and insects which render an autumnal lodging in any town on the Mediterranean coast anything but comfortable. Although I do not possess one-half of the qualities which Mr. Kingsley attributes to a model field or out-door naturalist, I was often obliged to "rough it." The first difficulty I had to surmount was in "clearing" my dredges and sieves at the custom-house on my arrival in Paris. The ordinary searchers could make nothing out of these outlandish articles, and referred to the superintendent, who, after further investigation and inquiry, decided that they were "machines," and therefore liable to duty. After some further explanation, however, I succeeded in inducing him to reconsider and alter his decision, and I escaped any payment. Still greater, and more frequent trouble awaited me on my journey homewards, in getting my cargo of shells passed by the douaniers on the Lago Maggiore, and in Switzerland and France; but I had no reason to complain of our own custom-house officers.

I started from London on the 1st of August, 1855, and went to Genoa, *viâ* Paris, Lyons, Chambéry and Turin; this being the most direct and expeditious, as well as the cheapest, route. At Genoa I succeeded in getting a boat with two men for six francs a day, exclusive of the hire of ropes, for which I had to pay a like sum; and this made my dredging there expensive, besides not being able to do much work, in consequence of having to get out of the port and offing on each occasion. The best ground I met with there was off Foci (two or three miles east of Genoa), in about forty fathoms water. After staying at Genoa three or four days, I took the steamer to Spezia, where I arrived after a boisterous voyage of sixteen hours, the distance run being not much more than sixty miles. I there put up at a tolerable inn, called the Hotel de l'Univers, where I made the usual preliminary bargain, and got a good-sized bedroom, with café au laît, bread and butter for breakfast, the table d'hôte dinner, and café noir in the evening, for five lire di moneta regia (or four shillings) per day, besides wax-lights and attendance. The former I bought at a shop; and I paid a lire per day altogether for attendance. The table d'hôte was, during the first week of my stay at the inn, tolerably well filled, ten or a dozen guests being the average number; but the company afterwards dwindled away to such an extent, that an officer in the Piedmontese army (Captain Chiavarini, whose civility I shall not easily forget) and myself were the only guests; and on one occasion I formed the whole of the company, and had a solitary dinner. Immediately on my arrival at Spezia I engaged a boatman, and was so well pleased with him that I continued to employ him during the whole of my stay there. His name was Giovanni Solese, and I can safely recommend him to any brother naturalist who may be inclined to follow in my footsteps. He was a middle-aged and short but active man, with fine dark eyes, and a most intelligent and benevolent countenance. His "moglie" kept a small shop, and let lodgings; and in the winter he worked at his other trade of a blacksmith. Solese's mate or fellow-boatman was, at first, his brother, a taller man, who wore large ear-rings, and was rather taciturn; but he was succeeded by an ancient mariner, who told me he recollected "Napoleone il grande" coming to Spezia, where it is well known he intended to form a magnificent harbour for his Mediterranean fleet. I had not much difficulty in arranging terms with the boatman; and I was well satisfied at having to pay only five francs per day for the boat, men, and 100 fathoms of rope, being less than half of what I paid at Genoa. My knowledge of the Italian language being very rudimentary, I had of course at first some trouble in explaining to the men the use of a dredge and the mode of working it, and this I did chiefly by means of signs; but, after a day or two, my "cacchiate," "basta," and "tirate" were understood perfectly well; and the men dredged and sifted the soil without me on the alternate days, when I was obliged to stay indoors to examine the produce of the preceding day, as well as to clean and arrange the specimens. It was, I can assure my readers, very hard work, from seven or eight in the morning until five in the evening while dredging, and sometimes till near midnight indoors. My usual practice on dredging-days was, after working with and directing the men until noon, to land on some part of the coast, bathe off the rocks, and then walk back to the little town, conchologizing along the shore on my way; the men in the meanwhile continuing to dredge some previously explored part of the Gulf in accordance with my directions. The modes of collecting which I adopted were three:—1st, by the dredge. Of these I took two with me. The larger one was of iron, and twenty-two inches wide at the mouth or opening, with an outer net or bag of rope-yarn fastened to the mouth of the dredge by strips of raw hide, and an inner and close-meshed net of twine. This dredge had a safety-chain attached to it, to assist in disengaging the dredge in case of its getting foul of a submarine rock. The other, or smaller dredge, was only about a foot wide, and was made of galvanized iron, with a flexible chain of the same material instead of the usual arms riveted by bolts and nuts. It was made for me, under the superintendence of Professor Robert Ball of Dublin, and answered pretty well for experimental or deep-sea dredging, but in my opinion it is not sufficiently capacious or heavy for ordinary work. The net for this dredge was single, and of close-woven twine. All the nets had been tanned, to prevent rotting. In such distant expeditions it is of course advisable to have a second dredge, in case of losing one. My sieves, which I took in a case, under lock and key, were six in number, and lined with brass wire of different degrees of fineness. The largest measured about twelve inches in diameter. They are, I need scarcely say, indispensable in the collection of the smaller shells. While dredging, I always had a large tub in the boat to wash the soil, as the sea was never sufficiently calm for that purpose, and it obviated any risk of losing the sieves overboard. 2ndly, from sea-weed. By this mode I obtained a great number and variety of the littoral shells, such as *Rissoa, Skenea,* and *Scissurella,* which inhabit and feed on the sea-plants and confervæ that so abundantly clothe the rocks, and are submerged at low water, or while the sea breeze blows inshore. The plan I adopted was, to collect in a bag or pocket-handkerchief a quantity of the sea-weed and coralline with their roots (and while bathing I had especial opportunities) from different depths; and on returning to my room I steeped the whole in my sieves for some time in a tub of *fresh* water, by which means the animals appeared to be instantaneously killed, and dropped into the sieves. These were then shaken over sheets of paper, and the contents were exposed to the sun and dried, and afterwards carefully sifted and separated from the stalks of sea-weed and larger shells. The examination of the residuum, which almost entirely consisted of minute shells, as well as the sorting and arrangement of the specimens, took up a great deal of my time, but amply rewarded me for the trouble. The 3rd, being the ordinary mode used by collectors, was by picking up shells on the sea-shore. The tides in the Mediterranean being so feeble and irregular, there was not at Spezia a line of "spolia marina," such as we see on the sandy shores of Great Britain; but by wading a little, and examining the under side of loose stones, I found a great many live shells which I never met with in my own country, such as the *Conus Mediterraneus,* and several species of *Trochus, Patella, Columbella, Vermetus,* and *Pollia.*

Twice I made excursions to the Island of Palmaria, at the entrance of the Gulf. I also went to Lerici (near which, on the beach, stands the house formerly occupied by Lord Byron and Shelley), and San Bartolomeo on the eastern, and Porto Venere on the western shore. The Gulf or Bay of Spezia is about seven miles in length, and varies from three to five miles in breadth. The tide recedes (for the Mediterranean, considerably) from its head or upper end, laying bare a large tract of sand. Farther seawards is a fringe or belt of *Zostera marina* (or Sea Riband), which appears to be a favourite haunt of the *Murex Brandaris* and *trunculus*, as well as of our common sand-eel (or *anguille* of the Italians), the *Muræna marina* of ichthyologists. Beyond this, to a depth of twelve fathoms, is a variety of ground; a great part being covered with Zostera and other kinds of sea-weed, another part being gravelly with occasional patches of shell-sand, another being rocky, and the rest stony and favourable for the growth of sponges and corals. The sponge and coral of commerce are not, however, found on that part of the coast. One day's dredging I devoted to the examination of a remarkable spring of fresh water which rises about fifty yards from the western shore of the Gulf, and is of such an extraordinary depth and volume as to be visible at a considerable distance, and even dangerous to small boats. It resembles *in petto* the Corrievreckan on the Scotch coast. I made two or three hauls in the vortex and round the edges of the spring, but got nothing except dead shells of littoral species, which must have been washed off the shore by the tide and waves and absorbed into the whirlpool. It is said that Napoleon the First had an idea of using the water of this spring for his projected harbour. On my dredging-days I always had a plunge into the bright and deep blue sea, either from the boat, or from a rock after I landed; but the difference of temperature between the atmosphere and water was too slight to make it a refreshing or invigorating process, there being no reaction after bathing. On one occasion this amusement had more of fright than refreshment in it. I had swum out from the rocks at Palmaria, leaving the men to moor their boat, and was returning, when I heard loud cries of "Guarda, guarda, signore!" I fully expected that a white shark (which Admiral Smyth describes in his list of Mediterranean fishes as "the most voracious of human food of all fishes") wished to make my acquaintance, or see whether the flesh of a Welshman was as good-eating as that of an Italian; and having somewhere read or heard that they were cowardly as well as greedy, I splashed about in the water as much as I could until I reached land, and then I understood what the boatmen meant by their caution. It was to look where I trod when I touched ground, because (as I then perceived) the rocks were stuck all over with a large sea-egg (*Echinus esculentus*), which might have lamed me if the sharp and stout spines with which they are armed had penetrated the sole of my foot. The men were at the time busy in collecting a quantity of this delicacy for home consumption.

I had not before tasted sea-eggs, although this large and edible kind is not uncommon on the Devonshire coast; but, on being persuaded by the men to do so, I certainly did not disapprove of their taste. The only part which is eaten are the lobes at the side. The flavour is peculiar and indescribable; and I can only compare it to something between an oyster and guava jelly. The substance is pulpy, and appears to melt in the mouth. The fishermen are very fond of all kinds of shell-fish, cuttles, and crustacea, the first of which they call "frutti di mare."

Outside the Gulf is deep water; but I was disappointed in my dredging there. For several leagues seaward, in from fifteen to fifty fathoms, I met with nothing but tenacious mud (which my boatmen called "fango"), with *Turritella communis* and a curious variety of *Calyptræa sinensis*, which moulded itself and adhered to the last whorl of the Turritella.

I found the heat much greater indoors than on the water, as might have been expected. On the land it was seldom less than 78° Fahr. in the shade. The boat was furnished with the usual awning, which extended over about two-thirds of it; but this I generally had taken down on reaching the dredging-ground to facilitate operations, and the only inconvenience I felt was from the perpendicular rays of the sun at noonday, which my "wide-awake" scarcely warded off. But in my room it was often very uncomfortable, because I could not follow the usual custom of closing the shutters and excluding all the sunlight, inasmuch as I should not in that case have had sufficient light to examine the smaller and almost microscopic specimens; but I was always obliged to strip myself of my coat and waistcoat. This, with the aid of the narrow streets and tall houses, gave me some little relief.

At Palmaria, the fishermen eke out their precarious livelihood by extracting the "dati di mare" (*Lithodomus dactylus*) from the limestone rocks which engird that island. This is done by means of a crowbar; and the fisherman is often several hours in the water, up to his middle, breaking the rock in search of the shell-fish, which he collects in a bag tied round his waist. This molluscous luxury fetches on the spot no less than four francs per hundred, and is sent by the steamers to Genoa and Leghorn. At Porto Venere, which is situate on a promontory at the western entrance of the Gulf, I observed a great many dealers in this article; the shell-fish being kept in pans of sea-water in dark cupboards. It appears to be the only foreign trade possessed by that ancient Roman town, which is so full of archways and picturesque ruins. It must not be imagined that a naturalist only uses his eyes for his own proper objects. His soul, "steeped in beauty" by the continual contemplation of the graceful and varied forms of Nature, is not insensible to artistic objects, although the angular works of his fellow-man cannot for one moment be put into competition with the "teres atque rotundus" which is the character of natural forms.

While I was at Spezia, the land breeze or "vento di terra" regularly set in from about 2 A.M. to 2 P.M., and the sea breeze or "vento di mare" blew inshore during the rest of the twenty-four hours. The first enabled mine and all the other boats and vessels to leave the little port and get a good offing, while the other cooled and refreshed the parched land and its inhabitants. Sometimes a sudden squall, caused by a wind called the "borasco," would arise, especially under high land, and made my short voyages not quite free from danger.

Although I am not a botanist, I could not help being struck with the prodigality of Flora in throwing her charms around this beautiful country. The coast was fringed with myrtle; and the olive-groves, being unpruned, had a much less stiff appearance than in the South of France. The grape-crop had again failed, but the vines, still faithful to their ancient husbands, spread their festoons and garlands as of old.

Through the kindness of my table-d'hôte companion (for I knew no one else, and did not meet with one of my countrymen during my stay at Spezia), I had an opportunity of joining some fishing-parties; and, as it is indirectly connected with my subject, I will endeavour to describe one of them. My dredging boat and crew (which were among the best in the place) were selected for the occasion, and at 9 P.M. the party met on the pier and embarked, having either a small lanthorn suspended inside the awning, or the moon when she was up and propitious. Our party consisted of half-a-dozen ladies and gentlemen. The boatmen rowed slowly to the fishing-ground while the ladies sung, and on reaching a cork buoy to which the lines were attached (which sometimes it took a long time and a considerable circuit to do, owing to the small size of the object and the difficulty of finding it), the sport commenced. There were about 150 hooks attached to lines about two feet in length, which were fastened at intervals of about a fathom to the main line. This was attached at each end to the buoy. The lines had been set in the previous morning, the bait consisting of strips of fish and small blennies. While the lines were being taken up by one of the boatmen, the other holding water or rowing in the direction of the main line, there was of course no little excitement, mingled with disappointment when sometimes at every other haul a shell-fish (*Murex Brandaris* or *M. trunculus*) was taken. These are, like our *Buccinum undatum*, to which they appear to form analogues, carnivorous and frequently take the fishermen's bait.

The *Murex trunculus* yields a rich purple dye, and being common in the Mediterranean (although not known in higher latitudes), is probably the kind which the ancients made use of for that purpose, as well as for the table. The fish caught were grey mullet and sand-eels, some of the latter weighing two or three pounds. Supper was then prepared; and with the aid of a brazier of charcoal, frying-pan, oil and salt, our fish were soon cooked. A flask or two of native wine and some bread completed the repast, and we returned to shore about midnight.

I staid at Spezia three weeks, and had intended to return by the "Ferugio" steamer to Genoa, and try my luck again in deep water; but a seat in a return-carriage having been offered me by a vetturino, I gladly availed myself of it, and enjoyed the journey across the Apennines and along the Riviera di Levante. The route is beautiful and more varied than by the Cornice. My only *compagnon de voyage* was a Lombardese gentleman. We passed the night at Sestri di Levante, about halfway between Spezia and Genoa; and, while taking a stroll on the beach after dinner, I was so charmed with the place as well as satisfied with the prospect of its dredging capabilities, that I made a bargain at the inn and with a boatman, and determined to return thither from Genoa, where I expected to receive letters. To give some idea of Italian conscience, I may mention that one boatman asked me twenty francs per day for the use of his boat with ropes and two men, which I afterwards got for five francs, being the same rate as I paid at Spezia! The inn (Hotel de l'Europe) was very superior to the one I lodged at in Spezia, and I was "très-content" with the accommodation during my subsequent stay of ten days. I was, however, disappointed with the dredging; for, although the water was deep, and the shells that were thrown upon the beach gave great promise, the sea-bottom for leagues, as far as Portofino to the west and the Golfo de la Riva to the east, consisted of the same tenacious mud which I found outside of the Gulf of Spezia, and contained scarcely any other shell than the *Turritella communis*. I therefore again set to work in washing sea-weeds and examining the sifted produce; and as the inn was a large one, and I was for several days the only guest in it, I was enabled to work in comparative luxury by changing my room when the sun came round, and using a vine-clad balcony (having a circular marble table in the centre) which faced the east and commanded a view of the Apennines. The inn being built on the beach, I had thus the sea breeze, shade, and lovely scenery on both sides. It is certainly the most picturesque spot I ever visited. The fan-shaped *Padinia Pavonia* displayed its iridescent hues in the rocky pools; the tall aloë-flower caused incessant surprise; and the humble sand-convolvulus made my heart throb with recollections of home and its familiar shores.

At Spezia I had experienced great difficulty in cleaning the larger whelks and Mediterranean Cone, in consequence of the strength and size of the muscles which connect the soft parts of the animal with the shell in the zoophagous Mollusks; and, in spite of the chloride of lime which I was obliged to use pretty freely, my room was certainly not odoriferous in the sense I could have wished,—to say nothing of a large and strange sort of fly which was attracted by the decaying animal matter and bred abundantly in the drawers of my wardrobe, which I had turned into an extempore cabinet. But at Sestri I met with an ally which relieved me from this nuisance: it was a small red ant, that came in swarms from some secret hiding-place, and effectually cleaned out the shells in an incredibly short space of time. It appeared to be a species of *Atta*, probably *A. structor*; field-ants being known occasionally to become domestic. Their tenacity of life was surprising. I wished to bring home a couple of specimens for an entomological friend, and put them in boiling-water for several minutes; but some time afterwards the specimens (which I had dried and kept in a small box with a glass lid) were as lively as ever, and seemed not to be at all the worse for being parboiled.

The excessive saltness of the Mediterranean appeared to me evidenced at Sestri by the thick crust of salt-crystals which was formed on the rocks by evaporation from the sea-spray. I never noticed this on any part of the British coast. Lieutenant Maury, in his 'Physical Geography of the Sea,' states positively (§ 252) that the Mediterranean sea is not salting up; but the analysis of Dr. Wollaston would seem to lead to an opposite conclusion.

While engaged in my work of sifting sea-weeds and picking out the shells, I could not help reflecting on the immense loss of animal life which is (perhaps innocuously as well as unthinkingly) caused by naturalists. I found on my return to England that I had brought home with me upwards of 13,000 specimens of marine Testacea, and several thousands of land and freshwater shells, besides sponges and zoophytes! Of a species of *Rissoa*, which I have now described and figured for the first time under the name of *contorta* (an analogue of our *Rissoa striata*), I took between 1100 and 1200 specimens! These numbers are of course exclusive of multitudes which were thrown away, as I neither cared nor had time for collecting more. This wholesale destruction of life is on first consideration startling; but I consoled myself with thinking that if I had not taken and destroyed these animals for scientific purposes, some of their natural enemies would have made another use of them, and that if even one-half of them had been allowed to die of old age or natrual infirmities, the "balance of power" might have been deranged, and results which we cannot foresee might have ensued from the redundancy of particular species. Whether the handiwork of modern naturalists and collectors has any effect in altering the relative proportion of species is another question. "O Lord, how glorious are thy works: Thy thoughts are very deep!"

At Sestri I had the good fortune to meet with a fellow-countryman and brother lawyer (Mr. Thomas Smythe of the Chancery Bar), whose taste for science and art made his company very agreeable.

From Sestri I returned to Genoa and proceeded to Nice, having received a kind invitation from the Chevalier Verany to see him. I there went through and made notes of his collection of shells from that and the Genoese coast. It does not appear certain that Philippi, Risso, Payraudeau, or any other naturalist who has written on the Mediterranean fauna, ever used a dredge or sieve; the mode which they probably adopted being to search the shores and drift-sand, or to procure the shells from fishermen and coral-divers. These methods, and especially the last, are obviously not well adapted to ensure the correctness of habitats and localities. M. Verany was, I have reason to believe, frequently deceived in the same way as our Colonel Montagu by the credulity or ignorance of others, and in investigating the question of geographical distribution, such errors frequently cause wrong conclusions.

From Nice I crossed the Col di Tenda to the Lago Maggiore, and paid a visit to a friend who had a villa on the borders of the Lake at Suna. I was much pleased with finding, in considerable plenty, the curious little snail, *Helix* (*Drepanostoma*) *Nautiliformis*, and a white variety of it, on the hills in different parts of that district, as well as in the Val d'Anzasca. It has not been yet discovered on this side of the Alps. The animal is a true snail, and has two pairs of horns, with eyes, or their analogous organ, on the tips of the upper or longer pair. On the shores and in the shallows of the Lake, I found a species of *Limneus* or pond-snail, which appears to be the *Gulnaria lacustris* of Leach, in company with *L. auricularius*, and this induces me to believe that they are different species. Several kinds of *Pupa* and other land-shells, which had been previously noticed only on the hills which environ the neighbouring Lakes of Como and Lugano, also occurred to me. Collecting in these woods was not unattended with some risk, for they swarmed with different kinds of snakes. I more than once found, in searching the dead leaves and moss, that my hand was within an uncomfortable distance of a viper. In the Canero woods I one day met with a large serpent, which lay stretched out at full length on a bed of fallen leaves. I at first thought it was dead, and raised it up by the middle with my stick; but the creature was only basking, and glided away. The peasants said this kind was "molto cattivo;" but I believe it was only the common snake of an extraordinary size. They also spoke of a small, but very venomous adder, not much thicker or larger than a man's finger, which would dart at, and kill, a dog. In a ravine behind Genoa, where I had been searching for *Paludinæ* in a brook, I saw an animal in the water under a large stone, which I at first took for an eel; but while I was speculating on the singularity of finding an eel in that country, and poking the creature with my stick, it climbed up a rock and escaped into a deep pool, hissing violently and showing a blunt and villainous head. Dr. Gray tells me it must have been a species of *Tropidonotus,* and that none of the freshwater snakes are poisonous. However, I never got bitten; and I generally took with me a small vial of sal-ammoniac as a remedy against such a contingency. I also met several times with the disgusting, but harmless, striped salamanders.

I here received intelligence of the death of my lamented and venerable friend, Monsieur de Charpentier, whose loss (although in the fulness of his years and honours) science has so sensibly felt. I had hoped to pass a few days with him before I returned to England.

From the Lago Maggiore I crossed the Alps by the St. Gothard Pass, and returned home through Lucerne, Basle, Strasbourg, and Paris. Londinum "longæ finis chartæque viæquet."

I will now proceed with the more scientific part of my memoir.

The extent of the geographical distribution of marine animals, as well as the laws which regulate that distribution, seem to be at present involved in such obscurity, that, although I may not be able to throw much light on the subject, any additional facts which I can adduce will, I am confident, be useful in assisting others in time to solve this difficult and interesting problem.

In considering this subject it is necessary, in the first place, to say a few words as to the definition and limits of what naturalists call "species."

The question whether a species exists in the scale of nature, or not, has been much discussed. Most naturalists maintain the affirmative. In the earlier stage of natural history it seems indeed almost absurd or supererogatory to doubt the existence of species; the number of objects presented for examination and comparison being few, and easily distinguishable by certain definite characters. As science however advances, the number of objects increases, and greater difficulty consequently arises in separating and distinguishing them from each other; the line of demarcation becomes more and more faint, and the naturalist is tempted, not only to distrust the distinctiveness of certain characters which he had before regarded as sheet-anchors, but even to doubt the possibility of establishing any characters at all. This phase is ultimately succeeded by more or less critical views, dependent on the idiosyncrasy of the naturalist, as the sphere of his observation is extended; and he is then, by a sort of innate facility, able to discriminate species from varieties, and to assign to each its proper and relative position. He finds that the characters of distinctiveness vary in the different groups or genera and species; that differences of a more or less important nature, such as form, size, colour, and appendages, arise from locality, food, and other causes, and only constitute varieties; and that there is an inherent tendency of all species to adapt themselves to certain changes of condition, and to undergo transformations of frequently the most Protean kind. The discrimination of species and varieties is one of the most important duties of the naturalist, because, without it, the study of nature would lead to no result, and there would be no precise data from which any conclusions could be safely drawn. The facility or habit of such discrimination depends on both synthesis and analysis, and is only attainable by practice and a large sphere of observation. Hence, local naturalists do not in general possess this quality; the usual form of their error being to split species, and attach too much importance to minute differences. The necessity of rigorous discrimination of species and varieties cannot, indeed, be too much or too frequently insisted on. Messrs. Hooker and Thompson, in the introductory essay to their recent and valuable work entitled 'Flora Indica,' which abounds in philosophical views and remarks as to species and varieties of plants, say with justice that "the discovery of a form uniting two others previously thought distinct, is much more important than that of a totally new species, inasmuch as the correction of an error is a greater boon to science than a step in advance."

It is unquestionable that the soft and hard parts of the Mollusca are of relative and nearly equal value; the former for generic, and the latter for specific distinction. Both must be studied in relation to each other; and it seems to me most illiberal in the malacologist or conchologist to ignore or depreciate the labours of his brother-naturalist. Philippi, in the second volume of his 'Fauna Molluscorum utriusque Siciliæ,' after stating that Bivona had seen the animals of several species of *Rissoa,* and that he had himself figured the animals of other species, concludes with this remark, " Hæ species omnes *simil-*

limis animalibus incoluntur." The same remark will apply to the "animals" or soft parts of the genus *Helix* and many others. Yet the "shells" or hard parts of the Mollusca are as readily distinguishable from each other, and form as good criteria of specific distinction, as the shell of a tortoise, a crab, or an insect, without reference to the other parts of the animal. Were it not for this test, fossil shells could no longer be regarded by the geologist as "medals of creation," and the important deductions which have been founded on them would be nugatory and valueless.

With respect to the separation and discrimination of "varieties," by which term naturalists understand a modification of the size, colour, and appendages of species, and sometimes even of their form, I have generally observed that when a difference of form exists between individuals evidently belonging to the same genus, in the same locality, and having the same food and other conditions of habitability, it is probable that such individuals belong to different *species*; but that when such difference exists between individuals belonging to the same genus, which inhabit distinct and separate localities, they ought to be regarded only as *varieties*. This is by no means however a certain rule, and it depends on the habits of the animal, the relative value of characters which distinguish each genus, and many other circumstances.

Now, putting aside the doubts which may be entertained by naturalists as to the distinction of certain species, we have positive data for ascertaining to some extent the distribution of British and Mediterranean Testacea, in the work of Philippi on the Mollusca of Naples and Sicily, and that of Forbes and Hanley on the Mollusca of Great Britain and Ireland. The descriptions and figures in each of these works are most accurate; and, whether all or many of the objects which have been so described and figured are true species or merely varieties, the same result is obtained, namely a comparison of the Testacea in each of these districts.

My first impression on examining the Testacea of the Gulf of Genoa was, that the fauna of the Mediterranean was mixed, and not peculiar to that sea. I found in it a large proportion of species which were familiar to me as British, and others having a more southern and even tropical habitat. This led me to inquire whether the division into certain definite areas, which the late Professor Forbes distinguished by the names of Boreal, Celtic, Lusitanian, and Mediterranean, was well founded; and the conclusion I have arrived at is, that such a division is arbitrary and irreconcilable with facts.

In Professor Forbes's Report (in 1850) to the British Association for the Advancement of Science, on British Marine Zoology, as well as in his introduction to the 'British Mollusca,' he has enumerated certain species which he called "peculiarly Northern" or "Boreal;" others which, according to his account, show the more powerful influence of the Scandinavian element in our fauna, and which he assigned to a "Celtic" type; some which he designated as "peculiarly British," and again others that he found to occur in our seas only in a few isolated patches which he regarded as "Glacial" outliers. Now, of the first-mentioned or "Boreal" species, I found several in the Mediterranean (viz. *Chiton Hanleyi*, *Mangelia brachystoma*, and *Neæra costellata*), another (*Mangelia Leufroyi* or *Boothii*) has been described and figured by Philippi as a recent Sicilian species, and a fifth (*Scissurella crispata*) I believe to be identical with the *Scissurella decussata* of D'Orbigny. Of the second division or "Celtic" species, I met with *Tapes pullastra* (of which the *Venus geographica* of continental authors is a variety), *Acmæa virginea*, *Lucina borealis* or *radula*, and *Lucina flexuosa*; and Philippi has given *Trochus millegranus* and *Eulimella Macandrei* (his *Melania Scillæ*) as Sicilian species. Of the third division, or "peculiarly British" species, several (as *Jeffreysia diaphana*, and the so-called *Skeneæ*, besides *Argiope cistellula* of Searles Wood, which I think cannot be distinguished from the *Orthis Neapolitana* of Scacchi) also occurred to me in the Mediterranean; and of the last division or "Glacial" species I detected three species (namely *Nucula decussata*, *Neæra cuspidata*, and *Cardium Suecicum* or *minimum*), and Philippi has given another (*Arca raridentata* or *Pectunculoides*) as Sicilian. I have moreover good reason to believe, judging from the very small extent of ground which has been as yet examined, that these exceptional species may be considerably added to when the wide extent of the Mediterranean Sea and its coasts has been more explored. I have myself been enabled to add to the Mediterranean fauna, in the short space of time which I devoted to this research, more than thirty species which had been hitherto considered as restricted to the British seas. It is obvious that negative evidence of the occurrence of any species (and especially of those which inhabit deep water) in any given area of sea is inadmissible; and naturalists do not differ from logicians or lawyers in rejecting such evidence.

It may indeed be argued in favour of the division into special or limited areas, that the species I have named, have, in the course of time, migrated or been diffused from the birthplace of their primæval ancestors, or from what is now called the centre or focus of their creation, and that this migration or diffusion has been facilitated by causes now in operation, and especially by oceanic currents. But it must be borne in mind that the great Gulf-stream, which is the only current that could be effectual for such a purpose, sets from south to north, and that the indraught current from the Atlantic into the Mediterranean, through the Straits of Gibraltar, sets from west to east. Major Rennell was indeed of opinion (according to Admiral Smyth, whose excellent and elaborate work on the Mediterranean I have had frequent occasion to consult), that there is a general tendency of the Atlantic waters between 30° and 45° of north latitude, and from 100 to 130 leagues off the land, to move towards the Strait of Gibraltar, at a rate of not less than from fourteen to seventeen miles in twenty-four hours; although this opinion, the Admiral says, ought to be received *cum grano salis,* especially if depth be admitted as a condition of these 400,000 square miles. However, granting that this may to some (I am not prepared to say to what, or any) extent account for the migration or diffusion of species *from* the Lusitanian coast to the British or Mediterranean seas, it cannot be considered to operate in the opposite direction; and I therefore do not see how any species which we may for the present call, with Prof. Forbes, "peculiarly Northern" or "Boreal" (such as *Chiton Hanleyi*), or "Celtic" (as *Lucina flexuosa*), or "peculiarly British" (as *Jeffreysia diaphana*), or "Glacial" (as *Cardium Suecicum*), can find their way into the Mediterranean, while the Gulf-stream continues its present course. We will even assume that there is a counter-current (although our present hydrographical knowledge does not warrant the assumption) *from* the north to the south,—I would ask, how is it possible that species, which, like *Chiton Hanleyi,* inhabit the coralline zone, can be transported across the Atlantic to such a distance? The stationary habits of the adult animal, which passes its life adhering to stones and shells, forbid the idea of its voluntary migration. In its embryo state this Chiton is doubtless (as Mr. Clark has shown in the 'Annals' for December 1855 with respect to its congener, *Chiton cinereus*), like many other Mollusca, free, and capable of swimming about with considerable activity; but this stage of growth only lasts three or four days, when the metamorphosis or final development takes place, and the creature, having "sown its wild oats," settles down for the rest of its life, and only crawls about for a short distance in search of food. The same remark occurs to me with respect to the littoral species, such as *Skenea planorbis* (a well-known inhabitant of Great Britain, and now for the first time noticed by me as Mediterranean), which would appear to be physically incapable of crossing the stream of the English Channel in order to diffuse itself along the western coasts of Europe and gain ingress into the Mediterranean. How can this, or any other *littoral* species, many of which are common to the British and Mediterranean seas, find its way from one to the other? Voluntary locomotion, it is tolerably clear to all who know the proverbial slowness of pace at which a snail, whether land or marine, can travel, would require an immense time to complete the journey, even if the animal knew or could find its way. Bivalves, being destitute of a head or eyes, would of course labour under a greater disadvantage; and besides, their motion is never progressive, but is effected by eccentric and irregular leaps. The only other modes, therefore, in which this great change of position could be accounted for, are, either that the shell-fish may be torn from their submarine abodes, and carried perforce by the current, or that they may be in their embryonic state wafted to the place of destination. The former mode would require it to be taken for granted that there exist no rocks or other obstacles in the course of their passage, that the current reaches the sea-bottom (which is more than doubtful), and that the shell-fish in question live within the range of the current. The other supposition can only apply to the Bivalves, Brachiopods and Chitons, whose embryo or fry are free and tolerably active swimmers, undergoing during that period of their existence a singular metamorphosis, as I have myself witnessed in the case of the common oyster. But as the fry are developed and attain their normal state within a few days at the furthest after being excluded from their parent, and then become fixtures for life, or nearly so in the case of the Chitons, it is hardly possible that the time allotted to the first stage of their existence would enable them to traverse such a vast distance. If we reject Forbes's proposition that the species I have before mentioned are Boreal, Celtic, British, or Glacial, and consider them as Mediterranean, the same difficulty arises; and we shall not find the mode of transit from the Mediterranean to the British seas more easy or probable when we reflect that the only ingress into or egress out of the Mediterranean is through the Straits of Gibraltar, and especially if the only current which flows through that passage is an indraught, and sets *from*, instead of *to*, the Atlantic. The popular idea of a counter- or under-current *from* the Mediterranean outwards is (to say the least) not proved; and I do not think Lieutenant Maury, in his recent and excellent treatise on the physical geography of the sea, has made out a strong case in its support, in opposition to the opinions of Admiral Smyth and Sir Charles Lyell. If there is such an outer- or under-current from the Mediterranean into the Atlantic, shell-fish might, it is true, be transported from the former to the latter; but they would in that case be, metaphorically as well as literally, "at sea," because, according to Maury's charts and account of the Gulf-stream, the course northward of that great current lies far beyond the range of the Mediterranean outlet into the Atlantic. If there is no such outer current, shell-fish leaving the British shores would, after crossing the English or Irish Channel, have to traverse, by a circuitous route, the western coasts of Europe by means of the great Arctic current, which is supposed to pass under the Gulf-stream, before they could reach and enter the Strait of Gibraltar. Either of these suppositions therefore, except perhaps with respect to pelagic or floating shell-fish (such as the Pteropods and *Ianthina communis*), does not appear to me well founded, and still less probable in the case of shell-fish which permanently adhere to rocks, or their fry, for the reasons I have before given. I therefore cannot help thinking that the migration or diffusion, beyond a limited range, of marine shell-fish by means of oceanic currents now in operation is physically improbable, and that it is unnecessary thus to account for the present distribution of these animals.

For the same reasons, I am not disposed to admit the theory which has been propounded and maintained by so many naturalists, that certain areas now exist, containing species peculiar to each, and having each its own separate nucleus or centre from which these species have radiated.

In the last edition of Lyell's 'Principles of Geology' is a map showing the extent of land in Europe which can be proved to have been covered by the sea during the earlier part of the tertiary, or the eocene, period; and a wide opening from the Bay of Biscay to the Gulf of Lyons, in the upper part of the Mediterranean, appears to have formerly connected that sea with the North Atlantic. It has been also proved by Brocchi, Philippi, and Searles Wood, that a large proportion of shells now living in the Mediterranean are identical with fossil species from the tertiary strata, both in Italy and Great Britain, and *vice versâ*; and it is not too much to assume, that in former æras marine currents existed by which animals might have been transported from one to the other of those districts, or rather that they were then diffused throughout a larger area than at present. Whether the original birthplace or nucleus of these shell-fish was in that part of the ocean which is now called the North Atlantic, or in the Mediterranean, is immaterial;—all I contend is, that the areas of geographical distribution, as proposed by the late Professor Forbes and others, are too much restricted to existing circumstances, and that they ought rather to be referred to a prior state of things. As yet, we want infinitely more information and data as regards the distribution of recent and fossil shells, as well as a more accurate discrimination of species and varieties, and a knowledge of the conditions which influence the transition of one to the other, before any satisfactory theory can be established. Whether the term "species" used by naturalists to denote distinct assemblages of animals and plants which have certain characters in common, has indeed any foundation in nature, is another question; but it is extremely difficult, if not impossible, to say, with any degree of certainty, what modification of form (to an extent which we should now consider amounts to specific distinction) may have taken place in any race of animals, and particularly in the Invertebrata, during the lapse of so many thousands or myriads of years as have been assigned to the tertiary period. We know the great change which is continually occurring in the form of recent species caused by a difference of station or habitat, food, and many other conditions, and to which we give the name of "variety." How far then is it right to pronounce, without doubt or hesitation, that any of the tertiary species differ from living analogues; taking into account not only the gradual modification of form which I have before adverted to as probable, but also the absence of numerous links both in fossil and recent species? I am however satisfied that the proposed distribution of the European Mollusca into any definite provinces or regions is not warranted by a mature consideration of those geological and conchological data which we at present possess.

It is by no means certain that any definite provinces or regions originally had any existence. We know that some species of shell-fish are what is termed "cosmopolite," and are found in every part of the world at various depths of the sea. The most familiar instance that occurs to me is *Saxicava rugosa*, which, according to Sir Charles Lyell (Principles of Geology, p. 650), "is spread over all the North Polar seas, and ranges in one direction through Europe to Senegal, occurring on both sides of the Atlantic; while in another it finds its way into the North Pacific, and thence to the Indian Ocean. Nor do its migrations cease till it reaches the Australian seas." This species of shell-fish is found in the sublittoral and laminarian zones (between low-water mark and fifteen fathoms, or thereabouts), *but never in deep water*, on the coast, perforating submarine limestone rocks. Now, although the fry of the Saxicava is undoubtedly free during the short period of its first stage, before the shell is developed and its boring powers brought into action, and it can therefore be wafted some distance, I am not aware that any marine current or stream sets from one side of the Atlantic to the other, nor that there exists any intermediate station, fitted for the reception and habitat of the animal, where it could settle and propagate a succession of emigrants to continue the route. Even at the greatest rate assigned by Sir Charles Lyell to oceanic currents (three miles per hour), it would take thirty or forty days for the fry of a Saxicava to traverse the Atlantic; and it is not reasonable to suppose that the development of the animal would be postponed for such an extraordinary period, or its vitality suspended, for the purpose of its migration,—to say nothing of the innumerable obstacles that would occur in its passage, from cross currents, being snapped up by other animals for food, or a subsidence into some deeper part of the sea or abyss from which it could not extricate itself. It seems to me more probable that the species in question was at its first creation diffused over the whole of the ocean, and that the area of its habitability was afterwards limited by some accidental circumstance, such as a deposit of mud, which choked and exterminated the animal in the intermediate districts. Something like this I have noticed on the coast of South Wales, in the case of a once extensive colony of *Pholas dactylus* having become extinct within the memory of living man, in consequence of the bed of peat which they had inhabited having silted up and been covered with sand and mud by the action of the tides. Changes of climate, and many other conditions on which the habitability of such animals depends, may have contributed to confine the original area for other species within narrower limits; and it is therefore not necessary to resort to the theory of migration, or diffusion of species from one province to another, in order to account for their present distribution.

Mr. Searles Wood, in his account of a British Crag shell (*Pyrula reticulata*), which he considers to be identical with a species now inhabiting the Indian Ocean, is of opinion that certain shell-fish which formerly lived together, but are now found to inhabit different climates, have since retired or migrated into those parts of the world, the one north and the other south, where the temperature of both is very different from that which must have been favourable to their existence at the period anterior to the formation of the Coralline Crag, and that they have therefore in some degree changed their nature in assimilating such extremes to their present existence; and he assumes that their dispersion was effected by oceanic currents in opposite directions. He, in fact, attributes the changes which have taken place in geographical distribution, not to any alteration in the temperature, but to an alteration in the habits of the animals themselves, caused by gradual migration. But I cannot help recalling to my mind the apophthegm of the old poet, which appears applicable as well to the nature of inferior animals as to that of mankind: "Cœlum, non animum, mutant qui trans mare currunt." I consider it to be far more likely that a uniform temperature once prevailed, accompanied by a general diffusion of all animals over the whole world; and that owing to successive changes of temperature, induced by the formation or elevation of land in some parts and its submersion under the sea or depression in others, certain species became extinct, or survived, as the climates became colder or warmer in different parts of the globe. Many species (as *Dentalium dentalis*) occur in the tertiary strata of Great Britain, which, apparently, have ceased to live in our seas, although they still inhabit the Mediterranean; and others (as *Mya truncata*) are recorded by Philippi as occurring in the same formation in Sicily, which in like manner have apparently ceased to exist in the Mediterranean, although they still inhabit the British and North Atlantic seas. In each of these cases, the species are conspicuous and abundant in their respective localities. The upper and lower tertiary formations, both in Great Britain and Sicily, as well as in the Subapennine district, contain also many species which now inhabit only arctic or tropical climates; and they are found associated with other species which now live in the British and Mediterranean seas. Besides the *vast* extent of coast and ground in these seas, which has never yet been explored by naturalists, as well as of the tertiary strata in Italy and the North of Europe (where a few scratchings here and there, rather than a systematic examination of their contents, are all that appears to have been hitherto attempted), it must not be forgotten that the whole of the North Atlantic and Mediterranean seas, together with the area of dry land in which the tertiary formations in Europe have been traced, form after all but a small portion of our globe.

The above remarks must be understood to apply rather to the extent and mode of geographical distribution than to the existence of special faunas. I do not deny that certain species may, and probably do, occur only in limited areas. The question as to the distribution of land animals and plants seems to me to involve other considerations than those which refer to marine animals, namely the influence of climate and winds, as well as (in the case of plants) the dormant vitality of seeds.

Too much care cannot be taken in the formation of materials for extending our knowledge of geographical distribution. The most accurate discrimination of species and varieties is indispensable; as well as the collection of specimens *ab ovo,* and from as many localities as possible. The young of the acephalous Mollusks, or Bivalves, always exhibit, after undergoing their metamorphosis, the peculiar character of the species to which they belong; but in the Gasteropoda, or Univalves, the case is often different, owing to the first whorls of their shell being (as in the Cowries) covered by the mantle of the animal, and the consequent deposition of shelly matter, so as to conceal the spire, the truncation or decollation of those whorls (as in *Cæcum*), or the altered position of the branchial opening and subsequent loss of the spire, as in *Fissurella*.

The present distribution and existence of the same species of marine Testacea, in many and widely separated parts of the globe, may be in some measure accounted for by the equable temperature which is usually maintained in the sea, independent of climate, and by the want of solar influence beyond a limited depth; water being, as is well known, one of the worst conductors of heat. Admiral Smyth states that there is a sensible diminution between the surface-temperature and that obtained at great depths in the Mediterranean, and which he roundly estimates at 1° for every twenty fathoms in depth, except where the agency of submarine currents may be at work, but that below 180 fathoms to the greatest depths which he had explored, the temperature varied but little from 42° or 43° of the Fahrenheit scale; and he adds, that a comparison of his eight-fathom observations on the mean temperature of that sea, led him to consider that the Mediterranean waters average about 3° 5′ of Fahrenheit more heat than that of the western part of the Atlantic Ocean.

The greatest specific variation between the British Testacea and those of the Mediterranean occurs, as might have been expected from the difference of latitude and temperature, in the denizens of the littoral and laminarian zones; particularly in the genera *Mytilus, Chiton, Patella, Trochus, Buccinum, Fusus,* and *Murex*. In each of those zones certain species seem to be represented by their analogues; as *Mytilus edulis, Chiton cinereus, Patella vulgata, Trochus lineatus, Buccinum undatum* and *Fusus Islandicus* of our own coasts are respectively replaced in the Mediterranean by *Mytilus minimus, Chiton Siculus, Patella scutellaris, Trochus fragarioides, Murex trunculus* and *Fusus corneus*.

It is remarkable that examples of the same species from the Mediterranean are smaller than those found in the British seas. *Tellina balaustina, Jeffreysia diaphana* and *Rissoa pulcherrima* are instances of this.

A much greater range of variation is found to exist in land than in marine animals, owing to the more uniform temperature of the sea and its coasts. According to Mr. MacAndrew, each of the islands which form the groups of the Canaries, Madeiras, and Azores, possesses some species peculiar to itself; and every British conchologist is aware of the very limited habitat which some land and freshwater shells, as *Helix Pisana, Assiminia*

Grayana, Limneus involutus, and others, have in our own country, and how local and apparently capricious appears to be the distribution of many species.

The speculation as to the successive and recent creation of species appears to me very questionable, and more abstruse than that of geographical distribution; because we do not know the extent of modification to which species originally created have been subject, nor whether all existing species, or the remains of former species, have been either discovered or destroyed. Humboldt has characterized this subject as one of the mysteries which natural science cannot reach.

Although considerable pains have of late years been taken to reconcile the labours of British and Continental naturalists, much yet remains to be done. The former want of intercourse between naturalists of our own and other countries, arising from continual warfare, national jealousies, and the difficulties of travelling and communication, has unfortunately caused great confusion in the nomenclature of science; and no pains ought to be spared in removing it as much as possible, giving due credit to authors of every nation according to the priority of publication. To give some idea of the multiplicity of names which have been given by different authors to the same species of Testacea, I may mention that for our common cockle (the *Cardium edule* of Linnæus) and its varieties, no less than sixteen, and for our oyster fourteen different names have been assigned by British, French, Italian, and German conchologists; and for another shell (*Bullæa scabra* of Müller), six generic and seven specific names have been given by British, Danish, Norwegian, Italian, and American writers!

The opportunities which have thus occurred to me of a careful examination and comparison of an extensive series of Mediterranean species, and especially those of the more difficult genera (such as *Rissoa* and *Odostomia*), have led me to form what I believe to be more just conclusions with respect to the same species in Great Britain; and the result will be shown in the subjoined list. That list contains all the species which I found on the Piedmontese coast, as well as some which I observed in M. Verany's collection from Nice and Genoa. I have added a few remarks as to some of these, and the descriptions of ten new species. The names of recorded species are those of Philippi and the authors of the 'British Mollusca,' except in a very few cases where it appeared to me necessary to adopt or notice those given by earlier discoverers. Those species which were not found by myself, but were communicated by M. Verany, or noticed by me in his collection, are distinguished by italics. I had no means at the time of making out the synonymy for the latter species, and I therefore give the names chiefly on his authority. I have adopted the arrangement of the 'British Mollusca,' as preferable to that of Philippi, who used Lamarck's system. The accompanying plate contains figures, from Mr. James de Carle Sowerby's well-known and accurate pencil, of my new species, and of *Bulla ovulata*, which was indifferently figured by Brocchi. I have not thought it necessary to particularize the localities, except in a few instances of rare or peculiar species.

Any attempt to tabulate, with precision, the per-centage or proportion of Mediterranean species, in comparison with those of Great Britain, would be unsatisfactory, as it must necessarily fluctuate with the continual discovery of new species. The general (although confessedly imperfect) result at which I have arrived from my own investigation and reference to other lists is, that out of about 500 species of British marine Testacea, one half are identical with those of the Mediterranean, and that we possess consequently about 250 species which have not yet been described or indicated as Mediterranean. The species of Mediterranean Testacea probably number 850, out of which about 600 have not yet been described or noticed as British.

The works which I have consulted in the preparation of this memoir, and especially with regard to the question of geographical distribution, are,—Brocchi's 'Conchiologia Fossile Subapennina,' Philippi's 'Fauna Molluscorum utriusque Siciliæ,' Forbes and Hanley's 'British Mollusca,' Smith's 'Mediterranean,' Searles Wood's 'Crag Mollusca' in the Palæontographical Society's publications, Lyell's 'Principles of Geology' (ninth edition), Maury's 'Physical Geography of the Sea,' Hooker and Thompson's 'Flora Indica,' Risso's 'Fauna of Southern Europe,' Payraudeau's 'Mollusca of Corsica,' D'Orbigny's Contribution to Barker-Webb and Berthelot's 'Natural History of the Canaries,' Professor Edward Forbes's Reports to the British Association, and Mr. MacAndrew's Pamphlet on the Geographical Distribution of the Testaceous Mollusca in the North Atlantic and neighbouring seas (1854), besides many other scattered contributions to natural history.

Acephala Lamellibranchiata, or Bivalves.

Septaria Mediterranea, Lam. Nice.
Teredina personata, Lam. Nice!
Teredo navalis, in ships' bottoms. Nice.
Saxicava Arctica, *Phil. & Brit. Moll.*
Venerupis Irus, *Ph. & B. M.*
Corbula nucleus, *Ph. & B. M.*—C. rosea (*Brown*, 1827), *B. M.* (C. Mediterranea, *Costa*, 1829, *Ph.*). Besides the localities indicated

on my authority in the 'British Mollusca,' I have taken this species on the west coast of Scotland in an immature state; and the Mediterranean specimens confirm my idea of its distinctness, and identity with Costa's species

Sphænia Binghami, *B. M.*

Neæra costellata, *B. M.* (non Corbula costellata, *Ph.*).—N. cuspidata, *B. M.* (Corbula cuspidata, *Ph.*).

Pandora obtusa, *Ph. & B. M.*

Thracia phaseolina, *Ph. & B. M.*

Solen siliqua, *Ph. & B. M.*

Solenomya Mediterranea, Ph.

Solecurtus strigilatus, Ph.—S. candidus, *Ph. & B. M.*—S. coarctatus, *B. M.* (Solen coarctatus, *Ph.*).

Diodonta fragilis, B. M. (*Tellina fragilis*, Ph., *Petricola ochroleuca*, Lam.).

Tellina balaustina, Ph. & B. M.—T. pulchella, *Ph.*—T. donacina and varieties, *Ph. & B. M.*—T. serrata, *Ph.*—T. incarnata, *B. M.* (T. planata, *Ph.*).—T. Costæ, *Ph.*—*T. fabula*, Ph. & B. M.—*T. tenuis*, Ph. & B. M.

Syndosmya alba, *B. M.* (Erycina Renieri, *Ph.*); var. (Er. similis, *Ph.*).—S. prismatica, *B. M.* (Er. angulosa, *Ph.*).

Scrobicularia piperata, Ph. & B. M.—*S. Cottardi*, Ph.

Donax anatinus, *B. M.* (D. semistriatus, *Ph.*).—D. trunculus, *Ph. & B. M.*

Mesodesma Donacilla, Ph.

Mactra inflata, *Ph.*—*M. stultorum* and *var. cinerea*, Ph. & B. M. —*M. subtruncata*, B. M. (*M. triangula*, Ph.).

Tapes aurea, *B. M.* (Venus aurea, *Ph.*).—T. læta (Venus læta, *Ph.*) and variety.—T. decussata, *B. M.* (V. decussata, *Ph.*).—T. pullastra, *B. M.*, and var. (Venus geographica, *Ph.*).—T. virginea, *B. M.* (V. Beudanti, *Ph.*).

Cytherea Chione, Ph. & B. M.—C. Venetiana, *Ph.*

Venus casina, *Ph. & B. M.*—V. ovata, *B. M.* (V. radiata, *Ph.*).—V. striatula, *B. M.*; and variety (V. gallina, *Ph.*).—V. verrucosa, *Ph. & B. M.*

Artemis exoleta, *B. M.* (Cyth. exoleta, *Ph.*).—A. lincta, *B. M.* (C. lincta, *Ph.*).

Lucinopsis undata, *B. M.* (Venus undata, *Ph.*).

Circe minima, B. M. (*Cyth. apicalis*, Ph.).

Astarte triangularis, *B. M.* (A. lævigata, *Ph.*).

Isocardia Cor, Ph. & B. M.

Cardium aculeatum, *Ph. & B. M.*; young (C. ciliare, *Ph.*).—*C. echinatum*, Ph. & B. M.; *young* (*C. Deshayesii*, Ph.).—*C. erinaceum*, Ph.—C. tuberculatum, *Ph.*—C. edule, *B. M.*, var. (C. rusticum, *Ph.*).—C. pygmæum, *B. M.* (C. exiguum, *Ph.*). Although there can be no doubt of the identity of these two species, it is rather singular that Philippi does not notice the interstitial punctures, but merely says, "interstitia leviter transversim striata."—C. minimum, *Ph.* (C. Suecicum, *B. M.*). Philippi's name has the decided priority and is more appropriate than the local name of Lovèn.—C. papillosum, (*Poli*) *Ph.* (C. nodosum, (*Turton*) *B. M.*). Poli's name has much the priority of Turton's. The Mediterranean specimens are coloured, but appear to differ in no other respect from our own.—C. punctatum; (and variety (C. scabrum), *Ph.*).—C. fasciatum, *B. M.* (C. parvum, *Ph.*).—*C. Norvegicum*, B. M. (*C. sulcatum*, Ph.).

Cardita sulcata, *Ph.*—*C. aculeata*, Ph.—C. trapezia, *Ph.*—C. calyculata, *Ph.*

Lucina Pecten, *Ph.*—L. radula, *Ph.* (L. Borealis, *B. M.*).—L. flexuosa, *B. M.* (Ptychina biplicata, *Ph.*).—L. leucoma, *B. M.* (L. lactea, *Ph.*).—L. spinifera, *Ph. & B. M.*

Montacuta bidentata, *B. M.*

Turtonia minuta, *B. M.*

Kellia suborbicularis, *B. M.* (Bornia inflata, *Ph.*).—K. nitida, *B. M.*—K. rubra, *B. M.* (B. seminulum, *Ph.*).

Galeomma Turtoni, *Ph. & B. M.*

Chama Gryphoides, *Ph.*

Mytilus Gallo-provincialis, Ph. Nice: on ships' bottoms only.—M. minimus, *Ph.*

Modiola barbata, *Ph. & B. M.*—M. tulipa, *Ph. & B. M.*—M. lithophaga, *Ph.* (Lithodomus lithophagus, *Lam.*).

Crenella marmorata, *B. M.* (Mod. discrepans, *Ph.*).—C. discors, *B. M.*—C. costulata, *B. M.* (Mod. costulata, *Ph.*).

Nucula nucleus, *B. M.* (N. margaritacea, *Ph.*).—N. nitida, *B. M.* —*N. radiata*, B. M. Nice.—N. decussata, *B. M.* (N. Polii et sulcata, *Ph.*).

Leda (Nucula) emarginata, *Ph.*—L. (Nucula) minuta, *Ph.*

Pectunculus pilosus, Ph. & B. M., *and varieties.*—*P. violascens*, Ph.

Arca Noæ, *Ph.*—*A. tetragona*, B. M. (*A. navicularis*, Ph.).—A. barbata, *Ph. & B. M.*—A. diluvii, *Ph.*—A. lactea, *Ph. & B. M.*

Avicula Tarentina, Ph. & B. M.

Pinna pectinata, Ph. & B. M., *and variety* (*P. ingens*, auct.).—*P. muricata*, Ph.

Lima inflata, *Ph.*—L. squamosa, *Ph.*

Pecten varius, *Ph. & B. M.*—P. pusio, *Ph. & B. M.*—*P. Testæ*, Ph.—P. polymorphus, *Ph.*—*P. Danicus*, B. M. (*P. adspersus*, Ph.).—P. hyalinus, *Ph.*, and variety.—*P. maximus*, Ph. & B. M.—P. Jacobæus, *Ph.*—P. opercularis, *Ph. & B. M.*—P. sulcatus, *Ph.*

Spondylus Gæderopus, *Ph.*

Ostrea plicatula, *Ph.*—O. cristata, *Ph.* Whether this is a variety of O. edulis, it is rather difficult to say, as the latter species is subject to great variation. I certainly never met with the common form of our oyster (whether "native," "Welsh," or "rock") in the Mediterranean, nor is it mentioned by Philippi or Payraudeau as a recent species. The kinds now found in that sea are solitary, and not gregarious. It is well known that the Romans got their principal supply from Britain, although the Circeian oyster ranked as a delicacy with sea-eggs from Misenum and with broad scallops, the boast of luxurious Tarentum.

Anomia Ephippium, *Ph. & B. M.*, and varieties (A. polymorpha and margaritacea, *Ph.*).—A. Patelliformis, *B. M.* (A. scabrella and elegans, *Ph.*).

Acephala Palliobranchiata, or Brachiopods.

Terebratula caput-serpentis. Villa Franca.

Argiope (Orthis) truncata, *Ph.*—A. (Orthis) Neapolitana, *Scacchi* (Orthis seminulum, *Ph.*, Megathyris cistellula, *Searles Wood*). A careful comparison of Mediterranean specimens with those from Zetland of this variable species, confirms my former opinion of its identity with the Argiope (Megathyris) cistellula of the 'British Mollusca.' It would be desirable if Philippi's name of seminulum could be retained, instead of the prior but less appropriate name given by Scacchi.

Pteropoda.

Hyalæa vaginella, *Ph.*

Spirialis Australis, Eydoux & Souleyet.—*S. Trochiformis*, Eyd. & Soul. (S. Flemingii, *B. M.*).—*S. rostralis*, Eyd. & Soul. (S. Macandrei, *B. M.*).—S. Jeffreysii, *B. M.* Spezia, where only a single specimen, however, occurred to me.

Heteropoda.

Carinaria Mediterranea. Nice.

Gasteropoda Prosobranchiata.

Chiton fascicularis, *Ph. & B. M.*—C. Siculus, *Ph.*—C. Cajetanus, *Ph.*—C. variegatus, *Ph.*—C. Hanleyi, *B. M.*—C. Polii, *Ph.*

Patella scutellaris, *Ph.*—P. fragilis, *Ph.*—P. Tarentina, *Ph.* (P. athletica, *B. M.*).—P. Lusitanica, *Ph.* I did not meet with any of the usual forms of P. vulgata ; and Philippi only mentions it doubtfully as fossil. It is however a very variable species, and may be identical with P. cærulea of Lamarck (not of Linnæus), or some other of the allied species which are described by Philippi.

Acmæa virginea, *B. M.* (Patella Gussonii, *Ph.*).

Dentalium dentalis, *Ph.*; and var. semicostata.—D. novemcostatum, *Payr.* (D. dentalis, var. β, *Ph.*). Specimens of the last, which I took at Spezia, have ten ribs and no intermediate smaller ones, but numerous fine longitudinal striæ. The extremity or apex in my largest specimen is truncated, but apparently not by an accidental fracture. Colour the same as in D. dentalis, but the size is larger.

Pileopsis Hungaricus, *B. M.* (P. ungarica, *Ph.*).

Gadinia Garnoti, *Ph.*

Calyptræa Sinensis, *B. M.* (C. vulgaris, *Ph.*) ; var. gibba ; and var. fulva.

Crepidula unguiformis, *Ph.*

Fissurella Græca, *Ph.* Not the F. Græca of most British authors, which is F. reticulata of *B. M.*—F. costaria, *Ph.*—F. gibba, *Ph.*

Emarginula elongata, *Ph.*—*E. cancellata*, Ph.

Scissurella. I cannot help thinking the position assigned to this genus by its founder, D'Orbigny, is correct, and not between Adeorbis and Ianthina as proposed by the authors of the 'British Mollusca.' S. elegans, *D'Orb.* (S. striatula, *Ph.*) and var. This species is very variable in form and sculpture, the longitudinal ribs being more or less distinct and partial, and the apex more or less flattened or convex; but the fine transverse striæ are always observable under a lens magnifying four or five diameters. It has *not* an operculum; but I unfortunately had no microscope with me to examine the animal. I found it plentifully alive in sea-weed at Spezia and Lerici.

Scissurella cancellata, n. s. Pl. II. f. 1.

Testa orbiculato-depressa, alba, nitidiuscula; anfractibus 3, rotundis, ultimo costis curvis circa 20 elevatis longitudinalibus, carina fissurali interruptis, costellisque totidem transversis decussato; vertice planato, carina lata acuta subincrassata canaliculata circumdato, costis radiatim cincto; canali transversim et arcuatim striato; apertura suborbiculari; umbilico angusto; latitudine $\frac{1}{20}$, longitudine $\frac{1}{30}$ unciæ.

Although I only found a single specimen (at Sestri di Levante), it is so different from any of the species hitherto described, that I cannot help noticing it. Philippi has described and figured three species; but the only one this approaches in form (his S. plicata, which is the S. costata of D'Orbigny) he says has no transverse striæ, "striis transversis *nullis*." It agrees with S. Bertheloti of D'Orbigny (Webb and Berthelot) in the sharp keel which projects considerably beyond the last whorl; but the ribs in that species are much more numerous, and it also wants the transverse striæ. It differs from S. striatula of Philippi in the stronger, fewer and more distant ribs, both longitudinal and transverse, as well as in the flattened spire and strong keel. This is also twice the size of either of Philippi's species.

Haliotis lamellosa, *Lam.* Palmaria I.—*H. tuberculata,* Ph. & B. M. *Trochus granulatus,* Ph. & B. M.—T. zizyphinus, *B. M.*—T. conulus, *Ph. & B. M.*; and var. β. dilatata of Philippi, who refers it to T. ziziphinus. This last resembles closely the smooth variety of our species; and the difference of colour (on which the authors of the 'British Mollusca' lay stress), as well as the smaller size of the Mediterranean specimens, scarcely, I think, warrant a specific distinction; var. (T. violaceus, *Risso*).—*T. dubius,* Ph. (T. conulus, var. ?).—T. exiguus, *B. M.* (T. crenulatus, *Ph.*); and var. T. striatus, *Ph. & B. M.*—T. fragarioides, *Ph.*—*T. articulatus,* Ph. (*T. fragarioides, var.* ?).—*T. Laugieri,* Ph.—T. divaricatus, *Ph.*; var. lævis; and var. minor.—*T. sanguineus,* Ph.—T. Adansonii, *Ph.*—T. magus, *Ph. & B. M.*—*T. canaliculatus,* Ph. Nice—T. varius, *Ph.*—T. Richardi, *Ph.*—T. umbilicaris, *Ph.*—T. leucophæus, *Ph.*; var.; and monstr.—T. tumidus, *B. M.* (T. Racketti, *Ph.*).

Trochus zonatus, n. s. Pl. II. f. 2, 3.

Testa orbicularis, compresso-conoidea, tenuis, viridescenti-alba, zonis nigris strigisque obliquis rubris ad suturam anfractuum maculatis pulchre notata; anfractibus 4, convexiusculis, nitidis, sulcis spiralibus latis (in ultimo anfractu utrinque 6, in penultimo 3) excavatis et interstitiis confertim concentrice striolatis; sutura distincta; apertura rotundo-rhomboidea, ad marginem exteriorem vix angulata; umbilico profundo, aperto; long. $\frac{1}{20}$, lat. $\frac{1}{30}$ unciæ.

Sestri di Levante and Spezia, at the roots of sea-weed in the littoral zone; not common.

Although this pretty little shell has relations with Trochus umbilicaris in its young state, it may be readily distinguished by the greater convexity of the whorls and the almost total want of any angularity or keel on the last volution. The young of this species closely resembles a Skenea, and it appears to form a passage to this genus.

Monodonta corallina, *Ph.*—M. Vieilloti, *Ph.*—M. glomus, *Ph.*—*M. Jussieui,* Ph.

Turbo rugosus, *Ph.*

Phasianella pullus, *Ph. & B. M.*—P. intermedia, *Ph.* I found the last species in greater plenty than P. pullus, but in the same locality. The spire is longer and the suture deeper, and the markings are very peculiar and unmistakeable, as Philippi also remarked. The fry resembles a Lacuna in form, and has the last whorl and umbilical rea spirally striated.—P. speciosa, *Ph.*; and var.

Adeorbis subcarinata, B. M. (*Natica? subcarinata,* Ph.). Nice.

Ianthina communis, B. M. (*I. bicolor,* Ph.).—*I. pallida,* B. M. (I. patula, *Ph.*).

Littorina Neritoides, *B. M.* (Turbo Neritoides, *Ph.*).

Rissoa lactea, *Ph. & B. M.*—*R. labiata,* Ph., allied to, if not identical with, R. striatula, *B. M.*—R. crenulata, *Ph. & B. M.*; and var. minor.—R. cimex, *Linn.* (R. calathiscus, *Ph.*); and var. alba.—R. calathus, *B. M.* (R. cimex, *Ph.*).—R. Montagui, *Ph.*; var. lineolata; and var. minor.—R. scabra, *Ph.* An analogue of R. punctura, *B. M.*, which it somewhat resembles. In fresh specimens the spiral cingula are of a fulvous colour, as in R. Montagui, var. lineolata.—R. Beanii, *B. M.* It seems surprising that this common and widely diffused species should not have been known to Philippi, although I suspect his R. textilis is the younger state of it before the outer lip and rib are formed.

Rissoa Philippiana, n. s. Pl. II. f. 4, 5.

Testa clavata, turrita, fusca, solidula; anfractibus 6 planatis, in medio subcarinatis, costellis longitudinalibus (in ultimo anfractu 12) cingulisque transversis (in ultimo anfractu 5) instructis, cingulis duobus superioribus tuberculos efformantibus; sutura profunda; apertura subrotunda, marginata, subeffusa, tertiam spiræ partem æquante; umbilico nullo; long. $\frac{1}{12}$, lat. $\frac{1}{20}$ unciæ.

This may possibly be the variety of R. dictyophora, which Philippi referred to in these words, "variat cingulis transversis in carinas acutas elevatis;" but it does not correspond with his description and figure of the typical species. In the last and penultimate whorls there are two rows, and in the preceding whorl one row of tubercles.

Foci, near Genoa, on sea-weed in the littoral zone; not common. Nice, Verany.

Rissoa costata, *B. M.* (R. exigua, *Ph.*).

Rissoa contorta, n. s. Pl. II. f. 6, 7.

Testa brevi-cylindrica, ad apicem obtusa, lutea aut alba, solidula; anfractibus 4, ventricosis, sensim crescentibus, lævibus, nitidis, zonis duabus fulvis cinctis; sutura profunda; apertura subrotunda, subeffusa, tertiam spiræ partem superante, margine connexo, soluto; umbilico angusto; long. $\frac{1}{20}$, lat. $\frac{1}{30}$ unciæ.

Genoa, Foci, Sestri di Levante and Spezia, on sea-weed in the littoral zone; common. Nice, Verany.

This elegant species appears to be the representative of our Rissoa striata; but it has a different habitat, the latter being found under stones and at the roots of Corallina officinalis in the sublittoral zone.

Rissoa glabrata, *Ph.*; and var. alba; (R. punctulum, *Ph.*, Moll. Sic. vol. i. p. 154). Not the species referred to with doubt by the authors of the 'British Mollusca' under the name of Odostomia glabrata, but allied to R. vitrea, from which it differs in the greater solidity of the shell, its more obtuse whorls, and more contracted aperture which is strengthened by an outer rib. It varies considerably in size. I found it in abundance on all the coast, and noticed it in M. Verany's collection from Nice.—R. vitrea, *B. M.*—R. proxima, *B. M.*—R. inconspicua, *B. M.* (R. rudis, *Ph.*); var. *a.* albula, *B. M.* (R. nana, *Ph.*); var. *c*, *B. M.* (R. radiata, *Ph.*); var. *d*, *B. M.*; var. (R. granulum, *Ph.*).—R. semistriata, *B. M.* (R. subsulcata, *Ph.*).—R. pulcherrima, *B. M.* Some older and more produced specimens agree better with Philippi's description and figures of R. soluta than the species described under that name in the 'British Mollusca,' but they want the peculiar markings of R. pulcherrima.—R. fulgida, *B. M.*—R. parva, *B. M.* It is remarkable that Philippi did not notice the typical form, and that the other and more common form (interrupta) did not occur to me among so many thousands of Mediterranean Rissoæ.—*R. simplex*, Ph.; probably a variety of the last; var. (R. pulchella, *Ph.*): this has some analogy with R. inconspicua in respect of markings, but differs in the form of the spire and apex.—R. violacea, *Ph.*—R. ventricosa, *Ph.* (R. rufilabrum, *B. M.*).—R. oblonga, *Ph.* (R. costulata, *B. M.*); var. (R. similis, *Ph.*); and var. minor.—R. variabilis, v. Mühlfeld (R. costata, *Ph.*). The name of costata given to this species by Desmarest must be relinquished, as it was long previously used by Adams for the R. exigua of Michaud; var.: this somewhat resembles R. labiosa in form, but the texture, colour and markings are different.—R. labiosa, *B. M.* (R. elata, *Ph.*).—R. auriscalpium, *Ph.*—R. monodonta, *Ph.*—R. thermalis, (*Linn.*) *Ph.*; var. minor (R.

ulvæ, *B. M.*).—R. cingillus, *B. M.*—R. rubra, *B. M.* (R. fulva, *Ph.*); var. unifasciata.—R.? littorea, *B. M.* (Truncatella littorina, *Ph.*).

Rissoina Bruguieri, *D'Orb.* (Rissoa Bruguieri, *Ph.*), *R. decussata.* Nice.—*R. Chesnelii*, Mich. Nice.—*R. marginata*, Mich. Nice.

Jeffreysia diaphana, *B. M.*

Jeffreysia cylindrica, n. s. Pl. II. f. 8, 9.

Testa longo-cylindrica, ad apicem obtusa, hyalina; anfractibus 4, brevissimis, nitidis, ultimo reliquos superante; sutura distincta; apertura ovata, subeffusa, $\frac{2}{3}$ spiræ partem æquante, margine subconnexo; umbilico angusto; long. $\frac{1}{30}$, lat. $\frac{1}{50}$ unciæ.

Of this very minute but peculiar species I took only one specimen, by dredging in about 12 fathoms at Spezia. It approaches somewhat in form the Chemnitzia Gulsonæ of Clark, which I think ought to be referred to the same genus.

Skenea planorbis, *B. M.* The Mediterranean specimens, like those from Guernsey, are girdled with a single row of circular reddish-brown spots.—S. nitidissima, *B. M.* (Truncatella atomus, *Ph.*).—S. rota, *B. M.* Mediterranean specimens are girdled with three bands of reddish-brown, one on the outer edge or periphery, and the others on the upper and under side of each whorl; which, with the striæ, render them exquisitely beautiful objects.—*S. exilissima* (Delphinula exilissima, *Ph.*).

Turritella communis, *Ph.* & *B. M.*—T. triplicata, *Ph.*

Turritella? pusilla, n. s. Pl. II. f. 10, 11.

Testa turrita, lutea vel fusca, solidula; anfractibus 12, convexiusculis, interdum varicosis, plicis 8 longitudinalibus (quarum 3 mediæ prominentiores) costellisque transversis (in ultimo anfractu 8, in penultimo 5) decussatis, in superioribus anfractibus nodulis efformatis; sutura profunda; apertura ovato-rhomboidea, subeffusa, sextam spiræ partem æquante; long $\frac{1}{5}$, lat. $\frac{1}{18}$ unciæ.

In about twelve fathoms, Gulf of Spezia; not common. It has somewhat the habit of a Cerithium, but differs in its shorter spire, and, above all, in the form of its aperture.

Cæcum trachea, *B. M.* (Odontidium rugulosum, *Ph.*).—C. glabrum, *B. M.*

Aporrhais pes-pelicani, *B. M.* (Chenopus pes-pelicani, *Ph.*).—*A. desciscens* (Chen. desciscens, *Ph.*).

Cerithium vulgatum, *Ph.*—C. fuscatum, *Ph.*; var. minor.—*C. mammillatum* Ph.—C. reticulatum, *B. M.* (C. lima, *Ph.*); var. major; var. β. *Ph.*—C. angustissimum, *Forbes* (Report on Ægean Invertebrata, 1843).—C. adversum, *B. M.* (C. perversum, *Ph.*).

Scalaria communis, *Ph.* & *B. M.*—S. Turtonis (S. tenuicosta, *Ph.*).—*S. pseudoscalaris*, Ph.—*S. pulchella*, Ph.

Vermetus semisurrectus, *Ph.*—V. subcancellatus, *Ph.*—*V. gigas*, Ph.—*V. glomeratus*, Ph.

Siliquaria anguina, Ph. Nice.

Eulima polita, *Ph. & B. M.* —E. nitida, *Ph.* (E. polita, var. *B. M.*). —E. distorta, *Ph. & B. M.*—E. subulata, *Ph. & B. M.*

Chemnitzia. For the sake of more convenient arrangement (this genus being otherwise perhaps too extensive), I have adopted the views of my late friend Professor Forbes, in separating this genus and Eulimella from Odostomia; although the transition from one of those so-called genera to either of the others is gradual and almost imperceptible. Adult and perfect specimens have occasionally the columellar tooth or fold. I have detected it even in C. elegantissima or lactea, as well as in C. gracilis, indistincta, and fenestrata. C. elegantissima, *Ph. & B. M.*; var. costis flexuosis et dente columellari.—C. pusilla, *Ph. & B. M.*—C. gracilis, *Ph.*: this species is very distinct in form and the want of angularity in the whorls from the preceding, with which the authors of the 'British Mollusca' supposed it to be identical. The difference is as great between these species, as between either of them and C. elegantissima.—C. pallida, *Ph.* (Parthenia varicosa, *Forbes, Æg. Inv.*).—C. rufa, *Ph. & B. M.*—C. scalaris, *Ph. & B. M.*—C. unica (Aclis unica, *B. M.*).—C. fenestrata, *B. M.*—C. indistincta, *B. M.*

Odostomia clathrata, *B. M.* A single specimen of this distinct species occurred to me at Spezia; and I observed another at the British Museum, in Mr. MacAndrew's collection from the Canaries.—O. interstincta, *B. M.* (Rissoa suturalis, *Ph.*); var. angustior.—O. terebellum, *Ph.* The form, disposition of the ribs, and the greater prominence of the tooth, distinguish this from the last species. It is also a British species, having been found both by Mr. Barlee and myself on the Scotch and Devonshire coasts; var. angustior.

Odostomia tricincta, n. s. Pl. II. f. 12, 13.

Testa brevi-fusiformis, lutea, zonis tribus angustis fuscis in ultimo anfractu (2 in penultimo et antepenultimo, 1 in proximo) ornata, solidula; anfractibus 6 (quorum 2 supremi sinistrorsum retorti) ultimo reliquos æquante, complanatis, nitidis, costis circa 20 longitudinalibus subflexuosis interdum bifidis interstitia æquantibus obsitis; sutura distincta; apertura ovato-rhomboidea, ad basin subeffusa, tertiam spiræ partem æquante, columella prope mediam uniplicata, labio reflexo; long. $\frac{1}{10}$, lat. $\frac{1}{23}$ unciæ.

Sestri di Levante, at the roots of Corallina officinalis; not common. Nice, Verany.

I also observed specimens of this prettily marked shell in Mr. MacAndrew's collection from the Canaries at the British Museum. It may possibly be the Rissoa doliolum of Philippi; but he does not notice the coloured bands, nor the fold on the pillar lip, and the number of ribs in his description and figure are fewer.

Odostomia excavata, *B. M.* (Rissoa excavata, *Ph.*).—O. Humboldti (Chemnitzia Humboldti, *Ph.*). Sestri di Levante; and Verany had also found it at Nice.—O. conspicua, *B. M.* My specimens, which were dredged in about 10 fathoms in the Gulf of Spezia, measured three-eighths of an inch in length, and nearly one-sixth in their extreme breadth. A half-grown specimen is in the British Museum, among the shells collected at Lisbon by Mr. MacAndrew; and I before noticed it in the 'Annals' as an Adriatic species.—O. acuta, *B. M.*—O. conoidea, *Ph. & B. M.*—O. unidentata, *B. M.* (Eulima monodon, *Requien?*).—O. Eulimoides, *B. M.*—O. Rissoides, *B. M.*—O. plicata, *B. M.*; var. dente inconspicuo (Rissoa elongata, *Ph.*).—O. obliqua, *B. M.*—O. Warrenii, *B. M.*—O. dolioliformis, *B. M.*

Eulimella clavula, *B. M.*—E. acicula, *B. M.* (Melania acicula, *Ph.*).

Eulimella striatula, n. s. Pl. II. f. 14, 15.

Testa subcylindrica, aciculata, hyalina, limo partim induta; anfractibus 8–9, complanatis, ultimo tertiam spiræ partem subæquante, concentrice confertim rugoso-striatis; sutura distincta, obliqua; apertura oblonga-rhomboidea, supra acutangulata, infra latiore, subtruncata; columella flexuosa; long. $\frac{1}{10}$, lat. $\frac{1}{40}$ unciæ.

I took two live specimens of this very distinct shell by dredging in about 10 fathoms at Spezia. It is more delicate than Eulimella acicula, and has the volutions more flattened, the suture more oblique, and the last whorl and aperture proportionably longer; and it especially differs in having distinct undulating transverse striæ. All the species of Eulimella exhibit under a microscope similar, but very faint, and close-set, striæ. One of the characters assigned to the genus Eulimella by its founder (Professor Edward Forbes) is "solid, smooth, and polished;" so that either this character must be expunged, or the genus merged in Odostomia or Chemnitzia.

Eulimella nitidissima (Aclis nitidissima, *B. M.*).

Truncatella truncatula, *Ph.* (T. Montagui, *B. M.*); var. costellata.

Natica olla, *Ph.*—N. millepunctata, *Ph.*—N. macilenta, *Ph.*; var. immaculata.—*N. nitida*, B. M. (N. Marochiensis, *Ph.*).—*N. monilifera*, B. M. (N. Guillemini, *Ph.*).

Sigaretus haliotoideus, *Ph.*

Velutina lævigata, *B. M.*

Lamellaria perspicua, *B. M.* (Coriocella perspicua, *Ph.*).

Cerithiopsis tubercularis (C. tuberculare, *B. M.*, Cerithium pygmæum, *Ph.*).

Tritonium cutaceum, *Ph.*—*T. nodiferum*, Ph.

Cassis saburon, Ph.—*C. undulata*, Ph.

Cassidaria Tyrrhena, Ph.; *var.* (C. Echinophora, *Lam.*).

Ranella reticularis, *Ph.* (R. gigantea, *Lam.*).

Murex tetrapterus, *Ph.*—M. Brandaris, *Ph.*—M. distinctus, *Ph.*—M. cristatus, *Ph.*; var.—M. Edwardsii, *Ph.*—M. corallinus, *B. M.* (Fusus corallinus, *Ph.*).—M. rudis (F. rudis, *Ph.*).—*M. erinaceus*, Ph. & B. M.—M. trunculus, *Ph.*

Lachesis minima, *B. M.* (Buccinum minimum, *Ph.*); var.—*L. mammillata* (*Nesæa mammillata*, Risso, *Bucc. Folineæ*, Ph.). Nonne præcedentis varietas?

Pollia D'Orbignyi (Buccinum D'Orbignyi, *Ph.*).—P. pusio (Bucc. pusio, *Ph.*).

Nassa reticulata, B. M. (*Buccinum reticulatum*, Ph.); *var.* (*Bucc. prismaticum*, Ph.).—N. variabilis (Bucc. variabile, *Ph.*); varieties δ & ε, *Ph.*—N. incrassata, *B. M.* (Bucc. Ascanias, *Ph.*).—N. pygmæa, *B. M.* (Bucc. asperula, var. *Ph.*); var. sine varicibus mediis.—N. mutabilis (Bucc. mutabile, *Ph.*).—N. Neritea (Bucc. Neriteum, *Ph.*); var. minor.—N. corniculum (Bucc. corniculum, *Ph.*); var. minor, γ. *Ph.* —N. scripta (Bucc. scriptum, *Ph.*); var. β. *Ph.* & var. decollata.

Buccinum minus, *Ph.*

Fusus corneus, *Ph.*—F. craticulatus, *Ph.*—F. Syracusanus, *Ph.*—*F. rostratus*, Ph.

Fasciolaria lignaria, Ph. (F. Tarentina, *Lam.*).

Mangelia reticulata (Pleurotoma reticulatum, *Ph.*).—M. scabra (P. scabrum, *Jeff.* in Ann. Nat. Hist. 1847). The discovery of a Mediterranean specimen with the last, to which it bears a closer affinity than to M. linearis, confirms the impression I formed some years ago that this is a distinct species. It is not, as the authors of the 'British Mollusca' supposed, the southern or purple-tipped form of M. linearis.—M. linearis, *B. M.* (P. lineare, *Ph.*).—M. purpurea, *B. M.* (P. Philberti, *Ph.*); var. minor.—M. gracilis, *B. M.* (P. gracilis, *Ph.*).—M. nebula, *B. M.* (P. Ginannianum, *Ph.*).—M. brachystoma (P. brachystoma, *Ph.*).—M. costata, *B. M.* (P. tæniatum, *Ph.*).—M. rugulosa (P. rugulosum, *Ph.*); var. minor.—M. Vauquelini (P. Vauquelini, *Ph.*).—M. cærulans (P. cærulans, *Ph.*).—M. costulata (P. costulatum, *Ph.*).—Judging from the solitary specimen which I took of this, it is more nearly allied to our Mangelia turricula than to the Pleurotoma striolatum of Scacchi, to which the authors of the 'British Mollusca' considered that it very closely approached.—*M. Leufroyi*, B. M. (P. Leufroyi, *Ph.*).—*M. attenuata*, B. M. (P. attenuatum, *Ph.*).—*M. lævigata* (P. lævigatum, *Ph.*).

Columbella rustica, *Ph.*

Mitra ebenus, *Ph.*—M. lutescens (var. lactea), *Ph.*—M. Savignyi, *Ph.*

Conus Mediterraneus, *Ph.*

Cypræa Europæa, *B. M.* (C. Coccinella, *Ph.*).—*C. pyrum*, Ph. (C. rufa, *Lam.*).—*C. lurida*, Ph.

Ovula carnea, Ph.—*O. spelta*, Ph.

Ringicula auriculata, Ph.

Marginella miliacea, *Ph.*—M. minuta, *Ph.* The number of folds on the pillar lip varies from four to six.—M. clandestina, *Ph.*—*M. secalina*, Ph. Nice.

Gasteropoda Opisthobranchiata.

Tornatella fasciata, *Ph. & B. M.*

Cylichna truncata, *B. M.* (Bulla truncata, *Ph.*).—*C. mammillata*, B. M. (*B. mammillata*, Ph.); var. *B. M.* (truncatula, *Jeffr.* in 'Annals'), spira non exserta. This still appears to me a distinct species. It is common at Spezia in muddy ground from eight to ten fathoms.—C. strigella, *B. M.* Common at Spezia with the last.—*C. umbilicata*, B. M.

Cylichna fragilis, n. s. Pl. II. f. 16, 17.

Testa cylindrica, nitidissima, hyalina, ad apicem constricta et longitudinaliter striatula, aliter lævissima; spira laxe involuta; vertice parum conspicuo, oblique attenuato; apertura superne angusta, infra dilatata, truncata; long. $\frac{1}{15}$, lat. $\frac{1}{30}$ unciæ.

A solitary example of this remarkable shell occurred to me in dredging at Spezia, in about 10 fathoms; and Mr. MacAndrew has also taken it on the coast of Spain. It has somewhat the habit of an Akera.

Akera bullata, B. M. Genoa.

Bulla Hydatis, *Ph. & B. M.*; var. minor et subglobosa; var. β. *Ph.*, minor, viridula et lævissima.—B. ovulata, *Ph.*, Spezia; and I also noticed a specimen in Mr. MacAndrew's collection in the British Museum under the name of "Cylichna strigella." As the only figure which has been published of this species is in a work little known (Brocchi, Conchiologia Fossile Subapennina, 1814), and is not, to my mind, satisfactory, I have added another figure of it (18, 19) to Pl. II.

Scaphander lignarius, B. M. (*Bulla lignaria,* Ph.).

Scaphander gibbulus, n. s. Pl. II. f. 20, 21.

Testa ovata, turgida, nitidissima, hyalina, utrinque striis circiter 10 flexuosis versus extremitates approximantibus concentrice insculpta, in medio lævissima; vertice subtruncato, umbilicato, ad marginem exteriorem incrassato; apertura in medio coarctata, superne angulata patula, subtus canaliculata; columella ad basin uniplicata; long. $\frac{1}{5}$ fere, lat. $\frac{1}{10}$ unciæ.

In from 10 to 12 fathoms, Bay of Spezia; not uncommon. The animal is flesh-coloured.

Philine aperta, *B. M.* (Bullæa aperta, *Ph.*).—*P. catena,* B. M. Nice.

Aplysia depilans, *Ph.* (A. hybrida, *B. M.*).—*A. punctata,* Ph.—*A. depressa,* Cantraine, and other species which have been published in the 'Journal de Conchiliologie' for 1853.

Pleurobranchus aurantiacus, Ph.—*P. stellatus,* Ph., and other species, for which reference must also be had to the last-mentioned publication.

Umbrella Mediterranea, Ph. Nice.

Cephalopoda Dibranchiata, or Cuttles.

Argonauta Argo, Ph.

Sepia officinalis, *Ph. & B. M.*, and other species, which have been so admirably described and figured by Verany in his splendid work.

The total number of species named in the above lists amounts to 375.

XV.—*Notes on the Review of G. R. Gray's "Catalogue of the Genera and Subgenera of Birds" in the December Number of the 'Annals.'* By G. R. Gray, F.L.S. &c.

In a recent notice of my "Catalogue of the Genera and Subgenera of Birds," published in the 'Annals and Magazine of Natural History' for December 1855, a number of objections are stated to some of the minor details of that work, which might lead the reader to suppose that its author had been actuated rather by caprice than by principle in the matters referred to, and would therefore give an erroneous impression of the nature of the work, and of its utility to the ornithological student. With the view of guarding the reader from such an impression, I am desirous of putting him in possession of my reasons for adhering to the principles which, after long and anxious consideration, I had deliberately adopted, and which twenty years' unremitted attention to the subject has only served to strengthen and confirm.

Let me observe, in the first place, that no edition of my work was published in 1844, although that date is given to a previous edition of it by the reviewer in several places. As however he mentions this previous edition as containing "upwards of 1100 distinct types," it is probable that the original edition of 1840, in which that number of generic types is to be found, is the one referred to. The only other edition (the second) previous to the one now noticed, was published in 1841.

Passing over the observations on the multiplication of generic names by the same authors for the same generic types, and on barbarously compounded generic names, with which I have nothing to do but to record them, I come to the first objection taken by the reviewer, in regard to misspelt names. "There seems," he says, "to be no reason whatever why such an error should be retained *in perpetuum*," and adds, that "Mr. Gray appears to hold, that right or wrong we are bound to adopt the spelling originally given by the proposer of the genus, and to allow of no corrections or emendations even of faults due to typographical errors only." This is a strong charge, to which I distinctly plead "Not Guilty." I certainly hold no such opinion, and I am not aware of any statement of mine by which the charge can be supported. It is true that in a work destined to give, in a concise form, the history of each division, I think myself bound to record even the variations in spelling that may have been used by different authors, or by the same author at different times; and when the reviewer asks "what benefit can we derive" from such a record, I answer without hesitation that, for want of this information, naturalists frequently lose much time, and sometimes unavailingly, in their search in indexes and elsewhere for particular names, because the spelling has been varied from that with which they are familiar. In some cases too the etymology may be doubtful, and the proper mode of spelling not easily decided. The introduction of these variations is consequently in my opinion a useful addition to such a work; and it is moreover justified by the example of other authors, both in this country and abroad, who have not thought it desirable to leave them "unnoticed and forgotten."

The reviewer next expresses his "fear that confusion is likely to be caused by the introduction of the French names which Mr. Gray has permitted in some parts of his list." If the objection had been that these names have been introduced too rarely, it would, as it seems to me, have been better founded. No harm can result from their insertion, except the unpleasantness arising from the indication that, in too many instances, those who have done nothing more than apply a Latin name to a division already clearly established under a French one, have thus cheaply obtained the credit of having established that division for themselves. To avoid the necessity of appealing to recent cases, let us pass for a moment from genera to species, and call to mind the natural indignation which has been universally felt and expressed at the wholesale appropriation by Gmelin of hundreds of species of birds established by Latham under English names, but which one of the most ignorant of compilers *conveyed* to himself simply by converting Latham's English into Latin. For this reason, on the plain principle of *suum cuique*, it will be my endeavour to increase rather than to curtail the citations of such names, the Latinization of which, in many cases, requires merely the slightest alteration in the termination to render them much more euphonious than the Greek compounds, which it has been proposed to substitute in their places. Thus the *Picazuros** of M. Lesson have been latinized by M. O. Des Murs under the generic name of *Picazurus*; and I think no one will deny that *Picazurus gymnophthalmus* would be at once a better-sounding denomination than *Crossophthalmus gymnophthalmus*, and more just to the original author of the division.

A modern author of some note was considered to have overcharged a branch of Ornithology "with new and useless denominations," because he gave Greek compounds to those divisions which had previously received French names; while I am accused of causing confusion by simply recording the existence of these previous names.

The next point on which the reviewer thinks the principles which I have adopted "do not work well," has reference to the question "what edition of the 'Systema Naturæ' we ought to begin with,"—a question which he says "has been already discussed in a previous review of a former edition of Mr. Gray's book in this Magazine;" and a note at the bottom of the page refers us to "Mr. Strickland's article in the 'Annals and Magazine' for 1851." The date, however, is widely incorrect, Mr. Strickland's article having been published in January 1842. In that paper the author, after some mistaken remarks on Mœhring, thinks "a strong case" has been "made out for establishing a statute of limitations." "Let naturalists," he continues, "agree once for all, to draw an absolute line at the date of 1760, when the elaborate standard work of Brisson

* This word is wrongly printed in the Catalogue as *Picazores*, an error copied by the reviewer.

appeared, and when the 'binomial method' was first dawning on the mind of the great Linnæus, and let them admit no genera on the authority of any prior author, nor even of the earlier works of Linnæus himself." To this purely arbitrary decision I can find no reason whatever for subscribing. In my work it is justly stated, "The synonymy commences with the edition of Linnæus's 'Systema Naturæ' published in 1735*," that is to say, with the first edition of that immortal work; and I have yet to learn in what respect this principle does not "work well." The question has nothing to do with the "binomial method," which has reference only to species; and Linnæus himself discriminates between the earlier formation of genera, which were well circumscribed and accurately named long before the complete circumscription and limitation of species by the use of trivial names. For this reason, any "statute of limitations" in regard to genera that should stop short of 1735, would rest on no intelligible principle, and could not therefore command a general assent. I will only observe further, that were the date of 1760, as proposed by Mr. Strickland, to be taken as the "absolute line" of the "statute of limitations," it would exclude the great and universally quoted edition of the 'Systema Naturæ' (the tenth) published in 1758, in which the binominal system was complete in regard to Birds; and the binominal system was not even then merely "dawning on the mind of the great Linnæus," but had been fully carried out through the whole vegetable kingdom in the edition of the 'Species Plantarum' published in 1753.

The edition of the 'Systema Naturæ' published in 1735 being then taken as the starting-point, from which the great author of a uniform system proceeded in the establishment of genera, it is objected to me that I seem "to give that and the other earlier editions an occasional preference over the subsequent and more perfect publications." The fact is, that all the editions are referred to, for the purpose of showing, in conformity with the entire plan of my work, when the genus was first proposed and established by Linnæus. And here, as elsewhere, I offer to every student the means of tracing out the facts necessary to complete the history of each division, being quite aware of the natural divergence of minds on all questions of opinion, and leaving it open to all to form their own opinions in conformity with those principles which appear most satisfactory to themselves. My aim is solely to produce a record of facts as complete as possible, and I make no pretensions to the vain attempt of producing uniformity of opinion.

The reviewer goes on to object that I take "it for granted that the first species on the list of each of these editions was intended to be the type of the genus,—a point which admits of much argument." It is with the view of saving "much argument," which would assuredly be the result of any other system, that I have laid it down as a principle *for my own guidance*, that where no other species is stated

* Systema Naturæ, sive Regna tria Naturæ systematice proposita per Classes, Ordines, GENERA et Species. Lugd. Bat. 1735.

by the author as typical, it is the safest, best, and only certain rule, to regard the species first enumerated as the type. This is a subject to which I have given much thought: some rule was found to be absolutely necessary; it was in the highest degree desirable that the rule should be uniform; and the principle adopted was the only one, which after long and careful deliberation appeared to me to fulfil the required conditions. Others may, if they think fit, and as some modern authors have done, take the tenth or the twentieth species in the list as the type of a Linnæan genus, and may give plausible reasons for so doing; but all must admit that such a course is one leading to interminable argument, and leaves the door open to much individual caprice.

The reviewer proceeds to give instances in which he considers me to be wrong. "*Chenalopex*," he says, "(a term *always* hitherto appropriated to *Anas Ægyptiaca*,) is proposed to be used for the *Alca impennis*, as having been so applied by Mœhring in 1752." Now it so happens that Vieillot adopted this generic name from Mœhring in his "subsequent and more perfect publication" of his "Analyse" in 1818; while Stephens did not employ the same word for *Anas Ægyptiaca* until 1824. I think the reviewer will *now* admit that *Chenalopex* has not *always* been appropriated in the manner stated by him. And let me here observe in behalf of this unfortunate author (Mœhring), whose work ('Genera Avium') I have been charged with disturbing from the "dusty shelves" on which it had lain "forgotten for a century," that long before I could have written or published a single word, his work had been considered worthy of quotation by Brisson, Illiger, Cuvier, Vieillot, Lesson and others, through whose writings I first became acquainted with his merits.

Again, the reviewer says, "The type of the genus *Tanagra* is altered, because the *T. episcopus* (*always* hitherto considered as such) does not stand first in Linnæus's list." Here again the reviewer is in error. *Tanagra* was established by Linnæus in 1766, and the *first* species in his list is *T. jacapa*. In 1805 Desmarest considers *T. tatao* (=Aglaia) as the type of *Tanagra*; in 1811 Illiger, taking the first-named species in Linnæus's list, recurs to *T. jacapa*; in 1816 Vieillot gives *T. cayanensis* (=Iliolopha); in 1817 Cuvier adopts *T. violacea* (=Euphonia); in 1820 Temminck takes *Lanius leverianus* (=Cissopis); while it is not until 1827 that Swainson proposes *T. episcopus* as the type of the genus *Tanagra*. But, even were it possible to set aside all the previously proposed types of this genus, there still remains a fatal objection against this last-named appropriation of the name, if "the stern law of priority" is to have any weight, inasmuch as M. Boie had in the previous year proposed the name of *Thraupis* for a species which must be arranged along with *T. episcopus*; and consequently, were the views of the reviewer to be critically carried out, the name of *Tanagra* would be erased from the nomenclature of the Tanagers altogether. To this conclusion I am not prepared to follow him; any more than I can admit, after the above recapitulation of facts, the correctness of his statement that *T. episcopus* has *always* hitherto been appropriated as the type of the genus *Tanagra*.

If I have "not ventured to carry out these rules [that is to say, the recognition of the first-named species of a group as its type, when no other is indicated as such] throughout to their legitimate result," I have at least shown in the two instances especially cited, *Strix* and *Falco*, how the matter stands in relation to them. Throughout all the editions of Linnæus from 1735 to 1766, *Strix Bubo* is uniformly placed at the head of his genus *Strix*; while the modern innovation of considering *Strix flammea* as the type was not legitimately adopted until 1809 by Savigny; and so much has the propriety of this determination been doubted, that no fewer than four ornithologists have since proposed as many different names for the division of which *Strix flammea* forms the type. Had I therefore "ventured" to meddle with this, which I cannot but consider as an unfortunate appropriation, I could not have been charged with an infringement of the maxim "*quieta non movere*." So with regard to *Falco*, it will be seen by the quotations in my work itself in what manner Linnæus altered his opinion as to the species to be placed first, as follows:—in the editions of 1735, 1744 and 1758, *Falco chrysaetos* (= Aquila); in those of 1748 and 1756, *Vultur percnopterus* (= Neophron); and finally in 1766 *Falco coronatus* (= Spizaëtus).

But I will not pursue this subject farther. In my work it will be found that I have endeavoured to give as complete a view as possible of the facts, by referring to these and similar changes, in order to assist the student in the application of his own particular views to the facts of each particular case. I feel abundantly satisfied that the adoption of the "statute of limitations," as proposed, would have led to the alteration of many more names than I have "ventured" to change, by adopting as my guide the first species of each genus, as it stood when first established. No "statute of limitations," nor any other rule but that of mere caprice, would sanction many of the types adopted for the older genera by modern authors, whose great fault it has been that they have disregarded the labours of their predecessors, and thus involved themselves in those numerous uncalled-for alterations and repetitions against which the reviewer so justly declaims.

I pass over the remarks on the subject of names closely resembling each other, as it is probable that no two persons would ever agree on the exact degree of permissible similarity in sound or spelling, and it is certain that the natives of different countries would entertain different opinions on the subject; and come next to the reviewer's expression of "regret that Mr. Gray had not thought fit to adopt the very simple rule given in the British Association Committee's Report for the formation of the names of the families and subfamilies in *idæ* and *inæ*." On this point (which is quite secondary to my main object of "Genera") I have to observe, that the rules which I have adopted were collected, as the best that had been proposed by my predecessors, and those which appeared to me to combine most completely the principles of fairness and justice towards others, prior to the publication of the Committee's Report. I saw in it no inducement to change them, and I have not found that the most competent judges have adopted the changes of nomenclature therein recommended. For instance, I am blamed for using the word *Coraciadæ* instead of *Coraciidæ*; yet I perceive that the President of the Linnæan Society, in the title of a very valuable memoir in the last published part of the "Transactions" of that learned body, does not hesitate to employ the similar term *Leucosiadæ* in preference to *Leucosiidæ*, as directed in the Committee's Report.

The reviewer's suggestion of "a Catalogue of the unabbreviated names of the authors of the different genera, and of the chief works in which they have published them," is one that has not escaped my attention. I have in my possession an extensive list of authors, accompanied with references to their works; but it is not my intention to publish it at present, although I may find occasion to do so hereafter.

In relation to the names of genera proposed by Dr. Schiff (to which the reviewer might have added the names of Dr. Reichenbach and others), I held it to be my duty to give all the generic and subgeneric names that came within my knowledge, whether accompanied by the statement of the typical species or not. I have fortunately been enabled in most cases (with the exception of the names of Rafinesque) to supply this deficiency; and I hope that I may thus have been the means of preventing, to a certain extent, the multiplication of names for the same divisions, although I do not attempt, as it would be useless, to set limits to the subdivision of genera. The addition of the name of the publisher, as well as of the author, would have involved the total reconstruction of my book on a different plan.

This article is longer than I had intended, but I must be permitted to end it with the words of a well-known ornithologist:—"We have chosen our path:—not having fallen into it by blind chance or wayward prejudice; but having selected it from all that lay before us, with free and deliberate preference. And in full confidence, as far at least as human reason and foresight can inspire us with confidence, of having chosen the right way, we shall steadily pursue it."

BIBLIOGRAPHICAL NOTICES.

A Popular History of Palms and their Allies. By BERTHOLD SEEMANN, Ph.D. &c. London: Reeve. 1856.

IN introducing his subject to the reader Dr. Seemann states, that his attention was first directed to the family of Palms through inquiries set on foot in his school days, in connexion with the conversion of his pedagogue's cane into succedanea for cigars. We cannot lay claim to the possession of so inquiring a spirit in our youth, or at all events it did not take that direction. The associations connected with the name of palm-trees in our minds, and we fancy in those of most persons, are of a more elevated and less practical nature. To us they have a mingled character of strangeness and a sort of classical grandeur. The frequent mention of palms in the Bible, the marked attraction they have exerted on all travellers, and the unusual and peculiar forms revealed in the scanty and imperfect pictures which until of late years were alone accessible, combined to invest them with a peculiar, and in some degree mysterious interest.

Until recently, the means which general readers had of forming an idea of palms were scanty enough. The conventional date-palm of oriental landscapes, repeated from copyist to copyist, and not at the first-hand very much like the original; the stock-group of cocoa-nut palms in every tropical sketch,—these formed the type upon which most readers built their conceptions of palms; and, familiar enough to travellers, they were only superficially known to any but professed botanists. Even botanists do not date very far back their knowledge of this family. Humboldt remarks, in his 'Ansichten der Natur,' that only fifteen species were known at the time of Linnæus's death. Martius's great work on palms; the labours of our indefatigable Indian botanists,—that worthy band of naturalists who have turned to such good account the rich opportunities opened in the East India Company's service; the travels of Humboldt and Bonpland, and more recently of Wallace and others in America: have wonderfully extended our knowledge of this family; to which public attention is continually drawn more strongly by the wonderful variety and abundance of their œconomic products. Cocoa-nuts, as articles of commerce, are now rivalled by their husk, or coir: palm-oil is not what it was twenty years ago, a *salve*, having a questionable preference in the eyes of old-fashioned domestic "leeches,"—but the source of "enlightenment" for thousands,—not merely actually, but figuratively, since the civilizing influence of the commerce in this article appears to bid fair to lay the foundation of the taming of the wild slaving nations of Africa.

It would be difficult to name any vegetable material used in the arts, or as a staple of food, which is not furnished by one or other of the palms. Timber; fibrous substances, coarse and fine, capable of conversion into cordage, clothing, &c.; nuts, hard and enduring enough to serve as vessels for liquids, or to furnish substitutes for bone or ivory; starch, sugar, spirit, vinegar, succulent green vegetable food, oils of various characters, wax, sweet fruits, nuts—all these are yielded, sometimes several even by the same tree. Hence the family is of the highest direct importance to the natives of the tropics, to which regions it especially belongs, while commerce renders it indirectly important, by converting it into a *property* for them, since they can barter the raw products for the industrial products of civilized nations.

Mr. Wallace's interesting little work on the Palms of the Amazon furnished a new set of ideas to the general reader, and Dr. Seemann's 'Popular History of Palms' is exceedingly well calculated to satisfy the curiosity which Mr. Wallace's readers must have felt to know more of these interesting plants. It is especially full in the matter of the œconomical products; in fact, this is the strong point of the book, but the descriptions are interesting and often spirited. The amount of facts collected from various sources, and the practical acquaintance with the plants possessed by the author, concur to render this little volume very acceptable to the scientific botanist as well as the general reader. Twenty plates, illustrative of the most striking forms, are given; the drawing of them is tolerable; but we must exclaim against the abuse of the art of chromolithography exhibited in the blue and dingy-yellow tinting. This, however, is a small matter. We might suggest to the author, as he claims a scientific value for the substance of his work, to add to a second edition a systematic table of contents, and, if possible, a synopsis of the genera.

Museum of Economic Botany, or a Popular Guide to the Museum of the Royal Gardens of Kew. By Sir W. J. HOOKER, Director. Longman & Co. 1855.

In most departments of human activity, practice at the outset far outstrips Science, who, advancing cautiously, rule and measure in hand, carefully surveys each step of ground over which she asserts her mastery. It is long before she thus reduces under law and order the extensive tracts discovered in the arbitrary *forays* of practice into the region of the unknown; but a time comes when practice does not find it so easy to descend into "pastures new," and when increased difficulties of existence render it no longer profitable to waste strength in tentative excursions. Then Science assumes her native pre-eminence, and becomes the leader and law-giver.

This truth obtains in the science which deals with vegetables, or at least is beginning to become manifest. Advice and instruction are now sought from the botanist when new materials are required for textile fabrics, for paper, for supplying oleaginous substances, &c.; and this demand upon the scientific man is one that must necessarily increase.

The vegetable substances indigenous, or commonly cultivated in the countries inhabited by civilized nations, have long formed but a portion of those used for purposes of manufacture or as articles of luxury. We find many products mentioned in the Greek and Roman writers as obtained from the "East," the real nature and sources of which were unknown, and enveloped in mysterious or fantastic fables. In the middle ages, and more especially after the discovery of the New World and the Cape passage, these substances multiplied rapidly in commerce. When botanical travellers at length began to carry scientific curiosity into distant regions, some progress was soon made in the discovery of the sources of the gums, woods, fibres, and similar materials, which, though well known to the drysalter or the cabinet-maker, were stumbling-blocks to the botanist. The formation of museums was another important step to the regularization and accumulation of knowledge thus acquired; but it can hardly be said that this department of the science had been the object of a worthy systematic pursuit until of late years.

The formation of the Museum of Economic Botany in the un-rivalled Gardens of Kew—constituting a most valuable and characteristic feature of an institution of which the British botanist has good reason to be proud—made an epoch in the study of vegetable products, and a glance at the pamphlet before us shows the remarkable progress that has been made in a few years. This Museum, founded in 1847, has already outgrown its original tenement, wherein it gradually invaded room after room until it filled the house. Another building, of dimensions suited to the growing importance of the collection, is about to be erected in the Gardens. On looking over the multifold objects at present displayed, it is not difficult to distinguish a number of substances whose nature and origin have been revealed through the inquiries set on foot in this Museum,—forming as it does a centre for the reception of information of this kind. New facts, frequently furnished from all parts of the world, are now at once received and enrolled in the chronicles of science, instead of being scattered, often to be lost, in books of travels and private letters; and new or rare products are no longer buried in private collections of "curiosities," occupants of the drawing-room in one generation, of the lumber-room and the rubbish-heap in the next.

The objects were at first arranged in the Kew Museum according to their structure or uses. This was found inconvenient in many respects; especially that of requiring repetitions, when, as is not uncommonly the case, the same plant yields substances of very varied uses. The objects are now arranged in cases devoted to the natural orders of plants; a plan not only more consistent with scientific notions, but really conveying much more knowledge to the ordinary observer. The pamphlet which has served as the text of these remarks is a *catalogue raisonné* of the objects now exhibited. It contains a vast amount of information compressed into a small compass, much of which is new, and founded upon letters received with the objects from correspondents in all parts of the world;—much collected from works with which botanists only are acquainted, and many of which are not easily accessible. As an authoritative index to the useful substances furnished by the various orders of vegetables, this little book is not merely an indispensable guide to the Museum for which it was compiled, but it will be found a most valuable *aide-mémoire* by all those who are occupied with this department of knowledge. Further, as it indicates the boundaries of our present acquaintance with exotic vegetable products, it is most desirable that it should be in the hands of all travellers, and all residents abroad whose tastes and opportunities allow of their devoting attention to natural objects.

A Handbook to the Marine Aquarium. By P. H. Gosse. London: Van Voorst. 1855. 12mo.

The great importance of the Aquarium as a means of extending our knowledge of marine zoology is now so generally admitted, that there is little need for us to dwell upon it. Since the principle of maintaining the balance of animal and vegetable life in a confined space was first put forward, the Zoological Society has established a fine collection of marine animals, which has enabled even the general public to appreciate the beauty of these inhabitants of the deep. Mr. Gosse very naturally concludes, that this exhibition will induce many to attempt the formation of Aquaria in their own houses; and his object in publishing this little book is to furnish such persons with the necessary directions for the construction and management of their collections. It is, as he tells us in his preface, founded to a great extent upon the concluding chapter of his larger work upon the Aquarium, a work which, from its entering largely upon the natural history of the animals which may be kept in these artificial rock-pools, and from the expensive nature of its illustrations, is far too costly to be generally available as a guide for beginners.

This little handbook appears to contain every information that can be required for a commencement,—such as the different modes of constructing and fitting up the tanks, the mode of collecting animals and plants to stock them, and of keeping the inhabitants in health in their confined abode. We also find Mr. Gosse's receipt for making artificial sea-water, which, notwithstanding Mr. Warington's objections to it, appears to answer well, and will no doubt enable many to preserve marine animals in inland situations where they would be unable to procure natural sea-water. The whole of the directions are given in a plain and intelligible style, and the book will doubtless prove highly acceptable to those who interest themselves in marine zoology.

Popular Geography of Plants, or a Botanical Excursion round the World. By E. M. C. Edited by C. Daubeny, M.D. &c. London: Reeve. 1855.

A little work of no great pretensions, and, as such, deserving of a good word. It consists chiefly of gatherings from the narratives of botanical travellers, loosely dovetailed together and supported on the framework of Meyen's Geographical Regions. We think the author has *diluted* a little too much, in the desire to be popular; the mere fact of being sufficiently acquainted with plants to derive any distinct idea from the many names cited, would almost imply an amount of previous knowledge sufficient to form a basis for a little more in the way of general principles. However, tolerable success has been attained in keeping up the spirit of the narrative style adopted,—a matter of some difficulty considering the concision required, and the frequent sudden transitions and changes of scene. We can recommend the work for the reading of persons young or old who have a taste for plants, especially to amateur botanists who have not begun to study in this direction. It is also especially calculated to heighten the interest which ordinary persons may derive from visits to Kew or other botanical gardens.

The illustrations are very bad—so much so, as to act as a terrible 'damper' on the fire of the text.

The Flowering Plants and Ferns of Great Britain: an attempt to classify them according to their Geognostic relations. By J. G. Baker. London. 1855.

This tract is an enlarged form of a paper communicated to the British Association at its recent meeting at Glasgow. Its subject is of much interest in the study of the geographical distribution of plants, and has not received so much attention as it seems to deserve. Hitherto botanists have endeavoured to determine the causes of the migration, or creation, of the plants found in different districts, by attending to the collocation of the places where they grow, rather than from a consideration of the strata forming the crust of the earth. Mr. Baker has therefore done good service to science by this attempt at determining the geological causes that may be supposed to have had an influence. It is not to be expected that this attempt should be altogether satisfactory in its results, for many more observations than we at present possess are wanted before certain conclusions can be attained.

He arranges the strata into two great groups: (1) The *dysgeogenous,* "which are disintegrated with difficulty, and yield only a feeble detritus." "They absorb moisture readily, and furnish stations characterized by their comparative dryness," and contain a large proportion of carbonate of lime. And (2) the *eugeogenous,* "which abrade easily, and yield an abundant superficial detritus, which may be either of a sandy or clayey nature. They are comparatively impermeable, and consequently hygroscopic upon a grand scale, furnishing damper stations" than the other group. He then shows how these classes of strata are distributed through Great Britain, and endeavours to arrange the native plants into either those which are spread over the whole country, or confined to one or the other of the groups. We think that he has been tolerably successful, although we should not in all cases agree with him. Indeed, it seems probable that it is rather the superficial soil that must often be taken into account, than the underlying strata. The soil of large districts noted as clay on geological maps, may, and actually has, a strongly calcareous character from the presence of adjacent rocks, such as chalk, and accordingly possesses a flora containing many of the species usually called calcareous, or chalk plants, and does not produce others commonly found on a clayey soil, but which dislike the presence of lime or chalk. Mr. Baker has apparently attended solely, or chiefly, to strata, and neglected the detritus formed or deposited upon them.

Notwithstanding this objection, we have no doubt that the essay will be favourably received by botanical geographers, who find that they must consider all the causes in action, whether they be stratigraphical, detrital, geographical, or climatal.

In the Press.

We learn that Mr. Gosse has nearly ready a new work on the Marine Natural History of Tenby and its Vicinity.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

February 27, 1855.—Dr. Gray, Vice-President, in the Chair.

Notes on the Habits of some Indian Birds. Part VII. By Lieut. Burgess.

Subfamily Promeropidæ.

Genus Upupa.

Upupa Epops. Hoopoe.

In the upper portion of the Deccan the Hoopoe is a common bird, frequenting gardens and woody spots, and is very partial to sandy plots of ground, particularly outside the walls of villages. In such places the sand is perforated with the conical holes of the ant-lion, and that this is the food sought for by the Hoopoe in these spots, I discovered on opening the gizzard of one, which was of a very soft texture, and contained one large grub and two or three ant-lions. The Hoopoe breeds in the months of April and May, building its nest in holes in the mud walls which surround towns and villages in the Deccan. I transcribe a note taken on 7th May 1850 on the subject:—"To-day a man brought me word that about fifteen or twenty days ago he found a pair of Hoopoes breeding in a hole in the walls of a town; the nest contained two young birds; it was composed of grass, hemp, and feathers. The same man tells me that he has discovered another pair building." The head man of the town of Jintee brought me an egg of the Hoopoe, which has unfortunately been broken. It was of a very pale blue, or rather skim-milk colour. He found a nest in a hole in a fort wall; it was made soft with a few pieces of hemp, and contained three eggs.

Tribe Fissirostres.

Family Meropidæ.

Genus Merops.

Merops indicus. Common Indian Bee-eater.

A common bird in the Deccan, but remarkable for its brilliant plumage, and active fly-catching habits. It chooses for its perch the outside twig of a tree, whence it makes its forage amongst the insect tribes that are brought out by the morning beams. The Bee-eater breeds during the months of April and May, laying its eggs in holes in banks. On the 13th May 1850, I found a pair of these birds breeding in a hole in a bank; the hole was more than an arm's length in depth. At the bottom of it I found three young birds, one very small, with scarcely any feathers on it; another somewhat larger, and the third of considerable size and pretty well fledged. There was no nest.

That birds of this genus migrate, I had a convincing proof when returning to England in 1852. When about half way between Bombay and Aden, on the evening of either the 8th or 9th May, a large flock of Bee-eaters was observed fluttering about the ship, some three or four of which were caught after dusk, when they had settled on the ropes and shrouds. I obtained three or four for the purpose of preserving their skins, but in the confusion occasioned by a shower they were unfortunately thrown overboard. They were larger than *Merops indicus*.

Family Halcyonidæ.

Genus Halcyon.

Halcyon smyrnensis.

This and the black and white Kingfishers are the most common of their tribe in the Deccan, frequenting almost every stream and nullah. The former breeds during the month of May in holes in the banks of rivers, laying as many as seven eggs. They are of a beautiful pinky tinge, owing to the colour of the yolk showing through the thin delicate shell. The egg is about the size of that of the little Indian Owl (*Noctua indica*).

Family Caprimulgidæ.

Genus Caprimulgus.

Of the eggs of these birds, of which there appear to be several varieties in India, I merely subjoin a note made by Mr. Jerdon from Mr. Elliott's notes. He states, that he once found the eggs of the common species, two in number, placed on the ground without any nest. They were pink, spotted with brown.

Family Hirundinidæ.

Genus Cypselus.

Cypselus affinis. White-rumped Swift*.

I should certainly say that this is a common bird in the Deccan, about the city of Ahmednuggur. I have seen their nests crowded together under the roofs of old buildings, choultries and temples, and obtained the nest and eggs from a rock in the range of hills about twelve miles from Ahmednuggur, on the road to Aurungabad. This nest was obtained on 21st September 1849. It was built of mud and lined with grass, and contained two white eggs. The eggs are considerably elongated in form.

Cypselus palmarum, Hardw. Balasian Swift.

This Swift, according to General Hardwicke, builds its nest on the leaf of the palm. Dr. Jerdon says that it "is common in all the

* This Swift builds twice during the year; I obtained a nest and eggs in September, and also found a nest with young birds in April.

districts of India, except on the bare table-land." I have, however, never met with its nest or eggs.

Genus Hirundo.

Hirundo filifera, Stephens.

This very handsome Swallow breeds in old temples and under projecting stones in wells and banks of streams. On 28th January 1850, I found the nest of this species built in an old well under a large stone, near the water; the nest was not domed, but open, and the young ones, three in number, exposed to view. On 1st April 1851, I took an egg out of a nest of this Swallow; the nest contained three. The old birds began building about 15th March; the nest was composed of mud, lined with a few fibrous roots and feathers; it was built under a stone in the bank of a stream. The egg is $\frac{8}{10}$ths of an inch in length, by rather more than $\frac{5}{10}$ths in width; white, spotted with two shades of red-brown, the spots forming a broken belt round the larger end.

Order Rasores.

Family Pavonidæ.

Genus Pavo.

Pavo cristatus. Common Peafowl.

Peafowl abound in the jungles clothing the slopes of the Ghauts, and in some wooded districts in the interior. In the Deccan, in the wooded hilly portions of the districts of Jamkhair and Seogao they were plentiful, and a remarkably pretty sight it was to see them stalking about near the grain stacks, or running along the bushy banks of the nullahs. They are wary birds, and lead the sportsman a good chase when once they take to the low spurs of the hills, up which they run with incredible swiftness. The best plan to secure them is to wait for their roosting time, under the trees to which they resort. Thick mango trees appear to be their favourite resting-places. Peafowl breed at the end of the monsoon, in the months of September and October, laying, I am told, from three to five eggs, of a buffy white colour, 2 inches and nearly $\frac{6}{10}$ths in length, by 2 inches and nearly $\frac{1}{10}$th in width. The nest is said to be composed of grass, and formed on the ground amongst bushes.

Genus Gallus, Briss.

Gallus Sonneratii, Temm.

As I have not been fortunate enough to obtain the eggs of this jungle fowl, I have again recourse to my friend Dr. Jerdon's notes. He says, "I once found the eggs of this fowl, seven in number, on the ground in dense jungle at the foot of the Neilgherries. They were of a light pinkish-cream colour."

Family Tetraonidæ.

Genus Tetrao.

Subgenus Pterocles.

Pterocles exustus. Common Whistling Grouse.

This Grouse is common in the open plains of the Deccan, flying in flocks, and, as Colonel Sykes has remarked, announces its approach by its peculiar and piercing cry. I believe that this Grouse breeds during the greater part of the year. Eggs of this species (I believe) have been brought to me from the month of December to May. The Common Whistling Grouse lays three eggs in a slight hollow on the bare ground, and the colour of the eggs so much assimilates with that of the sandy ground on which they are laid, that it is very difficult to find them. The egg sent is, I believe, the egg of this species. It measures $1\frac{6}{10}$ths of an inch in length, and 1 inch and rather more than $\frac{1}{10}$th in width, and is of a stone colour, thickly spotted and blotched with grey and olive-brown. I have in my collection several eggs of the Sand Grouse, which vary much in their size and markings.

Pterocles quadricinctus. Painted Whistling Grouse.

This handsome Grouse frequents the low stony hills so common in the Deccan. It is not nearly so common as the last mentioned. I succeeded in getting two or three pairs, by waiting for them at a piece of water whither they used to come at dusk to drink. This Grouse most probably breeds at the same time and lays the same number of eggs as *P. exustus*. Many eggs of birds of the subgenus *Pterocles* were brought to me by the people in the districts, but as they are not generally very accurate observers, and call both *P. exustus* and *P. quadricinctus* by one common name, they could not tell me to which they belonged; but from my own observations, and the notes of Dr. Jerdon, I believe the egg sent with this paper is that of *P. quadricinctus*. Dr. Jerdon says, "I have lately got the eggs of this species, also very similar to the other, but rather smaller, and with the spots fewer and larger."

Genus Perdix.

Perdix picta.

I met with the Painted Partridge in the grassy valleys near and amongst the Western Ghauts near Nassick, in the thickly planted and rich gardens, and in one of the districts between the Godavery and the Bheema rivers. In the latter district the Shikaries brought me several pairs alive. Its very peculiar cry is heard at a considerable distance. When out shooting in a valley amongst the Ghauts, I saw one calling when perched on the low stump of a tree. Dr. Jerdon says, "It breeds during the monsoon, lays six or seven eggs of a smoky bluish-white colour, of an oval form, much depressed at the thick end."

Subgenus Francolinus.

Francolinus ponticerianus. Common Partridge of India.

This Partridge is found amongst bushes and underwood, but is particularly fond of thick grassy hedges round garden plantations. It is found either singly or in pairs. The Grey Partridge breeds during the months of February and March, laying its eggs, seven in number, in grassy spots, hedgerows, and amongst bushes. The egg is of a rich stone colour, 1 inch and $\frac{5}{10}$ths in length, by 1 inch and $\frac{1}{10}$th in width, but they vary considerably in colour and size. This Partridge is by no means a shy bird, but, on the contrary, appears to prefer fields and gardens near towns and villages to less frequented spots. By some it is called the Scavenger Partridge, but I believe there are no grounds for such a term being applied to it; its flesh is very fair eating. The crop of one which I shot was full of bajocce and small seeds.

Francolinus spadiceus. Spur-fowl.

I procured a specimen of the Spur-fowl on the Ghauts at Khandalla. It was flushed in a garden, and betook itself to a tree in which I shot it. Its gizzard contained a quantity of earth, some small stones, and small brown seeds. I was informed by a Shikarie that they breed in the months of February and March in thick jungles, making their nests on the ground or in thick close bushes, and laying three white eggs.

Subgenus Coturnix.

I herewith forward an egg, in itself a bad specimen, but the only one I was able to procure, and which I believe to belong either to *C. dactylisonans*, the large grey Quail, or to *C. textilis* (Temm.). I believe the egg to be that of the latter, as if *C. dactylisonans* be identical with the English Quail, the egg should be of a yellowish or dull orange-coloured white, blotched or speckled with umber-brown, whereas the egg now sent is of uniform buff, merely spotted and discoloured by a long exposure to wet.

Coturnix Argoondah (Sykes). Rock Quail.

This pretty little Quail, as its name implies, is an inhabitant of stony hills and bushy sides of streams and nullahs. It lives in bevies, and is to be met with in company with the grey and black-breasted Quail. The Rock Quail breeds generally during the months of November and December, but I have had its eggs brought to me as late as March, and have procured a young bird well fledged as early as 20th November. It does not, I believe, lay more than four eggs, as on three different occasions I have had that number brought to me, and on a fourth, four young ones just fledged were brought to me when out quail-shooting. The young were covered with down, and had the appearance of being powdered. The egg of this Quail is of a pale buff colour, 1 inch and $\frac{1}{10}$th in length, by $\frac{8}{10}$ths of an inch in width.

I take this opportunity of bringing to the notice of the members of this Society distinguishing marks between the Rock Quail and the Grey and Black-breasted Quail, and of proposing that the former species should not be confounded with the two last. The distinguishing marks of the former, the Rock Quail, are the stoutness and depth of the beak in proportion to its length, the much more rounded form of the wing, the secondaries and tertials being much more equal in size with the primaries than those of the Grey and Rain Quail; the much more defined sealy protection of the legs and feet in the Rock Quail, and what I believe the most distinguishing mark, the smaller number of eggs laid by the Rock Quail. I believe that the Grey and Rain, or Black-breasted Quail, lay *eight or nine eggs,* the Rock Quail not more than *four.*

BOTANICAL SOCIETY OF EDINBURGH.

December 13th, 1855.—Professor Balfour, President, in the Chair.

Colonel Madden was elected President for the ensuing year.

A considerable number of foreign botanists were elected Hon. Members.

The following papers were read:—

1. "Report on the State of the Society's Herbarium." By the Curator.

2. "Notes of a Botanical Trip to Ben Lawers and neighbouring Mountains in August 1855." By Prof. Balfour.

This appears to have been a very successful trip. It was stated that the alpine plants flowered remarkably well in the summer of 1855. Amongst the plants found may be mentioned *Polypodium alpestre* and *P. flexile,* and *Cystopteris montana.* The latter grew in a different place from that where Mr. W. Wilson originally detected it. Mr. J. Backhouse has recently gathered it in Caenlochan Glen, in Forfarshire.

3. "Report on Musci collected during the same trip." By Dr. Greville.

4. "Additional List of Mosses." By Mr. W. Nichol.

5. "On the rare Lichens of Ben Lawers." By Mr. H. Macmillan.

6. "List of Desmideæ." By Mr. H. G. Stewart.

7. "List of Diatomaceæ." By Prof. Gregory.

8. "Geological Notes." By Mr. Hector.

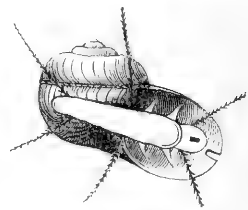
The above-enumerated papers, 2–7, all relate to the results of the same trip, and argue well for the attention paid by Dr. Balfour's party to the more obscure tribes of plants. They are little more than lists of names, and do not admit of abstract.

9. "Notice of some of the contents of the Museum in the Edinburgh Botanic Garden." By Prof. Balfour.

MISCELLANEOUS.

Memorandum on the Animal of Scissurella crispata.
By Lucas Barrett, F.G.S.

Tentacles long, serrated, at the base of which are placed the eyes; foot furnished with two pointed lappets and two long slender serrated cirri on each side. Operculum very thin, ovate, with an obscure subspiral nucleus.



No part of the animal was external to the shell. The only living specimen occurred at Hammerfest, in 40 to 80 fathoms' water. When it was placed in a glass of sea-water, it crawled up the side and scraped the glass with its tongue. After immersion in spirit it became inky-black.

Notes on the Marine Fauna of Weymouth.

To the Editors of the Annals of Natural History.

Weymouth, Jan. 23, 1856.

Gentlemen,—I beg to record the occurrence of *Squilla Desmarestii* at Weymouth as follows:—

In the autumn of 1851, a specimen was brought me that had been dredged in Weymouth Bay, near Portland. It measured $3\frac{1}{2}$ inches. It is in my cabinet.

On the 22nd December, 1855, I picked up one alive on Melcombe Sands. We had previously had several days of heavy gales from the eastward. This specimen, though alive, had been so long out of the water that it did not recover.

A third specimen was procured by my man on the 1st January, 1856. It was dredged in Weymouth Bay, in twelve fathoms' water. The bottom was of pebbles, and also live and dead *Pecten opercularis*. In my man's phraseology, it was a "pebbly and squinny bottom, with a lot of live squins." *Pecten opercularis* are here called Squins.

This specimen, I am happy to say, is now lively and well, and will enable me to give some information as to its habits. I have as yet only tried it with a pebbly and shingly bottom, and am therefore not in a position to write certainly as to its burrowing habits. I have satisfied myself as to its mode of progression, and can state that its tail is *not* used for that purpose, but solely as a *defensive* weapon. I hope shortly to complete my paper on its habits.

Gebia deltura.—On the 22nd December, 1855, I found on Weymouth Sands, at the same time with *Squilla Desmarestii*, two living specimens of *Gebia deltura.* Although living, they were too much injured to recover, and I was thus unfortunately prevented from studying their habits. The length of the larger one is nearly 2½ inches, and the smaller one 2 inches.

Great numbers of Harvey's *Syrinx* were thrown up at the same time, as also numerous specimens of an Actinia, which I doubtfully refer to *Actinia chrysanthellum* (Peach).

I am, Gentlemen, yours obediently,
WILLIAM THOMPSON.

METEOROLOGICAL OBSERVATIONS FOR DEC. 1855.

Chiswick.—December 1. Hazy: very fine: rain. 2. Cloudy: rain. 3. Clear and frosty. 4. Foggy: drizzly. 5. Clear: overcast. 6. Slight snow: windy at night. 7. Clear: fine. 8. Cloudy and cold. 9. Frosty: cloudy and cold: foggy. 10. Overcast: slight snow. 11. Uniform haze. 12. Overcast: sharp frost. 13. Frosty: fine, with sun: clear and frosty. 14. Overcast: rain. 15. Densely overcast: cloudy. 16. Fine: foggy. 17. Foggy. 18. Cloudy and cold. 19. Clear, cold and dry. 20. Frosty, with dry air. 21. Frosty throughout the day: severe Frost at night. 22. Frosty: overcast. 23. Overcast: fine: showery. 24. Very fine: showery at night. 25. Rain. 26. Boisterous, with rain. 27. Rain: cloudy: fine. 28. Very fine. 29. Fine: very fine: slight rain. 30. Cloudy and fine. 31. Fine throughout.

Mean temperature of the month	34°·99
Mean temperature of Dec. 1854	39 ·35
Mean temperature of Dec. for the last twenty-nine years ...	39 ·64
Average amount of rain in Dec.	1·492 inches.

Boston.—Dec. 1. Cloudy: rain P.M. 2. Fine. 3. Cloudy. 4. Fine. 5. Cloudy. 6. Fine: snow A.M. 7. Cloudy: snow P.M. 8, 9. Cloudy: snow A.M. and P.M. 10. Fine: snow A.M. and P.M. 11—13. Fine. 14. Cloudy: rain A.M. and P.M. 15. Cloudy. 16—21. Fine. 22. Cloudy: snow A.M. 23. cloudy: snow and rain A.M., and rain P.M. 24. Fine. 25, 26. Cloudy: rain A.M. and P.M. 27—29. Fine. 30, 31. Cloudy.

Sandwick Manse, Orkney.—Dec. 1. Drizzle A.M.: clear P.M. 2. Damp A.M.: damp, vapours P.M. 3. Showers A.M.: drizzly showers P.M. 4. Rain A.M.: showers P.M. 5. Snow-showers A.M.: sleet P.M. 6. Snow-showers A.M. and P.M. 7. Sleet-showers A.M.: clear, frost P.M. 8. Cloudy A.M.: cloudy, frost P.M. 9. Cloudy A.M.: fine, frost P.M. 10. Cloudy A.M.: showers P.M. 11, 12. Snow-showers A.M. and P.M. 13. Cloudy A.M.: showers P.M. 14. Rain A.M.: drizzle P.M. 15. Showers A.M.: showers, thunder and lightning P.M. 16. Hail-showers A.M.: sleet-showers P.M. 17. Fine A.M.: fine, cloudy P.M. 18. Cloudy A.M.: sleet-showers P.M. 19. Cloudy A.M. and P.M. 20. Bright A.M.: Cloudy P.M. 21. Bright A.M.: clear P.M. 22. Clear, frost A.M. and P.M. 23. Snow-showers A.M.: rain, clear P.M. 24. Bright A.M.: rain P.M. 25. Bright A.M.: clear P.M. 26. Drizzle A.M.: rain P.M. 27. Rain, drizzle A.M.: fine, cloudy P.M. 28. Damp A.M.: rain P.M. 29. Bright A.M.: cloudy P.M. 30. Bright A.M.: clear, aurora P.M. 31. Bright A.M.: cloudy P.M..

Mean temperature of Dec. for twenty-eight previous years ...	41°·03
Mean temperature of the month	39 ·41
Mean temperature of Dec. 1854	39 ·13
Average quantity of rain in Dec. for fifteen previous years ...	4·21 inches.

The following are the averages for November 1855, with which we have been favoured by our correspondent the Rev. Ch. Clouston of Sandwick Manse, whose usual report miscarried owing to the stormy weather which then prevailed:—

Barometer.		Thermometer.		Rain in inches.
A.M.	P.M.	A.M.	P.M.	
29·970	29·976.	43·53	43·46	1·37.

by Mr. Veall, at BOSTON; *and by the* Rev. C. Clouston, *at Sandwick Manse,* ORKNEY.

Days of Month. 1855. Dec.	Barometer. Chiswick. Max.	Barometer. Chiswick. Min.	Barometer. Boston. 8½ a.m.	Barometer. Orkney, Sandwick. 9¼ a.m.	Barometer. Orkney, Sandwick. 8½ p.m.	Thermometer. Chiswick. Max.	Thermometer. Chiswick. Min.	Thermometer. Boston. 8¾ a.m.	Thermometer. Orkney, Sandwick. 9¼ a.m.	Thermometer. Orkney, Sandwick. 8½ p.m.	Wind. Chiswick. 1 p.m.	Wind. Boston.	Wind. Orkney, Sandwick.	Rain. Chiswick.	Rain. Boston.	Rain. Orkney, Sandwick.
☾ 1.	30·072	29·887	29·70	29·90	29·95	46	33	38	39½	35½	nw.	nw.	calm	·03	....	·05
2.	29·879	29·811	29·53	29·85	29·87	44	26	36	41	42	n.	nnw.	sw.	·04	·07	·05
3.	29·988	29·983	29·68	29·65	29·65	40	31	31	47	48½	ne.	nnw.	wnw.	·02	....	·29
4.	29·828	29·690	29·50	29·42	29·39	47	36	39	48½	39½	sw.	w.	nw.	·01	....	·25
5.	29·557	29·509	29·20	29·33	29·27	44	30	37	33	37	w.	nw.	nw.	....	....	·11
6.	29·504	29·373	28·99	29·45	29·54	42	28	32	34	37	nw.	nw.	n.	....	....	·38
7.	29·580	29·480	29·18	29·60	29·77	42	27	34	36	36	n.	nw.	wnw.	....	·03	·50
8.	29·841	29·562	29·36	29·88	30·07	35	19	30	36	35	ne.	nnw.	ne.	....	·18	·04
● 9.	30·100	29·956	29·74	30·13	30·17	35	30	25	35	36	ne.	nnw.	ssw.	....	....	....
10.	30·079	30·037	29·82	30·07	30·02	35	22	30	41	38	n.	nnw.	nnw.	....	·21	....
11.	30·033	29·900	29·70	30·00	29·84	33	23	30	32	31	sw.	w.	nw.	....	·09	....
12.	29·885	29·692	29·44	29·74	29·90	33	13	23	31	32	sw.	wnw.	nw.	....	....	....
13.	30·097	30·015	29·76	29·93	29·80	36	15	23·5	34	41½	nw.	n.	w.	....	....	·25
14.	30·015	29·900	29·62	29·54	29·72	49	40	36·5	47	47	w.	w.	w.	·07	·03	1·05
15.	30·222	30·038	29·77	29·62	29·70	48	25	44	47	42½	w.	w.	w.	....	·13	·10
☽ 16.	30·251	30·183	29·92	29·84	29·93	47	29	35	42	40½	w.	w.	wnw.	....	....	·17
17.	30·086	30·035	29·80	30·12	30·19	43	35	26·5	37	37½	ne.	nw.	e.	....	....	·02
18.	30·214	30·075	29·87	30·18	30·16	40	21	35	39½	39	ne.	e.	sse.	....	....	....
19.	30·264	30·180	30·04	29·96	29·84	32	20	25	38	38	e.	se.	s.	....	....	·05
20.	30·093	29·918	29·86	29·73	29·71	32	17	24	38	38	e.	e.	sse.	....	....	....
21.	29·803	29·702	29·63	29·66	29·77	26	11	21·5	37	36	e.	se.	s.	....	....	....
22.	29.895	29·752	29·60	29·77	29.65	29	09	25	34	34	nw.	wnw.	ese.	·10	....	....
○ 23.	29·576	29·463	29·24	29·08	29·02	50	37	36·5	34	39½	sw.	s.	sse.	·07	·12	·17
24.	29·663	29·627	29·26	28·97	28·86	49	33	35	40½	43½	sw.	sw.	s.	·30	·18	·16
25.	29·626	29·386	29·30	29·02	29·15	50	35	36	42	42	sw.	s.	s.	·19	....	·53
26.	29·253	29·187	28·85	29·12	28·09	51	45	45	42	43	sw.	s.	ene.	·26	·15	....
27.	29·601	29·487	29·18	29·08	29·37	53	37	40	44	42½	sw.	s.	ssw.	·01	·04	·22
28.	29·743	29·616	29·28	29·46	29·19	58	39	40	41	44	s.	s.	sse.	....	....	....
29.	29·963	29·909	29·54	29·43	29·33	51	33	39	42	44½	sw.	ssw.	s.	·01	....	·18
30.	30·264	30·106	29·71	29·47	29·65	49	27	39	40	39½	w.	ssw.	s.	....	....	·07
☾ 31.	30·220	30·035	29·86	29·62	29·67	46	29	39	47	44	s.	s.	sse.	....	....	....
Mean.	29·909	29·790	29·54	29·632	29·620	42·41	27·58	33 2	39·35	39·48				1·11	1·23	4·64

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 99. MARCH 1856.

XVI.—*On the House Ant of Madeira.* By Professor O. Heer, of Zurich. Translated from the original* by R. T. Lowe, M.A.†

[With a Plate.]

I. *Apparition and Habits.*

Amongst the richly varied insect-tribes the Ants stand foremost probably in point of numbers. We meet with them everywhere, in field and garden, meadows and forests, from spring to latest autumn. In general the unwinged labourers alone are seen; but in July and August the winged males and females issue from their nests, and rise in such vast swarms into the air as to attract occasionally general attention. This was especially the case in August 1849. On the 7th of August immense swarms, consisting of *Myrmica rubra*, F., *Formica fuliginosa*, F., and *F. nigra*, made their appearance in Winterthur. From two o'clock till near sunset they appeared in small clouds, glistening in the sun and reaching up into the higher regions of the atmosphere. The ground in the town and its environs was quite strewed over with these little winged creatures. On the 8th of August a whole tract in width of the Lake of the Four Cantons, between Bauen and Flüelen, was completely covered with little black, winged ants (doubtless *Formica fuliginosa*, F.), so that from forty to fifty could be taken up out of the water at one handful. Many were yet alive; others were dead: they had not therefore been immersed collectively, but must have fallen on the spot into the water. On the same evening great bodies of the *Formica fuli-*

* An die Zurcherische Jugend auf das Jahr 1852, von der Naturforschenden Gesellschaft, LIV. Stück.

† The Translator desires thus to express his special thanks to Professor Heer for a copy of this valuable and interesting Memoir.

ginosa, F., were also seen in the Lake of Zurich; but it is related that at Schondorf in Wurtemberg, on the same evening, swarms like clouds (to judge from the description), of *Myrmica rubra* were moving between three and four o'clock through the country; and a like report referring to the same day was made from Soleure, Friburg, Bubendorf and Gelterkinden in the Canton of Basle: whence it is to be inferred that the swarms were moving in a southerly direction. The last great swarms (of *Myrmica rubra*, F.) we observed on the 11th of August, on the summit of the Uetliberg. Similar phænomena occur however every year, though not in these environs*. It depends in great measure on the weather. Should this happen to be fine at the time when the winged ants are quitting the chrysalis state, they all leave their nests at the same moment, and thus form those immense great cloud-like swarms; on the other hand, should the weather be unfavourable at this epoch, the swarms are distributed over a longer period, and are not therefore so striking. This is indeed the case too with our May Chafers. Let fine May weather all at once set in after a wet April, and all at once (in years when they abound) great quantities of them make their appearance, and again after a short time disappear; but if May

* The following account, which appeared in most of the leading journals at the time, is copied from the 'English Churchman' of Sept. 2, 1852 (No. 505, vol. x. p. 575).—Tr.

"*Extraordinary Phænomenon.*—A lover of natural history, who was in Romney Marsh on Tuesday the 17th ult., about 5 P.M., gives the following:—'I saw what appeared to be a column of smoke approaching me, about a quarter of a mile off. On the column reaching me, I found it was composed of red ant-flies. I think the column was a good quarter of a mile in length, and about from 50 to 100 yards in circumference: it quite darkened the sky. After it passed me it went over the river Rother, into which millions and millions of flies fell; and when I crossed it, the water was quite black. I watched the column for a mile and a half, and, notwithstanding the numbers left in the river, and on the trees, hedges, &c. over which it passed, the column appeared undiminished, and like a wreath of dark smoke. The extraordinary thing is, that the ant-flies throughout the whole marsh, thirty miles in length (as I hear it was so all through the marsh), should all have taken wing at the same time, and collected together in such vast numbers. A man who was collecting ant-eggs for me, informs me that he found himself covered with them, running up to the tops of the strands of grass and then taking wing. After the flight he scarcely found one ant-fly in the nests. Other persons who saw the flight, and who I do not believe intended to exaggerate, considered the length of the column to be a mile. The wind was in the east, the temperature very sultry, and there was every appearance of a thunder-storm. Had not my man observed the ant-flies rise from the ground, I should have thought that they came from the Continent. The column travelled at the rate of five or six miles an hour. Those persons fond of natural history will find an interesting account of these flights, and the reason, in the 2nd volume of Kirby and Spence, pp. 51, 52.'—*Sussex Express.*"

proves rainy, their flights are spread over a much longer period, and are thus less numerous. The great ant-swarms of August 1849 lead us by no means therefore to admit, that in that year an unusually great number of ants were produced; but make it only most evident to every one, how populous the Ant-tribe must be to send out such myriads of winged individuals, from any two of which a new colony might spring. Nor must we at the same time overlook that these winged ants form but by far the smaller portion of the colony, and that an infinitely greater number of unwinged ones remain behind in the nests. These creatures not only thus abound with us in the lowlands, but are met with here and there up in the higher Alps (up to 8000 feet above the sea), as they are also found in higher northern latitudes; Lapland, for instance, even possessing thirteen kinds. Still, in warmer countries they are met with in much greater numbers and more varied forms than with us. Thus they have their home all over the world, and everywhere belong to the most numerously constituted tribes of living creatures. The same condition existed also remarkably in the old world. We are already made acquainted with eighty-three kinds of Ants belonging to a former epoch, from the tertiary formation only; although but two localities (Œningen and Radoboj) have been more closely examined in this respect. These creatures therefore in all ages formed a very important section in the insect world. They must consequently perform a part of the highest importance in the œconomy of Nature. In Nature all is motion: unbroken continual production and destruction. Many animals, indeed, in all classes are appointed to destroy and carry away dead substances, and thus prepare again organic matter for new combinations. This office has been assigned to the ants also. They work up and destroy, with industry become proverbial, the productions of the vegetable and animal kingdoms. Though the chief bent of their activity is destructive, yet is it, through its operativeness in breaking up and clearing away, besides making preparation for new forms, of the greatest importance in Nature's collective household. And a good deal of the mischief, too, charged upon ants is very unjustly placed to their account; as when with us people maintain that they do harm to fruit-trees, and try therefore to drive them from their trees. Our species however only hurt the trees when they build their nests amongst their roots; but the trees themselves, as in general all plants, they only ascend to collect honey from the flowers, and to search for Aphides, whose sweet juices they lick off. Into our houses they seldom intrude, and the harm they do in them is, in fact, inconsiderable. In warm countries, on the other hand, the case is very different. There, ants are found which not only cause much harm to cultivation, but also force their way in enormous companies into the dwellings of man, and thus become terrible pests of the country. One of these kinds I had opportunity last year in Madeira to become acquainted with. At first, by the ravages which it caused in my dwelling, it occasioned me many annoyances; but afterwards, when I began to pay attention to its habits, it afforded me much amusement. I communicate these observations in the hope that they will induce some of our young friends to institute similar ones themselves, for which the richness of our environs in insects affords such manifold opportunity.

In the accompanying Plate (III.) is figured the small minute Madeiran Ant. Fig. I. represents the female, fig. II. the male; figs. III. & IV. the neuters, which present two very distinct forms. The one (fig. III.) has a remarkably large head; it is larger than all the rest of the body, and gives the little creature a most extraordinary appearance; in the other, the head is much smaller and nearly circular. These small-headed ants are the working-class of the colony, and form the mass of its population; we shall therefore call them the *labourers* or *workers*. The large-headed ants can scarcely amount to $\frac{1}{100}$th of these, and serve partly for the defence of the nest; we shall therefore distinguish them by the name of *soldiers*, from the rest. In still smaller number appear the *females*, which not only are much larger than the labourers, but are also distinguished by their transparent glassy wings and shining brown colour. The males are not much bigger than the labourers, and of a coal-black colour. Accordingly, with these ants the family consists of four quite different-looking individuals: of workers, soldiers, males, and females. This ant-colony is consequently further developed than those of our species, in which only one form of neuters (the common wingless ants) occurs.

The house-ant lives in very numerous societies, under stones in the ground, and also under the bark of trees, and within the walls of houses. The stones serve them, in common with all ants living in the ground, in place of a roof for shelter. Their nests go down pretty deep into the earth, and are divided into a great number of passages and chambers. They have several entrances, which are sometimes covered over, and run like burrows under the stones. Not unfrequently they form their nests in flower-pots standing before the windows and on the balconies.

They are found on the whole south side of the island of Madeira, up to a height of about 1000 feet above the sea, in incalculable numbers, especially in hot sunny places. In turning over ten stones in such places, these ants are pretty sure to be living under eight. In the city of Funchal there can scarcely be a house which does not harbour millions of these creatures, which mount up to the highest stones, issue forth in whole troops out of the chinks of the walls and floor, and in orderly regular columns traverse the room in all directions. They creep up the table legs, along their edges, upon the tables themselves, and even into chests of drawers, boxes, &c. Being extremely small, they can get in through the smallest cracks and holes. You may kill thousands on thousands, and yet perceive no decrease of them; they are continually replaced by new hosts in the rear. Only after very heavy rains, during which the water that came down in torrents made its way between the walls of our house, did we observe some sort of diminution, which we thought might indicate that a large number had been drowned. I found these ants however not only in Madeira, but also at Seville, in the rooms of our hotel in the middle of the city.

This little creature is attached to no particular kind of food; in houses it attacks all sorts of provisions laid in store, especially preferring sweet things (sugar, honey, syrup, preserved fruits); but not less also fresh fleshy fruits of all kinds. If you leave on the table a custard-apple, a lemon, or an orange, having only the smallest opening possible through the rind, you may safely reckon that in an hour's time it will be full of ants, going to and fro in whole trains. But if there be no opening in the fruit, it is then safe. It would be indeed an easy matter for the ants to gnaw through the leathery coats; but the essential oils, which they plentifully contain, appear to protect them; for all insects are known to avoid these oils. They seem to prefer flesh to vegetable substances. Raw and boiled meat is eagerly sought by them; but insects are very decidedly preferred. I had great trouble to guard my collections of insects from them. At first they made their way in numbers into the boxes, and my painfully collected treasures were grievously mutilated by them, until I found a means to make them more secure from them. They do not however seek after dead insects only, but attack also the living. Very droll it is to see how these tiny little creatures seize on flies! Let a fly settle on the table-cover near an ant, and at once the latter springs upon it, seizing it by a leg. The fly tries instantly to get free from its enemy and escape; but the ant has grappled on to the table-cover by its legs, and with its pincers holds the fly fast. Other ants soon come to help the first, and the fly is lost. This is much sooner the case when soldier-ants are near. These spring at once like cats upon the fly, and gnaw off first its wings and legs, so that it is then easily carried off by the labourers. But the soldiers never make the first seizure; they are much more cowardly than the labourers, and often quit the fly when it makes very active exertions to shake off its assailants. I have never seen the labourers do so. Sometimes they cannot, indeed, hold the fly fast, as when it is on a smooth wall or polished table; but they do not therefore let go their hold with their pincers, but remain clinging to the fly's legs when it flies away. When it again settles, the ant tries again to hold it, and, with the help of its companions hastening up, to master it. I often shut up flies and ants together in glasses, in order to observe this battle of the ants and flies; and have frequently had opportunity to satisfy myself with what extraordinary obstinacy* the labourers pursued the flies buzzing about, and how so insignificant a wingless little creature could master a winged one about a hundred times bigger. General Hardwicke relates, that the ants in India are the worst enemies of the Termites (the so-called White Ants); those also of Brazil are known to clear the houses of these dangerous guests. With what keenness our little ant attacks the Termites, I have more than once had occasion to observe. I had procured a great number of Termites, and had placed them, with the pieces of wood in which they lived, in a tin box, which was closed with a lid. The ants however managed to get into the box through a small chink, and within two hours the box was swarming with ants, which had destroyed nearly the whole of the Termites, amounting to a couple of hundred. But it is still much more extraordinary that even grasshoppers cannot withstand them. I had in a box half-a-dozen specimens of the Cape Grasshopper (*Gryllus capensis*, L.), which is abundant in Madeira, in order to observe their habits and their mode of chirp. To my surprise, I soon discovered that whole troops of ants had crept into the box, furnished as it was with little air-holes, and had attacked the grasshoppers. These were hopping restlessly about the box, and had also bitten and killed whole masses of ants, so that the bottom of the box was quite covered with their nibbled remnants; but at last the grasshoppers were forced to yield to hostile numbers, and, with the exception of the horny portions, were completely devoured. How should we be astonished to see an animal of the size of a mouse hunt elephants, and master them; and yet a grasshopper in proportion to our ant is bigger than an elephant! We can but be grateful to these ants for living in continual warfare with the flies, and other troublesome inmates of our houses. But they attack also useful insects. I had

* We have observed also the same obstinacy in our own ants, which will often rather let themselves be torn in pieces than release an object into which they have once fixed their jaws. I once saw an ant (*Formica fusca*) that had seized by the leg a great courser-beetle (*Carabus hortensis*), which, in spite of all its efforts, could not free itself.

placed in front of my room, on a balcony, a Cactus (*Opuntia Ficus indica**, L.), with cochineal insects, in order to acquaint myself more closely with the metamorphoses of these wonderful little creatures. Soon however the ants made their appearance here also, and, by degrees, ate up all the cochineals. This is a fact very well worth noting, since our ant must do great injury to the cochineal-breeding, which for some years past has become of the greatest importance to the Canary Islands. At least I saw this ant very plentiful in cochineal-gardens, where they ought to be exterminated as much as possible.

The predaceous animals, as a rule, spare those of their own kind. Strange to say, this is not the case with our ant. In hope of becoming more closely acquainted with their œconomy, I placed four winged females, with two soldiers and six labourers, in a glass, which was stopped at top, but with a hole in the stopper just large enough to let the labourers go out and in, but not the bigger soldiers and females. These therefore were obliged to remain in the glass, in which was placed sufficient food. The glass was soon entered by other labourers from without, which presently attacked the females and tore up their wings. Since the labourers are said to tear off the females' wings to prevent their flying away from the nests, I thought at first the matter might be thus explained; but in the course of a few days the females had their antennæ and legs also torn off; and at last we found their heads pulled off, and the labourers busy in tearing them completely asunder, and in carrying away the separate pieces out of the place. Strange to say, the females did not defend themselves in the least, which would however have been easy for them to do, from their considerably larger size and stronger fangs. They bore all these attacks with the greatest, and to us incomprehensible, resignation. Nay more; even the soldiers were attacked, and one of them killed; some of the labourers took all sorts of pains to carry away the head, and get it through the little hole in the stopper; but through this it would not pass. Thus individuals of their own species are killed and eat up when they are found in circumstances in which they can be no longer profitable, as was the case with these individuals shut up in the glass. Not unfrequently I saw ants that had been hurt† carried away by labourers, to which

* Rather *O. Tuna* (Mill.), D.C., which is the common species in Madeira, and that on which the Cochineal there usually exists. I do not recollect to have ever seen the true *O. Ficus indica*, L., in the island, though *O. vulgaris*, Mill., sometimes occurs.—R. T. Lowe.

† But apparently healthy ants also were sometimes carried off in this way. Rengger relates the same thing (Reise nach Paraguay, S. 250) of the Isau ant (*Œcodoma cephalotes*, Latr.). "The labourers are very often seen,"

they had affixed themselves by laying hold with their fangs at the abdominal pedicle. I imagined that they were carrying them to the nest to nurse them, in the same way as they treat their young with the greatest care; but the very barbarous habit above related would make it seem more probable that they were carried into the nest in order to be there fed upon, as being no more capable of work. With the ants, everything is turned to the most careful possible advantage of the common stock; and this reaches so far, that one of the same species, nay, even of the same family, is not spared, when it can no longer serve its purpose.

With this bad propensity, it must seem very strange that any different sorts of animals should be ever met with in their nests. Snails, worms, caterpillars, and such like, in general are never found under the same stone; seldom even a millepede (*Julus*), which they however attack only when the nest is disturbed, and then all the ants of every sort fall with great fury on the strangers, as if they considered these the cause of the misfortune which has befallen them. The millepedes then try, with violent contortions, to get free from the ants that cling to them. But claiming attention as animals peculiar to ants, are a Coccus, and a very curious little beetle (*Cossyphodes Wollastoni*, Westw.), which is never found elsewhere. I found it first in an ants'-nest in the country; but afterwards in the balcony of our apartment, where an ant-colony had established itself in a tub in which grew a *Diosma alba*, L.* I have seen at different times more examples of the same insect, and always at the entrance of the nest. For what reason this very peculiar little beetle lives in these ant-colonies, I am not able to explain. We are acquainted already with a great number of minute beetles which occur in the ant-nests of our own country. Some of these (such as the little club-beetles) are regularly tended by the ants; and, as I have often satisfied myself, they are carried down into the deeper parts of the nest with the same care and anxiety as the pupæ when the nest is disturbed; but the others are probably merely tolerated, without being adopted into the family. The *Cossyphodes* seems to belong to the former class.

says he, "travelling home laden with another of themselves. These are not chance prisoners from another nest, but they belong to one and the same household; for the one carried is often bigger than its bearer. Besides, I have often observed, when two ants were returning home, that one would lay hold of the other and carry it home. If moreover its load be taken from one of these carriers and placed on the ground, both travel then along the same road quietly home." The like has been observed also amongst our own ants. (Compare Huber, 'Recherches sur les Mœurs des Fourmis,' p. 140.)

* *Diosma ericoides* (Sims), Curt. Bot. Mag. t. 2332.—Tr.

In order to look more into our ants' manner of proceeding in their work, I placed a small wooden vessel in a tumbler of water, and stretched a thread from the vessel through the air to a ledge on the wall two feet off, and from this ledge a second thread to the ground. This thread was perpendicular, the first horizontal. The ants soon passed along the horizontal thread to the vessel in the water, on which I had laid a small piece of meat. No sooner was this discovered, than the ants set to work at it. In a short time, whole masses poured in. At first they were only labourers, but presently a few soldiers made their appearance in the train of the former. The soldiers cut up the meat into little pieces, drawing up their abdomen into an almost vertical direction, like that of their head. (Compare fig. III. 3). They presented thus a most curious appearance, when one looked down from above, and saw only the middle part of the body and the crown of the head. The meat was cut up into quite small fragments with their great hatchet-shaped pincers, being held fast at the same time by the two fore-legs. The labourers took these fragments between their pincers, and carried them away. Whole trains passed along the horizontal thread, and each of those that formed them had a fragment in its mouth. But the labourers alone were engaged in this act of transport: I never saw a soldier carrying away anything. At times, indeed, one or another went back over the thread, but always without taking anything with him. The ants soon discovered the perpendicular thread, and found out that they could get easier to the floor of the room by it than by the wall; and thenceforward the whole train always passed along this perpendicular thread down to the ground, and from thence to a corner of the room, where they disappeared through a little hole in the wall. Thus, from the vessel in the water they first passed along the horizontal thread to the wall, where they had to run along a ledge, and then arrived at the perpendicular thread, which reached down to the ground. The thread was always thickly crowded with ants, some passing downwards laden with fragments, the others empty, mounting upwards; and the up and down passers always arranged in files, so as not to disturb each other mutually in their way. More than once I placed ants, which I had fetched out of another room, in the vessel in the water. These also soon found, indeed, the thread leading to the wall; but there they dispersed themselves on all sides; whilst the others, without stopping, always ran to the perpendicular thread. This gave me a ready means of ascertaining whether ants from different nests came into my room or not. A closer investigation proved the first to be the case. It turned out that all the ants which resorted to the vessel in the water to fetch food, belonged to one colony, as well as all which appeared on the table on which the vessel stood; and that, on the other hand, those which were destroying the fruit on the window-seat, must belong to another nest. From this, however, I could not quite draw the conclusion, that one ant-colony, when it has fallen in with a prize, excludes another from a share in it. At least I have never seen them fighting with each other, which in such a case would scarcely not have happened. Probably all provision that may be discovered is considered common property, and each party keeps as much of it as it can carry away. But if once a nest has taken entire possession of a thing, then probably the others keep aloof, and leave it altogether to the first. Here, too, it is to be considered, that ants clearly have a sort of power of communication; for let only a single labourer discover a supply, and without delay there appears a whole troop of ants to work at it. We cannot otherwise explain this circumstance to ourselves, than that the exploring labourer had gone back into the nest, and thence procured help. It would be in consequence of this circumstance that, as a rule, ants of the same nest are always collected for a common work.

That ants have memory, Huber has already pointed out; and the following observation would also confirm it:—One of my fellow-lodgers had arranged in his room a similar apparatus to that which I have described above; only in this, from the middle of the horizontal thread, which was several feet long, a second shorter thread was carried to the nearest wall. The ants soon chose this last road; thus going from the vessel in the water to the middle of the horizontal thread, and thence to the wall over the thread at right angles to it. After some time this last was removed. At first all the ants stopped suddenly, exactly at the place where, before, the thread that led sideways was fastened, and ran no farther along the horizontal thread. They had therefore observed closely for themselves the place whence the side-thread had branched off, though it had no sort of mark. At last, after having run restlessly backwards and forwards for some time, they tried to proceed further on the thread, and thus arrived at the wall, where they collected together in a cluster, having thence to seek the way for themselves. Perhaps too the fact here communicated may be explained by the faculty of tracking in ants. The dog tracks out, as is well known, the way which his master has taken to a great distance; and so the ant, perhaps, possesses a like fine "scent," which enables it to find again with certainty the way along which it has once passed. As above noticed, the larger pieces of meat placed in the vessel were torn up on the spot into scraps of pretty equal size, such as a single labourer could well transport; in like manner were grasshoppers and larger insects also dealt with; but dead flies, which were placed in the vessel, were not divided, but carried off quite entire. To ascertain the strength of these little creatures, I tied with a thread first two, then three and four dead window-flies together, and they dragged even this load of four flies first to the perpendicular piece of wood to which the level thread was fastened, aloft, then horizontally along this, and then down the perpendicular thread till they brought it to the hole in the wall. Here the flies were first pulled in pieces, because the hole was too small to let them be carried through it entire. This carriage of the flies over the thread stretched through the air, was extremely droll to see. A single fly would sometimes be dragged away by only two ants; on the load of four flies were mostly from six to twelve labourers employed. Most of these had laid hold with their fangs in front, and pulled, going backwards, at the load; the rest had fastened on the other side, and pushed, going forwards, in a straight direction, holding on meantime by their legs to the thread. The motion forwards was always by short impulses; on each jerk there followed a longer or shorter rest. Men are well known to do the same in shoving along a great load: when several share the work, it is always managed by a cry (Yo ho), that all may lay hold at once, and so bring equally to bear the force applied. A like co-operation in these ants could not but be discerned: the hinder pushed at the same time as the front ones pulled, and at the same time they left off and rested for an instant together. But by what kind of means this unanimity in their operations was attained, I was not able to discover. The most remarkable thing moreover was, that sometimes all let go together, and a single one held the whole load in suspension. Here therefore again some agreement must have taken place, for not one fly ever fell to the ground: there was always an ant ready to hold on: but had all left loose at the same time, the load must have naturally fallen down. The load was altogether held by the fangs only; with their legs the ants clung fast to the thread, wherein the peculiar curvature of the first joint of the foot, and the remarkable claw (see fig. I. 6 *b*, *c*) corresponding thereto, had each essentially their share. Thus a single, and that an unusually minute ant, was able, hanging to a thread, to support four flies. What immense muscular power in the fangs and legs does this display !*

Whilst the ants were transporting this burden, they were not easily disturbed at their work; whilst otherwise they quickly run off when they are meddled with. For example, if one lifts up a fruit full of ants, or shakes it, they hurry out as fast as

* A house-ant (dried) weighs $\frac{1}{20}$ of a milligramme; but four window-flies (also dried) $18\frac{8}{10}$ of a milligramme. Thus this ant was able to bear a load 376 times its own weight.

possible. They do not go back to their nest, but hide themselves in some cranny, or else under some near object; but as soon as the danger is over, they come out again, and betake themselves afresh to their work. On such occasions one may satisfy oneself that they do not see far. On taking away from an ant the morsel it is carrying, it seeks about for it for some time, running hastily in zigzags up and down; but at times stopping still, and lifting its head up in the air. When placed at the distance of some inches, the ant does not go straight up to it, as would be the case if it could see it, but runs round about in different directions, and only when at the distance of about an inch, springs forward on it, as if seeming then to have first seen it. If we examine the eye of this ant, we shall find that (as, however, generally in all ants) it is of simple structure, as in most other insects, and only consisting of a small number of lenses (Ocellen).

In order to see whether these ants would try to pass over water, I several times destroyed the connexion formed by the thread between the vessel in the water and the wall, so that the ants which happened to be in the vessel were quite cut off. If there was a scum formed over the water (which is always the case when the water has stood some time, a thin film spreading over the water from the falling dust), then they tried to run away over it; a few got quite safe over, when the film could bear them; but others broke through and were drowned. But I never saw such a number fallen into the water that a bridge was formed by the dead bodies, as is related of other sorts of ants, and that by this means they reach vessels of provisions placed in water.

The work of these little creatures goes on alike day and night; and if you look after them during the day, or in the night, or early in the morning, you see always the same stirring activity. Hence they seem to observe no fixed resting-times, at least none in connexion with the change of day and night. This is also the case with most of our own native ants, of which Pliny already relates that they work by moonlight. These however hybernate. The ants of warm countries, and so of Madeira, on the contrary, do not. One of our own kinds (*Formica fusca*, L.) is also found there, and it too continues the whole winter in activity. Our house-ant is found throughout the whole year in nearly equal abundance. The males and females probably appear at the end of summer. Of the former I found only a single example, whilst females were found in several nests till the new year. In most cases it might well be that I observed none, because they keep in the deeper parts of the nest. The females lay minute little white eggs, out of which proceed little white maggots; the pupæ are free, not enclosed in cases, as in our common ants

(*Formica*), which pupa-cases with us are falsely called ants' eggs. The soldiers are met with in the nests in proportionally greater numbers than outside; they appear therefore to be provided for the work within the nest and its defence, whilst the labourers procure food and take care of the young. At least it is these which carry away the pupæ when the nest is disturbed. That the soldiers however go out also with the labourers, and are serviceable to them in their operations on the treasures they discover, has already been mentioned. Lacordaire (Introduction à l'Entomologie, ii. 498) relates of the Train-ant* (*Œcodoma cephalotes*, Latr.) of Bengal, that the soldiers accompany the trains, without mixing with the mass of the army. Stationed at the sides of the column, they are to be seen marching forwards, then again turning back to an earlier occupied post, halting a moment to see the train file past, and running hastily up and down, especially if a stoppage anywhere occurs, and their help be necessary. Nay, they will often, as Lacordaire relates, climb up the plants near the train, station themselves on the edges of the leaves, and from this elevated post inspect the train of their troops. In our Madeiran ants the soldiers play no such prominent part, always marching along in the same rank and file as the labourers.

All that we have said above relates to one kind of ant only, the *Œcophthora pusilla*; but in hot countries there are whole numbers of species which have similar habits, and which come into hostile collision with man. In Brazil this is so much the case, that the inhabitants there say, "The ants are the queens of Brazil, for they have the most power in the country." One of the largest and most dangerous kinds, which is spread over the whole of tropical America, continental as well as insular (*e. g.* Cuba, from whence we have specimens), is the Train-ant (*Œcodoma cephalotes*, Latr.). The female is bigger than our hive-bee; the labourers about twice as big as those of our red wood-ant. It lives in very populous colonies in the ground, into which they dig their dwellings, sometimes nine feet deep. It marches in great regular trains, and on its course strips bare of leaves, often in a short time, trees and shrubs. Rengger relates of the Isau ant (which I do not consider different from the train-ant†), that in one night many millions, inhabitants of a single nest, levelled to the ground whole plantations of manioc, maize, potatoes, melons, garden-stuff, &c. Having rapidly ascended the plants which they intend to plunder, they place themselves at the

* Visitor-ant, Angl.—Tr.

† From specimens seen by me in Rengger's Collection.

edges of the leaves, and with their fangs cut out in a short time a piece of about half the size of a farthing, which they then directly carry home. If, as very often happens, the piece falls to the ground before they have been able to lay hold of it, they set themselves at once afresh to work, and do not go down to look after the fallen piece. It has been maintained, that the Isau throws this piece on purpose to the ground to save itself and its fellow-labourers the trouble of carrying it down. But this is by no means the case; for the ants approaching from the nest pay no heed to these pieces of leaf, though the ground is often quite strewed with them, but each for itself bites its own piece out of a leaf whilst yet attached to the plant. This communication of the close observer Rengger serves to correct earlier statements, that the Train-ant bites the leaves off at the stalk, and lets them fall to the ground, where their companions stand ready to clip up the fallen leaves and carry them home. This stripping process is often so rapidly effected, that sometimes in the morning trees look like besoms which the evening before were standing in their whole beauty of foliage; nay, Lund relates, that he has seen a tree stripped within half-an-hour. Dr. Delacour speaks of a similar species, which sometimes in New Spain robs a garden of its whole crop of plants in one night. One of his acquaintance had planted a very fine vineyard: at the end of three years the ants made their appearance, and, in the space of one night, it was despoiled of the whole of its leaves and destroyed.

The Train-ant properly lives in the open air; but sometimes it makes inroads in regular trains, like a great army, into houses, where it immediately makes chase after the flies, the spiders, cockroaches, and all vermin generally. However useful this activity, yet is it so troublesome a guest, that those who live in the house are not unfrequently obliged to leave their dwelling for some time. When these ants swarm, the females are caught in great quantities; the abdomen is cut off, fried in butter, and esteemed a delicacy. Eaten undressed, its taste, says Rengger, is like that of a hazel-nut; and when slightly toasted, or covered thick with syrup, it tastes like burnt and sugared almonds. The Train-ant does not attack people; but this is by no means the case with certain other American species. Dr. Delacour speaks of a little reddish-yellow kind, which, by its sharp bite causing inflammation, is very dangerous to little children. His own child, twenty months old, once, in the middle of the night, awakened him by a violent shriek; on examination he found it covered by a crowd of ants, which had bitten it so violently, that in the morning it was quite covered with pustules, and for forty-eight hours lay in a violent fever. The same kind is a great enemy to young chickens, and makes it in many places very difficult to rear them. But still more dangerous, according to Dr. Delacour, are some of the wood-ants. In the year 1834, he says, a young man of respectable family, resting under a tree on the way from Tampico to Mexico, was attacked by the ants and completely eaten up. On the following day nothing was found but his skeleton, with the clothes. A similar accident he relates also to have happened in the year 1838; nay, he had once himself nearly fallen a victim to these creatures. In a forest near Turpan he had been leaning for a few minutes against the trunk of a tree, when all at once he was so violently bitten in all parts of the body, that he would have sunk down under the violence of the pain had not two of his hunting companions come up, stripped off immediately his clothes, and freed him from his enemies. In Paraguay, also, a species (*Odontomachus*) is found, which, when it makes its appearance, puts the inhabitants there into fear and terror. According to Rengger ('Reise nach Paraguay,' S. 262) it appears all at once in great companies, and attacks men as well as beasts; crickets, spiders, grasshoppers are immediately torn by them in pieces. I have, says Dr. Rengger, seen mice, covered with these insects, leave their hole in torture; young mice, which have been eaten up by them in their nest; lizards, and even snakes, flying before them. They attack people in their sleep, and gnaw them till the pain awakens them. Dr. Rengger saw a drunken mulatto whose eyebrows, partly during his own presence, as well as eyelashes, these beasts entirely eat off, and also gnawed the skin of his face to the quick. Two of his patients were attacked by these creatures in their bed, and one of them died soon after, partly in consequence of the fright.

In tropical Africa, also, certain ants occur which prove extremely troublesome to man. The most exact information we possess about them is that afforded by Mr. Savage concerning the Driver-ant (*Anomma arcens*, Westw.), which is found on the west coast of Africa. It is a little black ant, with very sharp and pointed fangs; and the neuters also present two forms, one smaller (the labourers) and another larger (the soldiers). They have no fixed dwelling, but seek their lodging in shallow hollows under roots of trees, overhanging rocks, and such like, where they find shade. The direct rays of the sun being fatal to them, they only come out on cloudy days and by night. If surprised by the sun at their work, they build over their path a vault with earth, which they glue together with their saliva. At other times the soldiers form a vault over the path for the shelter of the labourers. At the rainy season, if their places of abode are inundated, they form themselves into a round cluster; the young, with the weaker ones, within, the stronger on the outside, and thus float about till they come to dry land. If they fall in with a broad piece of water in the way, they form, by laying hold of each other, a chain across the water, along which the rest pass as over a bridge. The Train-ant is also said to do the same. Madame Merian relates the process thus:—The first ant places itself on a little bit of wood, and holds fast on to it by its fangs; a second lays hold of the first, a third in like manner of the second, and so on. In this way they let themselves be wafted over by the wind, until the last of the chain reaches the other side, and then at once they pass over the bridge by thousands. The Driver-ant often forms similar chains from the twigs of trees to the ground. Their food consists principally of animals, and they kill large-sized ones; even the gigantic snake (*Python natalensis*) is exposed to their attacks. Their first assault is directed on the creature's eyes; and, when surprised by them, their immense numbers win the day. They make their way into houses in crowds by night, when a universal flight of rats, mice, lizards, beetles, and other vermin, announces their arrival, and the inmates are obliged to leave their beds and take to flight into the open air.

Amongst the Ants of India, the *Formica indefessa*, Sykes, is spoken of as destructive in houses; and Lieut. Sykes has furnished (Transact. of the Entomol. Soc. of London, p. 104) some interesting observations, from which we shall extract the following in particular:—A table laid out with sweets and dishes had its legs placed in a vessel of water, and the water covered with oil of turpentine, making it impossible for the ants to reach the legs of the table. The table stood however near the wall, so that the larger ants, holding on by their hind-legs to the wall, could reach the table with their fore-legs and thus get upon it. The table was therefore drawn further back; but now the ants went a foot higher up the wall than the level of the table, and jumped down upon it from the wall, never falling between the table and the wall to the ground, but always alighting on the table.

In New Holland there are in particular two kinds of *Eciton* (*E. gulosum* and *E. forficatum*, Latr.) which are much dreaded, from their appearing in great numbers, and for their violent bite. They are distinguished by their long and straight fangs.

[To be continued.]

XVII.—*Characters of seventeen new forms of the* Cyclostomacea *from the British Provinces of Burmah, collected by* W. Theobald, jun., Esq. By W. H. Benson, Esq.

1. *Alycæus pyramidalis,* n. s.

Testa perforata, pyramidato-conica, læviuscula, confertim oblique arcuato-striatula, albido-carnea, apicem versus rubella; spira pyramidata, sutura valde impressa, apice obtusiusculo; anfractibus $5\frac{1}{2}$ valde convexis, ultimo postice inflato, tum constricto, deinde subtumido, aperturam versus latiori, tubulo calloso, elongato, retroverso, suturali, pone constrictionem oriente, munito; apertura obliqua, subcirculari; peristomate duplici, interno continuo, expansiusculo, externo expanso, reflexiusculo, anfractu penultimo brevissime angulatim adnato, superne antice sinuato, tum arcuato, ad umbilicum leviter emarginato. Operculo —— ?

Long. 12, axis 10, lat. 10 mill.

Hab. raro ad collem Therabuin, vallis Tenasserim.

Nearly related to the Cochin-Chinese *Alycæus gibbus,* Fér., but easily to be distinguished by its more pyramidal growth, and by the greater length of the spire in proportion to the breadth of the last whorl, its more symmetrical proportions, sculpture, &c. The origin of the sutural tube is about 4 millimeters from the anterior margin of the aperture. This shell was met with at no other place in the district, and seemed restricted to a spot of a few acres in circumference. The hill is of limestone, steeply scarped and almost inaccessible. Three species of *Helix* occurred there which were similarly deficient elsewhere.

2. *Alycæus umbonalis,* n. s.

Testa late umbilicata, depressa, subdiscoidea, confertim acute arcuatim costulata, cinereo-albida, apicem versus obtusulum, rubellum vel nigrum, rubescente; spira brevi, sutura profunda; anfractibus $4\frac{1}{2}$ convexis, ultimo ad latus, spiraliter rugoso-cancellatum, inflato, tum constricto, deinde tumidiusculo, tubulum retroversum, elongatum suturalem pone constrictionem gerente; apertura valde obliqua, circulari, undata, peristomate duplici, interiori continuo, expanso, nitidissimo, prope umbilicum sinuato, exteriori expanso, incrassato, ad anfractum penultimum breviter interrupto; umbilico perspectivo. Operculo corneo-fusco, multispirato, anfractuum marginibus scabre elevatis, extus profunde concavo, intus convexiusculo, nitidissimo, sulco marginato, umbone centrali papillari munito.

Diam. major 10, minor 8, axis 5 mill.

Hab. ad Akaouktong, prope ripas fluvii Irawadi, nec raro.

As the last-mentioned species exhibited a Cochin-Chinese form, so does this shell represent, on a larger scale, the little Western Himalayan species *A. strangulatus,* Hutton. The scabrous cancellation of the inflated part *only* of the last whorl is an unusual feature, no trace of the spiral rugæ appearing elsewhere on the whorls.

The origin of the sutural tube is about 4 millimeters from the aperture. The shell has much affinity with the Bornean *Alycæus Spiracellum,* A. & R., which has a somewhat similar operculum. Dr. Pfeiffer informs me that it is an *Alycæus,* and not a *Pterocyclos,* as conjectured by him before he had an opportunity of inspecting the shell.

3. *Alycæus Amphora,* n. s.

Testa anguste umbilicata, ovato-globosa, exilissime costulato-striata, albido-carnea, versus apicem acutiusculum rubella ; spira conica, sutura subprofunda ; anfractibus 4 convexis, ultimo inflato, juxta aperturam constricto, tubulo suturali longissimo prope peristoma oriente ; apertura verticali ; peristomate duplici, continuo, interiori breviter porrecto, intus pallide aurantiaco, exteriori expanso, striatulo, incrassato ; umbilico intus spiraliter striato, margine compressiusculo. Operculo —— ?

Long. $5\frac{1}{2}$, diam. obliq. 5 mill.

Hab. ad Moulmein, et in valle Tenasserim raro.

The shell occurs also of a smaller size. It approaches in form the Sikkim *A. Urnula,* nobis, but has a more globose aspect. The extreme length of the sutural tube is remarkable ; it extends so far round the last whorl as to be visible from the front on both sides of the shell. The aperture occupies about half the height of the specimen.

4. *Alycæus sculptilis,* n. s.

Testa late umbilicata, turbinata, subtrochiformi, acute costulata ; spira conica, sutura profunda, apice attenuato, acutiusculo ; anfractibus 5 convexis, ultimo ad latus inflato eo costulis confertissimis munito, tum constricto, antice læviori, tumido, tubulo suturali mediocri, ab apertura remoto, incumbente, circa umbilicum obtuse angulato, intus concaviusculo ; apertura obliqua, circulari ; peristomate duplici, interiori subporrecto, incrassato, margine superne profunde inciso, interiori dextrali interne crenulato vel denticulato, externo incrassato, expanso, reflexiusculo, superne incrassato prominente, ab anfractu penultimo sinu profundo separato. Operculo —— ?

Diam. $3\frac{1}{2}$, axis $2\frac{1}{4}$ mill.

Hab. raro ad Thyet-Mio prope fluvium Irawadi, non procul a finibus provinciæ Burmanicæ Britannicæ.

The specimen is much weathered, and has lost all its colour, so that I am unable to describe that part of its character. It presents a new form in the genus, and exhibits peculiar characters in the slit inside the aperture at its upper part, and in the crenulation or denticulation along the callous interior of the right lip. The teeth are twelve in number, and are disposed in pairs. The incision resembles that observable in some of the species of *Pterocyclos*, and there is a slight disposition towards the formation of a wing.

5. *Alycæus armillatus*, n. s.

Testa umbilicata, depresso-turbinata, costulata; spira conoidea, sutura impressa, apice obtuso; anfractibus $3\frac{1}{2}$ convexis, ultimo ad latus inflato, confertius costulato, tum constricto, antice tumido, læviori, tubulo suturali brevi, ab apertura remoto, munito; apertura obliqua circulari, peristomate duplici, interno valde porrecto, continuo, margine simplici, extus striato, exteriori expanso, reflexiusculo; umbilico subaperto. Operculo ——?

Diam. major 2, minor $1\frac{3}{4}$, axis $1\frac{1}{4}$ mill.

Hab. ad Thyet-Mio cum præcedente.

The exterior expanded peristome, forming a conspicuous collar round the porrect interior portion, is the most prominent character in this very minute species. The only specimen received is in a weathered condition, and so much bleached that the colour of the perfect shell cannot be ascertained.

Five new forms have here been added to this curious restricted genus, which now contains nine species, three of which are Himalayan, one Cochin-Chinese, and one (*A. Spiracellum*, A. & R.) from Borneo. The Ultra-Gangetic region must at present be considered the head-quarters of the type.

6. *Pterocyclos pullatus*, n. s.

Testa aperte umbilicata, convexo-depressa, confertim radiato-striatula, nigrescente-castanea, superne strigis luteo-albidis, fulguratis, fasciaque saturata ornata; spira convexa, sutura profunda, apice prominulo; anfractibus $4\frac{1}{2}$ convexis, ultimo longe descendente, subtus convexo; apertura vix obliqua, circulari; peristomate duplici, interiori breviter porrecto, superne sinu mediocri latiusculo, interrupto, exteriori vix expansiusculo, superne alam subrevolutam semicucullatam, antice breviter descendentem obtusam, ab anfractu penultimo distantem efformante; umbilico mediocri, profundo, perspectivo. Operculo intus concavo, extus concaviusculo, scabro; anfractuum marginibus elevatis; margine laterali lato, lamellis acutis spiralibus munito.

Diam. major 13, minor $11\frac{1}{2}$, axis 6 mill.

Hab. ad Akaouktong, prope fluvium Irawadi, satis frequens.

The less depth of the interior hollow of the operculum and the structure of the wing show a departure from the typical species of *Pterocyclos*, which becomes more apparent in the southern form next to be described.

7. *Pterocyclos Cetra,* n. s.

Testa late umbilicata, orbiculato-depressa, capillaceo-striatula, luteo-cornea, strigis radiatis, subremotis, irregularibus, ornata; spira planata, sutura impressa, apice vix prominulo; anfractibus 5 convexiusculis angustis, ultimo breviter descendente; apertura obliqua, circulari, peristomate duplici, interiori continuo, breviter porrecto, superne breviter emarginato, exteriori expanso, incrassato, superne lingua obtusa vix descendente, sinu profundo ab anfractu penultimo separata, munito; umbilico lato, non profundo, omnes anfractus exhibente, margine subangulato. Operculo —— ?

Diam. major 13, minor 10, axis 4 mill.

Hab. ad Moulmein, et in valle Tenasserim satis frequens.

8. *Cyclophorus? scissimargo,* n. s.

Testa umbilicata, globoso-turbinata, sub epidermide cornea albida, strigis distantibus angulatis picta, radiato-striata, striis exilissimis et lineis elevatis remotis spiralibus, his quidem ciliatis, cancellata; spira conica, sutura profunda, apice obtusiusculo, nigrescente; anfractibus 5 convexis; apertura obliqua, subcirculari, superne leviter angulari, peristomate duplici, exteriori et interiori acutis, sulco separatis, margine columellari emarginato, parietali adnato, superne breviter anguste inciso; umbilico profundo, anguste perspectivo. Operculo —— ?

Diam. major 7, minor $5\frac{1}{2}$, alt. 7 mill.

Hab. ad Phie Than vallis Tenasserim, raro occurrens.

This little species, which has some affinity to *C. triliratus,* Pfr., is singular on account of the incision which appears in the parietal margin near its junction with the right lip, a feature not observed in any other species of the Cyclostomacea. It is with some hesitation therefore that, in the absence of an operculum, I refer it to *Cyclophorus,* although the general habit of the shell bears out the location.

9. *Cyclophorus Calyx,* n. s.

Testa late umbilicata, orbiculato-depressa, radiato-striatula, albida, strigis castaneis radiatis superne picta; spira planata, sutura impressa, apice vix prominulo; anfractibus $4\frac{1}{2}$ convexiusculis, ultimo compresso, subtus, circa umbilicum minime profundum, latum, angulato; apertura obliqua, circulari, peristomate duplici, continuo, breviter adnato, externo incrassato, superne expanso, angulato. Operculo —— ?

Diam. major 10, minor 8, axis 3 mill.

Hab. ad Akaouktong, prope ripas fluminis Irawadi.

The flattened depressed form of this shell, and the angular expansion of the outer peristome at the top of the aperture, render it easy of recognition among the depressed and widely umbilicate forms of *Cyclophorus*.

10. *Leptopoma aspirans*, n. s.

Testa perforata, globoso-conica, acuminata, tenui, translucente, oblique et spiraliter exilissime striata, lineis elevatis 6 spiralibus, æquidistantibus, superne munita, albido-cornea, fasciis fuscis vel strigis angulatis castaneis ornata; spira acuminato-conica, sutura impressa, apice acutiusculo; anfractibus $5\frac{1}{2}$ convexis, ultimo ad periphæriam carinato, subtus læviori; apertura obliqua, subcirculari, peristomate tenui, horizontaliter breviter patente, marginibus callo tenui junctis, columellari leviter emarginato. Operculo ut in genere.

Diam. major 11, minor 9, alt. 12 mill., apert. $6\frac{1}{2}$ mill. longa.
Hab. in valle Tenasserim.

In form it most nearly approaches *L. vitreum*, Qu., but has a more acuminate spire. Its sculpture has greater resemblance to that of the more globose and depressed Bornean species, *L. sericatum*, Pfr. The smaller specimens have a more conical and trochiform appearance than the larger ones.

11. *Megalomastoma gravidum*, n. s.

Testa perforata, pupiformi, distorta, solida, læviuscula, vix striatula, fusco-albida; spira distorto-ovata, sutura marginata, apice conoideo-obtuso; anfractibus 6 convexis, penultimo elongato supra aperturam planato, dorso gibbo, ultimo angustiori, antice subito ascendente; apertura leviter sursum spectante, circulari, fauce fusca, peristomate albido, incrassato, superne angulato, expansiusculo, reflexiusculo, intus late sulcato, tum calloso-marginato, callo interiori dextrorsum superne angulato-sinuato, sutura canalis obsoleti ad angulum anticum raro apparente.

Long. 35 mill., diam. anfr. penult. 20 mill.
Hab. ad Moulmein.

In the obsolete channel, occasionally visible at the top of the aperture, this shell has possibly some relation to Gould's *M. sectilabre*. The indentation, invariably present in the internal callus of the aperture, seems to have some reference to the obliterated channel, and shows a passage to the *Pupinæ*. The form has a great resemblance to that of the gigantic *P. grandis*, Forbes (*Forbesi*, Pfr.), which it exceeds in size. As in that shell, the great length of the penultimate whorl, above the aperture, contrasts with the shortness of the same part in the allied species *M. Chrysallis*, Pfr., which does not appear in the collection.

The specimens received are weathered, and may possibly, in a perfect state, exhibit an epidermis and more colour. The operculum is, unfortunately, not forthcoming.

12. *Pupina Arula*, n. s.

Testa imperforata, conoideo-ovata, longitudinaliter striatula, nitidissima, fusco-rubella, apice conoideo, acuto, sutura calloso-marginata; anfractibus 6, ultimo spiram subæquante, antice breviter ascendente; apertura circulari, angulo superiori acuto adjecto, callo parietali superne lamella intrante munito; columella profunde incisa, canalem extus apparentem, lingua lata parietali obtectum, callisque duobus divergentibus marginatum, exhibente; peristomate obtuso, expansiusculo, extus marginato, margine dextro supra medium arcuato; basi foveata. Operculo —— ?

Long. 9, diam. 5 mill.

Hab. ad Yunglaw, in valle Tenasserim, raro occurrens.

It has much affinity with *P. aurea*, Hinds, the superior canal being rather simulated than actually developed, and being formed by an angle, at the top of the otherwise circular aperture, cut off from the lower portion, in part, by the parietal lamina.

13. *Pupina artata*, n. s.

Testa imperforata, pupiformi, ovato-acuminata, politissima, fusco-cornea, translucente, vel hyalina; spira ovato-conoidea, apice obtusiusculo, sutura callosa, lineari; anfractibus $5\frac{1}{2}$ convexiusculis, ultimo $\frac{1}{3}$ testæ partem superante; apertura verticali, circulari, bicanaliculata; peristomate obtusiusculo, margine parietali superne linguam acutam, callo verticali elongato, cum margine dextro subparallelo, marginatum, exhibente, infra cum basali canalem incisum, ascendentem, extus calloso-marginatum, efformante. Operculo testaceo pauci-spirali, concaviusculo, sutura elevata.

Long. 6, diam. $3\frac{1}{2}$ mill.

Hab. ad Moulmein satis frequens.

It has some affinity with the Australian species of the genus.

Although the following shell is not Burmese, yet as it is found in the Ultra-Gangetic portions of the Bengal Provinces, which are geographically a continuation of the same zoological tract, I shall give it a place here.

14. *Pupina imbricifera*, n. s.

Testa imperforata, ventricose ovato-acuta, politissima, fuscescente, pellucida; spira conica, apice acutiusculo, sutura leviter impressa; anfractibus $6\frac{1}{2}$ convexiusculis, ultimo spiram æquante, ventricosiori, antice subascendente; apertura circulari, bicanaliculata, peristomate pallide carneo, duplici, interno obtuso, breviter porrecto, externo expanso, subreflexo, superne longe ascendente, margine parietali calloso linguam acutam, cum margine dextro coniventem, et callum verticalem, validum, elongatum, arcuatim divergentem, cum processu labri exterioris canalem efformantem, exhibente, subtus cum basali exteriore canalem incisum, marginibus extus callosis, ascendentem, construente. Operculo —— ?

Long. 10, diam. anfract. penult. 5 mill.

Hab. in provincia Bengalensi orientali Sylhet.

This handsome species is singular on account of the great development of the callus, which runs up the penultimate whorl two-thirds of its height, forming, with the prolongation of the outer lip, a channel leading to the incision at the top of the aperture.

No species of *Pupina* has hitherto been described as inhabiting the mainland of either Cis- or Ultra-Gangetic India, although Sowerby has assigned a species to the island of Singapore, situated at the extremity of the Malayan Peninsula; these three species are therefore an interesting addition to the genus in a geographical point of view, the last one especially, on account of its occurrence so far to the northward.

15. *Otopoma Blennus*, n. s.

Testa anguste et profunde umbilicata, conoideo-globosa, crassiuscula, leviter striatula, sordide albida; spira conoidea, sutura submarginata, apice acutiusculo; anfractibus 5 convexiusculis, ultimo ventricosiore; apertura obliqua, ovali, superne angulata; peristomate recto obtuso, marginibus callo brevi, tenui, junctis, columellari leviter revoluto, expanso. Operculo —— ?

Diam. major 18, minor 15, alt. $18\frac{1}{2}$, axis $13\frac{1}{2}$ mill. Apert. $10\frac{1}{2}$ mill. longa.

Hab. raro ad Moulmein.

This species is in a worn condition, and in a fresh state may exhibit more colour. In form it is less depressed in proportion to the diameter than *O. clathratulum*, from which it differs otherwise in sculpture.

16. *Hydrocena Illex*, n. s.

Testa vix perforata, ovato-acuta, minutissime striata, spiraliter confertim tenuisulcata, succinea, translucente, versus spiram rubellofusca; spira nitida, elongato-conica, sutura profunda, apice obtusiusculo; anfractibus 4 valde convexis, ultimo $\frac{1}{3}$ totius testæ superante; apertura obliqua, ovata, superne angulata, peristomate tenui, non continuo, marginibus conniventibus, dextro recto, acuto, columellari reflexiusculo. Operculo tenui, corneo, pellucido, paucispirato, nucleo basali.

Long. $2\frac{2}{3}$, diam. $1\frac{2}{3}$ mill.

Hab. ad Phie Than, vallis Tenasserim, satis frequens, saxis calcareis adhærens.

Nearly allied to *Hydrocena* (*Cyclostoma*) *sarrita*, nobis, Annals, vol. viii. N.S. p. 188, but more slender in form. The presence of an operculum in this species enables me to fix the proper place of its ally, which inhabits a deep valley near Cherra, in the Khassya Hills.

17. *Hydrocena Pyxis*, n. s.

Testa obtecte perforata, ovato-conica, spiraliter sulcata, succinea, translucente, spiram versus rubente; spira conica, sutura profunda, apice obtuso; anfractibus 4 convexis, ultimo $\frac{2}{5}$ totius testæ æquante; apertura obliqua, semicirculari, peristomate tenui, acuto, non continuo, margine columellari expanso, reflexiusculo. Operculo —— ?
Long. $1\frac{1}{2}$, diam. $1\frac{1}{4}$ mill.
Hab. ad Thyet-Mio.

This species inhabits the northern frontier of the province of Pegu, that previously described representing the genus *Hydrocena* of Pfeiffer in the southern provinces. The careful examination of masses of byssus and tree mosses, in which my Cherra species, *sarrita, tersa,* and *Milium,* were detected, will probably reveal other Burmese forms. *H. Pyxis,* although smaller than *H. Illex,* is more coarsely sulcate, and the furrows on the lower whorl are more distant near the suture than below.

The large variety of *Cyclophorus pernobilis* figured by Gould, 65 millimeters in the greater diameter, was found sparingly by Mr. Theobald in the Tenasserim valley, associated with a smaller shell having a more angular periphery, considered by him to be merely a variety, and, in the decorticate state in which it has been sent, bearing a considerable resemblance to Pfeiffer's *C. alabastrinus,* a shell assigned to Ceylon. The figures 4 & 5. pl. 23. of the new edition of Chemnitz give a very imperfect idea of the beautiful colouring of the large shell, or of its bright orange peristome. I much doubt the propriety of Pfeiffer's reference of this shell to Schumacher's *C. aurantiacus.* A dubious shell, from Thyet-Mio, with closely-set flexuous spiral striæ, has much greater pretensions to be considered as that species.

C. expansus, Pfr., was not uncommon in the Tenasserim valley.

C. fulguratus, Pfr., was found, of various sizes, from Thyet-Mio to Rangoon, where the species has the following dimensions:—

Diam. major 39, minor 32, axis 26 mill.

The colour of the shining orange peristome is very rich. The operculum is thin and horny, the outer volutions being separated by a raised edge, and the inner ones ill-defined.

Megalomastoma sectilabre, Gould, is not among the shells received, a circumstance the more to be regretted, as my Bornean species, *M. Anostoma,* has been mistaken for it on the continent, but fails to answer the peculiar character assigned to it by Gould and Mason, viz. the occurrence of a fissure across the peristome at the opposite side from that on which it is observable in *M. altum*, Sow. Dr. Pfeiffer's supposed specimen of *M. sectilabre* is from Borneo, and is, unquestionably, *M. Anostoma*, showing a trace of the channel on the inside of the columellar lip, and none on the opposite side.

Pfeiffer's *Leptopoma Burmanum*, collected by Dr. Theodore Philippi at Mergui, is not to be recognized in the collection. A bleached and worn shell, without an operculum, and intermediate in size between that shell and *Cyclophorus expansus*, is marked from Phie Than, and is probably only a variety of the species last named, with a more acute keel and a less expanded peristome. *L. Burmanum* was described from an immature specimen, and will probably present a different aspect from the figure given in Chemnitz when found in its full development.

Cheltenham, 25th January, 1856.

Since the conclusion of the above paper, I have received, among some shells collected in the Burmese territory by Mr. Oldham, a third species of *Hydrocena*, intermediate between *H. sarrita* and *H. Illex*, but larger than either. It was found at the Myaleit Hill, near Ava, during the stay of the late embassy at that capital.

XVIII.—*Descriptions of three newly discovered species of* Araneidea. By John Blackwall, F.L.S.

Tribe Octonoculina.

Family Linyphiidæ.

Genus Neriëne, Blackw.

Neriëne cornigera.

Length of the male $\frac{1}{12}$th of an inch; length of the cephalo-thorax $\frac{1}{24}$; breadth $\frac{1}{28}$; breadth of the abdomen $\frac{1}{28}$; length of an anterior leg $\frac{1}{8}$; length of a leg of the third pair $\frac{1}{10}$.

The cephalo-thorax is oval, convex, glossy, slightly elevated before, where the eyes are situated, and has an indentation in the medial line: the falces are conical, divergent at the extremity, armed with teeth on the inner surface, and somewhat inclined towards the sternum, which is broad, convex, glossy, and heart-shaped: the maxillæ are inclined towards the lip, which is semicircular and prominent at the apex: the legs are slender and slightly hairy; the first and fourth pairs are the longest and equal in length, and the third pair is the shortest;

each tarsus is terminated by three claws; the two superior ones are curved, and the inferior one is inflected near its base. These parts are of a brownish-yellow colour, the sternum, base of the lip, and tibiæ of the first and second pairs of legs being the brownest. The eyes are seated on black spots; the four intermediate ones form a trapezoid, the anterior pair, which constitutes its shortest side, being the smallest of the eight; those of each lateral pair are placed obliquely on a small tubercle and are almost in contact. The palpi have a brownish-yellow hue, the digital joint being the brownest; the cubital and radial joints are short: the latter, which is the larger, is prominent at its extremity, in front, and has several long bristles at its base; the digital joint is oval, with a long, conical, hornlike process at its base, whose pointed termination extends to the extremity of the cubital joint, and is provided with one or two long bristles; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, prominent, complicated in structure, with a small, black, curved, pointed spine at the base, on the outer side, and are of a yellowish-brown colour. The abdomen is oviform, convex above, and projects a little over the base of the cephalo-thorax; it is thinly clothed with hairs, and of a dark, dull brown hue, that of the spinners being pale yellowish-brown.

This remarkable spider was discovered among moss growing under trees in a wood on the northern slope of Gallt y Rhyg, in the autumn of 1854.

Neriëne montana.

Length of the male $\frac{1}{10}$th of an inch; length of the cephalo-thorax $\frac{1}{20}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{20}$; length of a posterior leg $\frac{1}{6}$; length of a leg of the third pair $\frac{1}{8}$.

The eyes are seated on black spots, the anterior pair of the four intermediate ones forming the trapezoid, which are near to each other, being the smallest and darkest of the eight. The cephalo-thorax is oval, convex, glossy, with slight furrows on the sides, which converge towards an indentation in the medial line: the falces are powerful, conical, vertical, and armed with a few teeth on the inner surface: the maxillæ are enlarged at the extremity, and inclined towards the lip, which is semicircular and prominent at the apex: the sternum is broad, heart-shaped, convex and glossy: the legs, which are moderately long, are provided with hairs and a few fine spines; the fourth pair is slightly longer than the first, which surpasses the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. These parts are of a pale yellow-brown colour, the falces, maxillæ and lip having a faint tinge of red. The palpi resemble the legs in colour; the cubital and radial joints are short, the latter, which is the stronger, being somewhat produced at its extremity, in front; the digital joint is oval, with a small, conical process at its base, and a lobe near the middle of the outer side; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, complicated in structure, with a prominent, curved, scalelike process at the base, on the outer side, and are of a brownish-red colour. The abdomen is oviform, convex above, projecting over the base of the cephalo-thorax; it is thinly clothed with hairs, glossy, and of a dark yellowish-brown colour, the branchial opercula and spinners being much the palest.

This spider, which was found on Ingleborough, a mountain in Yorkshire, in September 1855, was received from Mr. R. H. Meade.

Genus Walckenaëra, Blackw.

Walckenaëra vafra.

Length of the male $\frac{1}{10}$th of an inch; length of the cephalo-thorax $\frac{1}{16}$; breadth $\frac{1}{22}$; breadth of the abdomen $\frac{1}{22}$; length of a posterior leg $\frac{5}{24}$; length of a leg of the third pair $\frac{3}{20}$.

The cephalo-thorax is oval, convex, glossy, with a strong, vertical prominence before, which is somewhat compressed on the sides and surmounted by a few hairs: the falces are small, conical, armed with teeth on the inner surface, and inclined towards the sternum, which is broad, glossy, and heart-shaped: the maxillæ are powerful and curved towards the lip, which is semicircular and prominent at the apex. These parts are of a brownish-red colour, with the exception of the anterior prominence of the cephalo-thorax, which has a dark brown hue tinged with red. The legs are long, slender, hairy, and have a bright yellowish-red tint; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi resemble the legs in colour, but the radial and digital joints are tinged with brown; the cubital joint is clavate; the radial joint projects two apophyses from its extremity; one, on the inner side, is large, pointed, curved outwards in front of the digital joint, and has, near its base, a minute process on the convex side, and a large obtuse one on the opposite side; the other apophysis, which is smaller and obtuse, is situated underneath; the digital joint is somewhat oval, convex and hairy externally, concave within, comprising the palpal organs; these organs are highly developed, complicated in structure, with two long, filiform, contiguous black spines enveloped in membrane, originating near the middle and curved in a circular form on the outer side; a shorter one, also originating near the middle and enveloped in membrane, is curved obliquely downwards, and their prevailing colour is brownish-red. The convex sides of the digital joints are directed towards each other. The eyes are seated on the anterior part of the cephalo-thorax, two on the summit of the vertical prominence, and the other six at its base, in front, each lateral pair being placed obliquely. The abdomen is oviform, convex above, and projects over the base of the cephalo-thorax; it is sparingly clothed with hairs, glossy, and of a brownish-black colour, that of the branchial opercula being pale yellowish-white.

Adult males of this species were discovered under stones in the woods about Hendre House, near Llanrwst, in October 1855.

XIX.—*On some species of* Epilobium.

By Charles C. Babington, M.A., F.R.S. &c.*

Having been led to examine the British species of *Epilobium*, and arrived at the opinion that some of them have not received as much attention as they deserve, and have therefore been misunderstood, it seems desirable to publish the results. My object in so doing is to direct attention to the plants—not to place before botanists a conclusion satisfactorily attained. There remains much to be done before we can be said well to understand these plants. Those upon which it is proposed to treat have been included under the names of *E. tetragonum* and *E. alpinum.*

Before proceeding to the discussion of the species, it will be well to clear the way by pointing out the characters upon which it is believed that we may depend. This will entail a slight sketch of the arrangement of our *Epilobia.* Leaving out of consideration the group called *Lysimachion* by authors (although there is a newly-discovered species of that section to be noticed before ending this paper), we shall find that, taken in its general sense, the form assumed by the stigmas will separate our plants into two groups: (1) those which have that organ formed of four spreading divisions so as to be cross-like, namely *E. hirsutum, E. parviflorum, E. montanum,* and *E. lanceolatum*; and (2) the rest of our species, whose stigmas are so placed as to form a club, either by having the four parts soldered together or by their being adpressed to each other. In the latter case, that is, when the stigmas are adpressed, they may sometimes be observed to separate slightly, but never, as I believe, to become cross-like. It is only when taken generally, that the stigma can be safely used

* Read before the Botanical Society of Edinburgh, 10th Jan. 1856.

as a distinctive character; but if allowance be made for exceptions in the case of individual plants, it does seem to afford valuable help in grouping the species. This is the more desirable from the true biological characters which separate the species being often not noticeable in the flowering state of the plants. The characters referred to are the mode of extension of the plants from year to year. The plants are either *turionate, stoloniferous,* or *rosulate*; the stoles are either scaly or leafy, the scales are somewhat inflated or not so. The leaves upon these offsets gradually increase in size from the base to the end of the shoot, and their pairs are all separated by long joints; are all placede lose together and forma rosette; or those at the end of the stole are so placed as to form a rosette, the others being distant. Taking these as the primary characters of the divisions, we obtain an arrangement which differs but little from that founded upon the stigma which has usually been employed. The following is the arrangement proposed:—

I. Turionate; that is, producing radical suckers.

1. *E. hirsutum.*

II. Stoles autumnal, rosulate. Stem erect.

† *Stem mostly round. Stigma 4-cleft.*

2. *E. parviflorum.*
3. *E. montanum.*
4. *E. lanceolatum.*

†† *Stem with raised lines. Stigma entire.*

5. *E. roseum.*
6. *E. tetragonum.*

III. Stoles æstival, long-jointed throughout, with small leaves. Primary stem erect. Stigma usually entire.

7. *E. obscurum.*

IV. Stoles æstival, long-jointed, with small leaves, ending in autumnal bulbs which become detached. Base of stem cord-like.

8. *E. palustre.*

V. Stoles æstival, leafy, rosulate.

9. *E. alpinum.*

VI. Stoles æstival, leafy, not rosulate.

10. *E. anagallidifolium.*

VII. Stoles æstival, scale-bearing, not rosulate.

11. *E. alsinifolium.*

In addition to the characters used in this arrangement, the following points deserve notice.

1. The stem in some of the plants rises erect directly from a fibrous root, and usually produces lateral branches from the axils of its lowest leaves so as to take a rather cæspitose form. This primary stem appears always to be erect, but the lateral stems or branches are usually procumbent at their base and frequently produce roots there, although throughout the greater part of their length they are erect or ascending. When the plants grow in water, or in very wet places, these adventitious roots are sometimes produced from the lower joinings of the upright primary stem, and the procumbent part of the branches is very long: if in this case a branch is carelessly pulled up, the plant may easily be supposed to have a cordlike base, when its real structure is very different. Towards the end of the summer, or in the autumn, these cæspitose species usually produce from close to the base of their stem very short flowerless shoots having their joints so much contracted that the leaves lie closely upon each other, and a rosette or rose-shaped tuft is formed. The original plant does not survive the winter, but in the ensuing spring the place which it occupied is more or less surrounded by a cluster of new cæspitose individuals resulting from the rosettes of the preceding autumn; each rosette producing from its terminal bud a new primary stem, and from some of its axils a few lateral stems.

In other plants, thick long stoles with distant leaves take the place of the rosettes. It is only at the end of these stoles that the least trace of the close arrangement of leaves forming the rosettes is to be found, nor is it always seen even there. These long stoles root and live through the winter, and their remains when attached to the base of the stem of the succeeding year may be taken for the chordorhizal structure if the stem fails to produce lateral stems from its lower axils. The character derived from the chordorhizal base is not therefore wholly to be trusted, although Fries has confidence in it.

2. Another habit is that in which there is no trace of the cæspitose mode of growth, but in its place there is a prostrate slender stem producing many adventitious roots, and turning upwards at the end so as to form the upright stem of the plant. If branches are at all produced from the lower part of the stem they are placed at some distance from each other, or in distant pairs, for the joints are long. Most of these species throw out from many of their lower joinings stoles furnished with long joints and pairs of very small leaves, and end in a sort of bulb, the scales of which are rather fleshy with their upper epidermis loose. These bulbs become detached in the winter, by the decay

of the stole, together with the stem which has flowered, and from them spring the plants of the following year.

We may now proceed to the consideration of the species which are usually included under the name of *E. tetragonum.* Fries appears to have been the first botanist who attempted their separation by a reference to their development; but that eminent writer has been unfortunate in the specimens distributed in illustration of the plants, as will be seen hereafter. Applying those characters to our native plants, it is found that there are at least two species included under the name of *E. tetragonum.* One of these will retain that name, and another is the *E. obscurum* of Schreber. The former has the cæspitose habit, and produces sessile or subsessile rosettes after the time of flowering: the latter is originally cæspitose, its primary stem being erect from the root and branching from its lowest axils, but these lateral branches are prostrate and rooting to some extent; and in the place of the rosettes of the former it has long rooting stoles. Specimens of this latter plant (*E. obscurum*) are what I have been accustomed to call *E. virgatum* whilst totally in ignorance of the *E. obscurum.* I hope to be able to show that no great error was committed in doing so. For it is my belief that Fries himself made the same mistake, if indeed it is a mistake, and that his *E. virgatum* exists as a distinct plant from *E. obscurum.* He has called various plants by the name of *E. virgatum* at different times. The plant first issued (Herb. Norm. ii. 46) as *E. virgatum* is very nearly related to *E. tetragonum,* although perhaps not exactly that species; for it may be the *E. Lamyi* (F. Schultz), as Koch supposed it to be. These specimens do not accord with the description given in the 'Novitiæ' (ed. 2. p. 113); but a trust in the accuracy of Fries caused them to be accepted as typical of his plant. The original source of the name is the 'Fl. Hallandica' (p. 66), and the description to be found there may help us in determining what was the plant really intended by its author. As the book is perhaps not very common, the characters are extracted. They are as follows:—

"*E. virgatum*; foliis lanceolatis sessilibus dentatis opacis caule tetragono pubescentibus, stigmate indiviso."

To this are added the following remarks:—

"Verum videtur *Chamænerion obscurum,* Schreb.; sed *E. obscurum* omnium fere auctorum ad præcedens [*E. tetragonum*] foliis alternis, ex. gr. Fl. Dan. t. 1267, pertinet. Radix subrepens. Caulis e basi tereti adscendenti erectus, 2–4-pedalis, vage ramosus, 4-angulus, pubescens, deorsum glabratus. Folia distantia, opposita alternave, sessilia, lanceolata, subcoriacea, remote dentata, plus minus pubescentia, constanter opaca. Laciniæ calycinæ villosæ. Siliqua villosa. Flos sequentis [*E. palustris*]."

These descriptions do not agree with the first specimens (H. N. ii. 46), and differ slightly from the description given in the 'Novitiæ;' but they do agree tolerably well with the specimens afterwards stated by Fries to be the true plant (H. N. x.), the leaves of which are subsessile, broad, and rounded at the base, from whence they narrow, with tolerable regularity, to their tip, which is suddenly contracted to an obtuse angle. They are opake, thin, and apparently flaccid, distantly denticulate, slightly hairy. The presence of the word "subcoriacea" in the 'Flora Hallandica' causes some difficulty, for it is hardly possible that the leaves of the plant sent to me in the 'Herb. Normale' (fasc. x.) can ever have been subcoriaceous. That specimen has an upright base, thickening from a slender broken point, and producing 4 or 5 whorls of fibrous roots,—a structure different from what I understand by Fries's term, "chordorhizum." After a careful consideration of the plant and the descriptions, I have arrived at the opinion that the *E. virgatum* (Fries, H. N. x.) is *E. obscurum*, and am inclined to the further opinion, that the *E. virgatum* of the 'Fl. Hall.' is the same plant. The peculiar base of the stem in the specimen probably results from its having grown in a very wet place.

Having thus, as it is hoped, shown the probability of *E. virgatum* being a synonym of *E. obscurum*, we may proceed to the consideration of the characters, &c. of that plant and its ally, *E. tetragonum*. I am indebted to my valued friend Mr. Borrer for directing my attention to these plants, and pointing out their more important differences. Since the original sketch of this paper was written, I have seen a valuable memoir by Dr. Grisebach (Bot. Zeit. 1852, p. 849), and Dr. F. Schultz has very kindly sent to me a copy of his excellent review of it (Arch. de Flore, ii. 41). From the study of Mr. Borrer's manuscript notes and his specimens, and of the writings of these two eminent botanists, I have obtained a tolerably clear idea of the subject.

The following is the mode in which the plants may be characterized:—

E. tetragonum (Linn.); *rosettes subsessile,* stem erect, *leaves strap-shaped much denticulate-serrate,* limb of the intermediate leaves decurrent, buds erect, seeds oblong-obovate tubercular.

E. tetragonum, *Linn. Sp. Pl.* ed. 1. 348; *Curt. Fl. Lond.* i. 66 (131); *Fries, Herb. Norm.* viii. 41 (specimen); *Reichenb. Fl. exsic.* 357 (specimen); *Gren. et Godr. Fl. de Fr.* i. 579; *F. Schultz, Archives de Flore,* ii. 51.

E. adnatum, *Griseb. in Bot. Zeit.* 1852, p. 854.

Stem upright from the root, usually branched from the base, with 2–4 raised decurrent lines from the edges of the leaves. Rosettes usually very nearly sessile, and although they are sometimes shortly stalked when the plant is flooded, they do not even then resemble the stoles of *E. obscurum*. Seeds rounded at both ends, but with a recurved point at the base; that is, if the front of the seed is observed, the base appears to be blunt, but if a lateral view is taken, the small point directed backwards is seen. The intermediate leaves appear to be always decurrent by their limb, as are often many of the others; they do not narrow much until near to their upper end; the little teeth are near together, conspicuous, and often have incurved callous points. The lower leaves are more nearly lanceolate, the lowest obovate.

Dr. Grisebach differs from all other botanists by thinking that this is not the typical plant of Linnæus, and accordingly changes its name to *E. adnatum*, and calls the *E. Lamyi* (F. Schultz) the *E. tetragonum* (Linn.). Dr. Schultz thinks that Grisebach is in error, and restores the Linnæan name to the plant that has usually been so called. In this I quite agree with him. Nevertheless there are difficulties attending the determination of the Linnæan plant that call for a few remarks. It is highly probable that Linnæus included the *E. obscurum* under the name of *E. tetragonum*. In the first edition of the 'Sp. Pl.' (i. 348) he gives the character as follows:—

"E. foliis lanceolato-linearibus denticulatis: imis oppositis, caule tetragono."

In the second and later editions of the same work it is

"E. foliis lanceolatis denticulatis: imis oppositis, caule tetragono;"

and the remark is added,

"Summitas, adhuc tenella, nutans."

Our *E. tetragonum* is very much better described by the former than the latter of these definitions, and the additional observation shows that Linnæus had, when preparing the second edition for the press, fallen into some confusion, for it need scarcely be remarked, that neither *E. tetragonum*, nor *E. obscurum*, nor *E. Lamyi* has a nodding summit. It is a curious fact, that Linnæus does not include *E. tetragonum* in his 'Fl. Suecica,' although it appears not to be a rare plant in Sweden. May we not thence conclude that he had little acquaintance with the plant, and thus account for his altering the character for the worse? This is rendered more probable when it is found that the figure quoted by him from Tabernæmontanus (Icon. p. 854) does not represent *E. tetragonum*, nor agree with the Linnæan description: what it does represent is a more difficult point to decide, and no attempt is now made to do it. There is only one specimen preserved in the Linnæan Herbarium with the name and authenticating marks of *E. tetragonum*. The place where it grew is not stated, and there is no clue to its history. It is not *E. tetragonum*, nor either of its close allies, but appears to be the plant now universally called *E. roseum*. It seems probable that Linnæus was led by this specimen into the mistake of altering the specific character of his plant and adding the erroneous remark. It is scarcely necessary to observe, that these alterations are derived from the peculiarities of *E. roseum*.

E. tetragonum is perhaps a less common plant in Britain than *E. obscurum*. My specimens are from Glen Falloch, Perthshire; Congestone, Leicestershire; Cambridge; Stapleton, near Bristol; Sussex; Sidmouth, Devon; Cork; and the Channel Islands.

E. obscurum (Schreb.); stoles with distant leaves, stem erect, *leaves tapering* from a rounded base sessile *remotely denticulate* faintly decurrent, lower leaves oblong blunt, buds erect, sepals linear lanceolate, seeds obovate-oblong tubercular.

"Chamænerium obscurum, *Schreb. Spic. Fl. Lips.* 147."

Epilobium obscurum, *Reichenb. Iconog.* t. 199. et *Fl. excurs.* p. 634; *Roth, Fl. Germ.* ii. 438. et *En. Pl.* ii. 152; *Fries, Herb. Norm.* viii. 42 (specimen); *Griseb. in Bot. Zeit.* 1852, p. 853; *F. Schultz, Arch. de Flore*, i. 218 et ii. 49.

E. virgatum, *Gren. et Godr. Fl. de Fr.* i. 578; *Sonder, Fl. Hamb.* 217.

Stem ultimately branching from the base as in *E. tetragonum*, and the whole plant closely resembling that species. In wet places the lateral stems are more or less decumbent, and rooting in their lower part. Stoles in dry places rather short and thick; all their leaves in distant pairs, small, successively enlarged, but not forming a rosette: in wet places they are long and sometimes branch; their leaves are oval, but narrowed below. It is only in the spring, when the new stems are commencing from the ends of the stoles, that anything resembling a rosette is found. In plants resulting from the stoles of the preceding year, it is the end of the stole itself that throws out roots, and sends directly upwards a *single erect stem*, which, at about the time of flowering, begins to branch from most of its axils; the lowermost buds producing stoles, the others flowering shoots. Individuals of this kind have therefore usually a short prostrate base, placed often at a right angle to it, and belonging really to the growth of the preceding year. The capsules are much shorter than those of *E. tetragonum*. The seeds of similar form with those of that species.

My British specimens of *E. obscurum* are from Wyken, Warwickshire; Ilfracombe, Devon; Llanthony, Monmouthshire; and Sussex; and I am informed by Mr. Borrer that it is found in Herefordshire by Mr. Purchas.

There is something in the look of this plant that distinguishes it from *E. tetragonum*. Tangible characters are afforded by the leaves. If well-grown specimens of the two plants are contrasted, the difference in the shape of those organs will be found to be rather considerable. The leaf of *E. tetragonum* is very well described as *strap-shaped*, for its sides are nearly parallel throughout the greater part of their length, the widest part being placed at about their middle. In *E. obscurum* the intermediate leaves are sessile, but apparently not at all decurrent by their limb (as is the case in its ally), although there is a slight appearance of decurrence from the sides of the rudimentary petiole; they are broadest close to their rounded base, and taper gradually from thence to their tip. Their teeth are much less conspicuous and much more distant from each other than those of *E. tetragonum*, and there are sometimes a few intermediate much smaller denticulations. The lowest leaves are usually shortly stalked and more oval than the others; and, in rare cases, many of the leaves possess this oval form and are slightly stalked, only those upon the upper part of the specimen having the true form belonging to the species. The leaves of *E. tetragonum* are always shining, those of *E. obscurum* opake, excepting on the stoles. The capsules of *E. tetragonum* are remarkably longer than those of its ally, and afford, as Mr. Borrer observes, a "striking *primâ-facie* distinction in the living plants." The stoles of *E. tetragonum* have their leaves all closely placed so as to form a subsessile rosette; those of *E. obscurum* have long joints, and therefore a rosette is not formed, although the leaves successively become larger. In very dry places, *E. obscurum* forms a kind of loose rosette at the end of a short stole. From the large size of the leaves at the end of the stoles of *E. obscurum*, they may sometimes be carelessly mistaken for a rosette.

E. obscurum is incompletely figured by Reichenbach (Iconog. t. 199), and represented by the specimen (No. 358) of his 'Flora exsiccata.' Unfortunately that specimen had not produced its stoles at the time when it was gathered; and as the plant drawn by Reichenbach was obtained from Leipzig, and Schreber's 'Spicilegium Fl. Lipsiæ' is the original authority for the name, there is the more reason to deplore the fact that so imperfect an illustration is given. In the text of the 'Iconographia,' Reichenbach quotes the *E. virgatum* (Fries, Fl. Hall. 66) as an undoubted synonym of *E. obscurum*, and the remarks already made will show that in my opinion he is correct in quoting it; but he seems to have afterwards suspected that he was in error, for in the 'Fl. excurs.' he leaves that synonym out, and describes another plant as *E. virgatum*, which he supposes to be markedly distinguished from *E. tetragonum* and *E. obscurum* by having a stigma that ultimately becomes quadrifid. Hartmann, as quoted by Koch, expressly states of *E. virgatum*, "stigma semper integrum, nunc inordinate 2–4-fidum, nunquam vero cruciatum vel regulariter quadrifidum." Fries says in the 'Fl. Hall.,' "stigmate indiviso," in the 'Novitiæ' "stigmate demum quadrifido," in the 'Summa' "stigmatibus in clavam coalitis." Petermann (Fl. Lipsiæ, 280) describes *E. obscurum*, which resembles the plant of this paper, as the *Chamænerion obscurum* of Schreber, but adds, "neque vero sec. herbar." Reichenbach makes a similar remark, but neither author tells us what the plant of the Herbarium really is. The extract from Schreber's description given by Reichenbach (Iconog. ii. 89, and Fl. excur. 635), for I have not succeeded in obtaining access to the original work, will apply tolerably well to the plant now called *E. obscurum*. Roth's works (Tentamen Fl. Germ. ii. 438, and Enum. Plant. i. sec. 2. p. 152) contain descriptions of *E. obscurum* agreeing with that of Petermann, and with the plant pointed out to me by Mr. Borrer and already described in this paper. Roth remarks of it, "planta ab *E. tetragono* diversissima est" (En.), and "planta per plures annos in horto . . . . excepta proceritate non mutavit habitum" (Fl.).

Sonder describes a plant as *E. virgatum* (Fl. Hamb. 217), of which he says "stolonibus elongatis, caule ex ascendente basi stricto," and quotes to it the specimen erroneously published by Fries (Herb. Norm. ii. 46) as *E. virgatum*, and now referred by Grisebach to *E. Lamyi* (F. Schultz). Sonder quotes *E. Lamyi* as being the same as his *E. virgatum*; but if his plant has really the elongated stoles and is chordorhizal, as he appears to intimate in the words quoted above, then it cannot be the *E. Lamyi* of F. Schultz, which that botanist states to have "radice perpendiculare," and also to possess "ad caulis basin foliorum rosulam 1 (rarius 2) proferente, stolonibus nullis." I am indebted to my valued friend and correspondent Mr. R. Lenormand of Vire for two specimens of the *E. Lamyi* (F. Schultz), marked as authentic, gathered in La Vendée. They present so much the appearance of *E. lanceolatum*, that we cease to wonder that Koch referred imperfect specimens of the plant to that species. They do not branch in their lower half, do not creep, have no stoles nor rosettes, have narrowly lanceolate rather strongly denticulate leaves with a wedge-shaped base on one of the specimens, and a broad base which is rather narrower than the middle of the leaf on the other. The plant is apparently very scarce, and presents much difficulty. Schultz (Arch. ii. 49) quotes Sonder's *E. virgatum* as a synonym of *E. obscurum,* where also he places the *E. virgatum* of Godron. I am indebted to Mr. Sonder for specimens gathered by himself near Hamburg (at one of the places mentioned in his 'Flora') in 1842, and sent to me with the name of *E. virgatum* (Fries); but I have no doubt that they really belong to *E. obscurum.*

It will be noticed that I have not quoted the *E. virgatum* of Koch (Syn. Fl. Germ.). It is omitted because there can be no doubt that that eminent botanist was unacquainted with the true characters distinguishing these plants; and that, as he tells us himself, he did not know the true *E. virgatum* until the second edition of his work was nearly completed. He states that most of the specimens called *E. virgatum* by him were merely *E. tetragonum,* or rather perhaps his words may mean that they were *E. obscurum,* which he considered as only a slight variety of that species.

Dr. F. Schultz thinks that the *E. virgatum* of Fries's 'Summa' is a hybrid between *E. palustre* and *E. obscurum.* As I have not seen the true plant of Fries (for his published specimens are respectively *E. Lamyi* probably and *E. obscurum*), it is out of my power to form any certain opinion. Schultz and Grisebach both place it in a section characterized by the plants possessing stoles and hybernacula like those of *E. palustre,* whilst Fries says that its stoles are "elongatos sparsifolios," like those of *E. obscurum,* but that its seeds equal those of *E. palustre,* and therefore are twice the size of those of *E. obscurum.* In another place Schultz remarks, that the difference between *E. virgatum* and *E. tetragonum* derived from the form of the seeds is not discoverable. Supposing him to mean *E. obscurum* under the name of *E. virgatum,* as is perhaps the fact, he is quite correct; but if *E. chordorhizum* (Fries) is intended, the size of the seeds must be quite different, as we learn from Fries's definite statement on the subject. Schultz also informs us (Arch. ii. 46) that the *E. Schmidtianum* (Roskov.), noticed by Koch (Syn. 266) under *E. palustre,* is not a broad-leaved state of *E. palustre* as Grisebach supposes, nor a form of *E. virgatum* (*E. obscurum*) as he formerly thought himself, but that it is a hybrid between *E. palustre* and *E. obscurum,* to which he gives the name of *E. obscuro-palustre.* I quite agree with Fries in believing that far too many difficulties are attempted to be removed by supposing the plants to be hybrids; and also, that hybrids are seldom produced naturally except in a few genera, such as *Verbascum,* and that most of the plants that are so called will prove to be extreme states of recognized species (see Fries, Mant. iii. 97). Nevertheless it is possible that there may be natural hybrids in this genus; that the *E. chordorhizum* (Griseb.), *E. palustri-obscurum* (Schultz), is one; and that the plant found by Mr. Baker at Gormire is the first of the two forms of it mentioned by Dr. Schultz (Arch. ii. 46), although the seeds of our plant have not the long base found in *E. palustre,* nor more than a very slight prolongation of the testa at their rounded summit. But I am more inclined to place it, provisionally, with *E. obscurum,* in the hope that Mr. Baker's attention may again be directed towards it. It agrees in most respects with the *E. virgatum* (Fries, Summa), but the top of its stem, when bearing unopened buds, is stated to nod, and its seeds are not smooth. Its stoles resemble those of *E. obscurum,* but are more slender. In a series of specimens I find no trace of the bulb-like hybernacula formed by *E. palustre, E. chordorhizum* (Griseb.) and *E. Schmidtianum,* which last plant Schultz states to have "les stolons de l'*E. palustre.*" It should be added, that its seeds are twice as large as those of *E. obscurum.*

If attention is paid to the stoles, there is no probability of *E. obscurum* being confounded with any of the other species, although those of *E. palustre* are somewhat similar in description. The latter plant has very slender stoles, each terminating in an autumnal hybernaculum which is already described, a long rooting base to its stem, very narrow leaves with a wedge-shaped base, nodding buds, and subfusiform seeds which are acute at the base and narrowed at the top where there is a prolongation of the testa into a kind of beak bearing the beard. It is nevertheless often difficult to distinguish bad or incomplete specimens of *E. obscurum* from *E. palustre,* for the lowest lateral branches of the former being usually prostrate and rooting for some distance, have, when torn off from the plant, much outward resemblance to the chordorhizal plants of *E. palustre.* Indeed it has already been stated, that there is much reason to fear that Fries himself has been deceived by such fragments*.

In the 'Cybele Britannica' (iii. 350) Mr. Watson mentions a plant or plants under the joint title of *E. virgatum* and *E. Lamyi,* and refers especially to specimens gathered by Mr. T. Moore in Kent, which were guessed by me to be possibly *E. Lamyi,* but which I now am certain are not the plant rightly so named. Mr. Moore's plant was found in company apparently with *E. palustre,* of which, although it presents some difficulties, I am inclined to the opinion that it is not a state, but think that it may be referred to *E. obscurum.* I am informed that

* My specimens of *E. palustre* are from the following places:—Clova, Forfarshire; Isle of Skye; Teesdale, Durham; Keswick, Cumberland; Llanberis, Caernarvonshire; Llanthony, Monmouthshire; Sandwich, Kent; Ma'am, Galway; Ventry, Kerry.

specimens of it were sent to Dr. Grenier, and that he called it the *E. tetragonum* of the 'Flore de France.' In that determination he was assuredly in error, for the plant can belong to no other species described in that admirable work than *E. palustre* or *E. virgatum* (the *E. obscurum* of this paper). In obtaining and quoting the opinion of either of the authors of that 'Flora,' it should be remembered that, although the work is a joint production, each portion has its own individual and declared author. Dr. Godron is the author of the account of the genus *Epilobium*. In such cases as this, Dr. Grenier may know no more than the inquirer about the subject upon which he is consulted.

[To be continued.]

XX.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[Continued from p. 154.]

The Glands contained in the Respiratory Cavity of Branchiferous and Pulmoniferous Gasteropods.

The respiratory cavity of all Cephalophorous Mollusks, in addition to the organs of breathing, lodges one, two or more glandular bodies, the structure and office of which are the subject even at the present time of dispute among comparative anatomists. In different genera these glands affect different relative positions in the cavity.

In some instances they are near and parallel to the rectum, in others they encircle the heart, in others they constitute a mass lying only on one side of this organ. Many of the Pectinibranchs are provided with two glands, in the space between which on the roof the branchia is situated.

By Cuvier they were called the muciparous glands. Dr. Sharpey has supposed the one to be a supplementary branchia, the other he has designated after Cuvier the mucous gland. By Swammerdam, Poli, Blumenbach and the elder anatomists, they were supposed to be concerned in the secretion of calcareous salts. Bojanus conceived that the glands contained in the breathing-chamber of the higher Gasteropods were homologous with certain glandular bodies described by him in the Lamellibranchs, in both holding a similar relation to the branchiæ. As he had proved the latter to be kidneys, he inferred that the former must be so also. The alleged muciparous glands of the

Gasteropods were believed by Meckel* to constitute the true renal system of these animals. A new demonstration of their renal character was subsequently rendered by Jacobson† by the discovery of uric acid in the substance of these glands. His researches comprised analyses of the glands of *Helix pomatia, Limax niger, Lymneus stagnalis* and *Planorbis cornea*. Jacobson's views, however, had been anticipated by Döllinger and Holmlich‡, who had long previously indicated these glands as the real kidneys of these animals. It is stated by Siebold and Stannius§ that in the dried kidneys of *Helix pomatia* and *Paludina vivipara*, when treated with nitric acid and ammonia, considerable quantities of murexid may be discovered. Treviranus has descended to the minuteness of asserting that in these Gasteropods a portion of the pulmonary or branchial, recently arterialized blood passes through the kidneys in its path to the auricle. In another place in their excellent work, Siebold and Stannius observe that in the Pectinibranchs the *kidney is replaced* by a gland which is situated behind the branchia between the heart and the liver, and which in the marine species *secretes the purple liquid*. This is the gland which Dr. Sharpey has described as a bipectinate and supplementary gill.

Kidneys have also been described by Quoy and Gaimard, under the several names of muciparous glands, organ of the purple, depurating organs, &c., in *Phasianella, Turbo, Buccinum, Mitra, Oliva, Capræa, Harpa, Dolium, Cassis, Purpura, Fusus, Auricula*‖. Leydig has also given an account of the renal siphon of *Paludina Vivipara*. More recently Mr. Huxley¶ has expressed his belief in the correctness of the prevailing views as to the true renal nature of the glands contained in the breathing-chamber of the branchiferous and pulmoniferous Gasteropods, and has adopted as conclusive of all doubts, the results obtained by the lithic acid tests in the hands of Jacobson, Meckel and Kölliker**.

The preceding outline of the literature of the question which relates to the renal system of the Invertebrata will suffice to reveal a chaos out of which it does not seem easy to evoke aught that is orderly and consistent. It is evident that the same names have been applied by different observers to very

* Müller, Arch. 1846, p. 13. taf. 1.

† Müller's Arch. vi. 1846.

‡ Dissertatio de Helice pomatia. Hirceb. 1813, p. 23.

§ Comparative Anatomy of the Invertebrata, transl. by Burnett, p. 253, note 3.

‖ Voyage de l'Astrolabe, Zoologie, ii.; or Isis, 1834, p. 285; 1836, p. 31.

¶ "On the Morphology of the Cephalous Mollusca," Phil. Trans. 1853.

** Entwickelungsgeschichte der Cephalopoden.

different organs. No clear views as to what should and what should not be characterized as distinctive of a renal organ in the Invertebrate animals, have ever been defined by anatomists. If a marked uniformity of structural type and plan runs through the entire series of other organs in the Invertebrata, such as the biliary, respiratory, circulatory, digestive, &c. systems, the inference is highly probable that a similar serial consistency of plan presides over the renal system. If such be the case in the Vertebrate, why should it not be so in the Invertebrate series? In another place* the author has shown, that the fluids, viewed as chemical and vital solutions, grow more and more simple as the zoological scale is traced downwards (or more and more complex as it is followed upwards); he thence argues that the same tendency to simplification is also manifested by the systems of the solid organs. This is the true science of the comparative anatomy of organs. Their history in this sense has never been written. If the true relation between the solid machinery of the glands and the fluids could be established, it would be most certainly discovered that at the point in the descending series at which a given constituent of the fluids, which a given gland was specially designed to withdraw, ceased to exist, the gland would also cease to exist. The proposition when thus enounced assumes almost a necessary certainty. The mind feels at once assured that no other law can explain the facts, which are indubitable. Anatomists have always worked on the presumption that the fluids of the lowest animal *must* have the same composition as that of the highest, and that consequently the necessities of the organism in the two instances must be the same. If the highest animal be provided with a kidney, therefore the lowest must be endowed with the same organ. Up to this æra in physiology, such in truth has been the fallacious reasoning by which the most distinguished cultivators of this science have conducted their researches. The same observation applies to the secreted products of the physiological actions of organs. It is supposed that because certain ingredients are found to exist under all circumstances in the secretions of the higher animals, consequently the same principles *must* exist in those of the lowest. This false logic has led astray the minds of men for an entire century. There may be nothing in common between the bile of the Mammal and that of the Cephalopod, yet each may be the product of the action of a *liver*. The same reasoning applies to the urinary secretion and to the renal system. Urea and lithic acid, the supposed basis and essence of this secretion

* "On the Chemistry, Physiology and Pathology of the Blood," in the British and Foreign Medico-Chirurgical Review for 1853-4.

in the urine of the Vertebrated animal, are not *necessarily* to be regarded as the basis and essence of the analogous secretion of the lowest Invertebrata. If such reasoning were grounded on truth, it would involve a ridiculous paradox to deny that the minute anatomy of this system of glands was not precisely the same in every grade of the series. But it may be proved immediately, and most readily, that the Malpighian coils of capillaries, so constantly and essentially distinctive of the kidney even of the lowest Vertebrated animal, disappear *in toto* from that of the Gasteropods and the Cephalopod. Here, at the very first step, the fundamental structural element of the higher phase of the organ vanishes. If it be so, is it not reasonable to infer that a correspondingly marked and essential change has occurred in the secreted product of each organ?

The preceding observations, general though they may be, are abundantly sufficient to justify the assertion, that in the present state of knowledge with reference to the comparative histology of the renal system, and the comparative chemistry of the renal secretion, the physiologist is not in a position to state with certainty and confidence whether the alleged kidneys even of the higher cephalous Mollusca are really so or not*.

As the complete history of the glandular bodies which are lodged in the respiratory cavity of the cephalous Mollusca will rightly fall within the compass of another series of researches, the author on this occasion will give only a slight sketch of their structure, and that more because they are constant attendants on the respiratory organs in this class of animals, and occupants of the chamber dedicated to respiration, than because they are asserted by some anatomists to be muciparous glands, and by others no less distinguished as true kidneys.

That gland (Pl. XI. fig. 1 *c'*, *c'*, and fig. 3 *g*) which Cuvier first designated "l'organe de la mucosité," is unquestionably traceable as one and the same body throughout various changes

* During my recent studies among the Invertebrata, I have accumulated a large mass of materials elucidatory of the serial anatomy of the renal system. It would be quite irrelevant to enter further into details in this place and upon this occasion. I trust that for such a task another opportunity will occur. I am deeply impressed with the belief that real service will be rendered to the comparative anatomy of the Invertebrata even by the publication of such results as have already been attained. It is certain that the urea and uric acid tests, in determining the renal or non-renal character of supposed kidneys in the case of the lower and lowest Invertebrata, lead to conclusions utterly unworthy of confidence. This point I have abundantly proved. The presence of uric acid in the renal secretion supposes a highly nitrogenous or proteinized composition of the blood,—in fact, such complex conditions as do not exist in the fluids of the lower invertebrated animal.

of form and place and size, in all the pectinibranchiate and pulmonated Gasteropods. Under all diversities, it is identifiable by its anatomical structure. Cuvier thus defines its office and locality: "Le rectum, et oviductus de la femelle rampent aussi le long du côté droit de cette cavité, et entre eux et les branchies est un organe particulier composé de cellules recélant une humeur très-visqueuse, servant à former une enveloppe commune, qui renferme les œufs et que l'animal dépose avec eux*." That gland which in *Buccinum* is situated between the rectum on the right and the branchia on the left (when the roof is *in situ*), and attached to the roof of the branchial chamber, is the same gland with that which in *Limax niger* (fig. 1 *c, c*) lies on the floor of the pulmonary cavity, is extended in figure, and circumscribes a space in the centre of which the heart is situated. These two examples will serve to indicate the extremes of figure and locality which one and the same gland may assume even in kindred genera.

In the Littorinidæ (fig. 7 *f*) it affects the same position on the roof between the branchia and the rectum.

In the Helicidæ (fig. 3 *g*) it appears under the form of an oval mass, situated still on the roof of the pulmonary cavity; and, when the parts are *in situ*, to the right of the heart. Thus in the particular of locality, this gland in *Helix* differs remarkably from that of *Limax*, in which it is placed on the floor (fig. 1 *c, c*) of the cavity. In the Lymneadæ it is observed to occupy the same situation as it does in the Helicidæ. The Planorbidæ are too small to render it practicable to examine this gland separately; but, as in the former family, its position is on the roof and on the right of the heart.

That gland which by Dr. Sharpey has been called the supplementary and doubly laminose gill, is a totally different organ from the former. It does not exist under any form in the pulmoniferous orders. It is largest and most developed in *Buccinum*; in the Periwinkle it is also very distinctly observable. It is situated always to the left of, and parallel to, the branchia. It is invariably tinged with a dark green colour. It terminates anteriorly in a long excretory duct which travels under the membrane of the vault and ends near the rectum.

By Cuvier, and all systematic naturalists, it is believed to be the organ which secretes the "purple and other dyes" which these animals are capable of pouring out, and has been accordingly designated the "colour-gland." In relative position and in general and minute structure, it is readily distinguishable from the "organe de la mucosité" of Cuvier.

* Règne Animal, vol. sur les Mollusques.

The author's purpose at present is simply to present a sketch of the structure of these glands. No opinion with reference to their function can assume a stable and reliable form which is not supported by the results of other researches into the structure of the corresponding organs of other classes of invertebrate animals. This more extended task is reserved for another occasion.

Although in *Limax* the so-called "muciparous gland" differs both in figure and situation from that of *Buccinum*, in minute structure they are not only similar but identical. The folds of which these bodies are composed were called the "*feuillets muqueux*" by Cuvier. They are attached to the internal face of a sort of a *tunica propria*, by which the entire gland is closely bound down. This tunic, regarded in its length, forms a cylinder. The axis of this cylinder is an open space. The sides bear the glandular folds. A transverse as well as a longitudinal section of the gland is required in order to display the true disposition of the glandular laminæ.

These bodies are richly ciliated both within and without. Each fold ends in an excretory duct. The ducts emanating from each fold are tributary to a common duct which runs along the axes of the gland and joins the rectum at different points in different genera. This fact, which can be readily verified, is worthy of remembrance. From this fact alone the conclusion is beyond dispute, that if these glands be the real bodies by which the "mucosity" with which, almost at will, the respiratory cavity in these animals may be filled, it can only attain this cavity by oozing through or transuding the *tunica propria* of the gland,—a conclusion repugnant to reason, and at variance with all physiological analogy.

In *Buccinum* the gland is flatter and less cylindrical than in *Limax*. This occasions a slight difference in the mode in which the laminæ (fig. 8 *a*) are attached to the *tunica propria*. It is by no means difficult to detach a single fold (*a*) in a perfect state and place it under the microscope. By this simple expedient the entire machinery of this gland is rendered at once evident.

A highly ciliated membrane, more delicate than, although the prolongation inwards of, the *tunica propria*, gives its form to, and contains the gland-substance of, this fold. The external surface of this membrane, although within the boundary of the *tunica propria*, is not the true interior of the gland. The true interior spaces of the gland communicating with the duct are not ciliated; nor is the *internal* surface of the rectum in which it terminates. It will be seen that the entire mass of the glandular fold or lamina under examination consists of two elements: first, the Florence-flask-shaped vesicles (fig. 8 *b*, *b*, and B, *b*), which may not incorrectly be said to represent the lobuli or acini of the glands of the vertebrated animal; and, secondly, the intermediate stromatous and cellular structure which fills up the spaces *external* to and between the vesicles. In the recent gland these two parts are so evidently distinct, and indeed so easily distinguishable, that they cannot be confounded. The cells (B, *b*) *within* the vesicles are densely crowded with semi-fluid albumen-looking contents, of low refractive power. The substance contained in these intravesicular cells is unquestionably *the* secretion of this gland. There it is, directly under the eye, in its very place of production. If by micro-chemical analysis its composition while thus isolated in cells could be determined, the problem as to the real nature and office of this gland might indeed very readily be solved; but the minuteness of the quantity thus presented to the eye renders such a determination impossible.

The nucleated cells (*c*) which occupy the interspaces between the cæcal vesicles are much larger than those contained within these parts; they are densely filled with oleous granules (*d*) of a greenish-yellow colour and of high refractive index. The nucleus in these cells is filled only with an albuminous formless semifluid substance. In this respect they will be found to contrast strikingly with the similarly placed cells of the "colour-gland" afterwards to be described. These extra-follicular cells, so densely charged with a secreted product, perform obviously an important part in the office of these glands. They are separated from those within the vesicles only by the walls of the follicles (B, *e*) themselves. These walls consist literally of only a *hyaline membrane*, structureless, answering simply and exclusively the mechanical purpose of a limitary or circumscriptive sac. No cell-elements are contained in its substance. It is evident therefore that the cells are the real factors in the act of secretion. The large pregnant cells (B, *e*), which stand on the outside of the cæcal follicles of the gland, are *soaked* in the circulating fluid. It surrounds them on all sides. But the blood does not penetrate in mass into the interior of the vesicles. The cells therefore by which these vesicles are filled cannot derive their contents directly from the blood. From the relative position of these parts—the blood, the extra-follicular or stromatous cells, and the intra-follicular cells,—it seems highly probable that the blood is first subjected to the agency of the externally situated cells which cluster around the grape-shaped ends of the glands, and that the prepared contents of these cells pass thence by endosmose into the interior of the follicles, where they for the second time conduce to form, and where they undergo the elaborative reaction of, a second system of cells. These last cells (B, *f*) are very unlike the former. In the gland of *Helix aspersa* they are best seen. Those which are disposed around the circumference of the space enclosed by the cæcum of the gland are the largest, and each of these cells contains a very apparent nucleus which is charged with greenish-yellow granules. As the eye approaches the centre of the cæcum, the cells lose their nuclei and become filled only with a mucus-like, pellucid, semifluid substance, which eventually escapes into the excretory channels of the gland. In the gland of *Buccinum* the dark nuclei of the circumferential cells (B, *f*) are much less distinct. But the mass of cells by which the cæcum is filled presents the same characters as in *Helix*. It is impossible here to avoid the reflection that the *cells* are considerably larger in size and more numerous in the glands of an Invertebrated than in those of a Vertebrated animal. In that of the latter, a network of blood-vessels accurately fits over and embraces externally the cæcal extremities of the gland. In the Invertebrate animal all glands are constructed in this respect on one general type. The blood courses in large streams through the stromatous substance; it never penetrates the hyaline membrane of the follicle. Those parts of the blood which are appointed to nourish the cells upon the agency of which the act of secretion depends, and which cells in their turn furnish the final secreted product, are destined therefore to pass through an external stratum of cells and through the basement or hyaline membrane of the follicle before they eventually reach the true secreting cells. This exemplifies the important part taken by cells in the act of secretion.

Let the physiologist now review the apparatus whose anatomical constitution has in part been defined. A large excretory duct (fig. 8, B, *g*), discharging its contents into the rectum, is traceable as other ducts into a constantly diminishing series of ducts, until at length the Florence-flask-shaped terminal vesicles (B, *e*) are reached. At this point the microscope discloses a complex system of cells and channels for the transmission of fluid,—a machinery in fact which is little inferior in intricacy to that of the glands of the highest animal. It may be reasonably inferred, that such an organized arrangement in a group of animals comparatively inferior must be designed to furnish a product far more important than the "mucosity" as supposed by Cuvier. It is next to impossible that this secretion can be any other than the *urine*. But this conclusion should receive all the certainty of an unquestionable demonstration, since, in this case, these bodies in the Gasteropods may be recognized as a starting-point of great value in the determination of analogies and homologies in the lower members of the series. This demonstration is reserved for another opportunity.

A second and much smaller gland exists in the respiratory cavity of the Pectinibranchiata, which hitherto has been variously called the "colour-gland" and the bipectinate supplementary gill. This body is not present in the breathing-chamber of the Pulmonata. In *Helix* a fringe-like fold (fig. 3 *e*) of the membrane of the cavity assumes almost the appearance of a gland; it is however nothing but a portion of the vascular respiratory membrane.

The so-called colour-gland is best studied in *Buccinum* and the Littorinidæ. In both it is situated on the extreme of the roof of the cavity, being separated from the other gland by the interposition of the branchiæ. It is considerably smaller in the Periwinkle than in the Whelk. It has a dark green colour. It commences posteriorly in a cæcal extremity. It is prolonged anteriorly into a tube or duct which travels underneath the mucous membrane of the vault until it approaches the termination of the rectum, where it has its outlet by a separate orifice. Viewed as an axis (fig. 9 *a, a*), this duct may be described as supporting the lobes or leaves (*b, b*) of the gland,—as symmetrical, bilateral, ramose diverticula. This gland presents a general exterior resemblance to the so-called "muciparous gland" of this chamber. It admits of division into two parts—the *lobes* first, which correspond with the laminæ; and, secondly, the *lobuli* (*c*) into which the lobes (*b, b*) are further subdivided. One of the *lobuli* in minute structure represents the arrangement of the whole gland. These *lobuli* do not exist in the "muciparous gland." This is one distinctive fact. The next is that the latter gland has a yellow colour, the former is of a dark green. But distinctions more essential than the preceding remain to be indicated. A lobule is represented by a bunch of grapes *flattened* (fig. 10). The grapes or terminal follicles (*a, a*) do not exhibit the same *figure* or shape as they do in the "muciparous gland;" they are more elongated and conical. From the latter they differ also in their contents. They circumscribe cells which cannot be confounded with those of the muciparous gland of the respiratory cavity. The stromatous tissue (fig. 10 *b*) which envelopes the *cæca* is obviously dissimilar from that of the latter gland. The dark green colour (*c*) of both the extracæcal and intracæcal cells is one striking fact of distinction. This colour is seated in the *nuclei* of the cells. Like those of the "muciparous gland," these cell-elements are divisible into two groups; those, first, which are external to the cæcum; and, secondly, those which are within (*d*). Those which are without are of a deep dark green colour (*c*); this colour is concentrated in the nucleus. Those which are within the limitary membrane of the cæcum are less darkly tinged (*d*). But it is evident that the latter cells circumscribe contents which are the derivative products of the former. The cells situated in the circumference of the vesicles are more dark than those placed in the centre. This gradation of colouring is expressive of the stages through which the secreted product passes. By this coloured substance this gland is strikingly distinguished from that of the "muciparous gland." The follicles differ in figure from those of the latter, but the cells do not; they are distinguished only by the *colour* of the material by which they are filled.

Arbitrating as mere physiologists, it would be quite impossible to say why one of these glands should be a kidney and why the other should not. It cannot be proved by the secreted product of this gland that it is one really designed to furnish a "coloured fluid." This inference is founded simply upon the colour of the cell-machinery by which this product is elaborated—not upon the colour of the finished excretion.

The author proposes for the present to leave this question in an unsettled attitude; but he will venture to state that neither of these glands is the source of the "mucus" or "mucosity" for which the Gasteropod Mollusks are remarkable. This "mucosity" is really supplied by a totally different machinery. It is poured forth by follicles which in all Gasteropod and Nudibranchiate Mollusks are more or less thickly strewn over the mucous and cutaneous surfaces. These follicles will be more minutely described in speaking of the respiratory organs of the Nudibranchiate Mollusks.

EXPLANATION OF PLATES V. AND XI.

PLATE V.

Fig. 1. Animal of *Littorina littorea*, removed from its shell, having the branchial chamber laid open,—the roof being everted in order to show its under or internal surface. *e, e,* roof; *d,* colour-gland of the author, "double"-gill of Dr. Sharpey and other naturalists; *a, a,* branchia, consisting of many hundreds of parallel leaves; *b,* a gland of the mucosity, supposed to have a renal function; *c,* extremity of the *intestinum rectum*; *g,* a second gland whose function is not determined; *j,* duct of the generative organ; *i,* floor of the branchial chamber; *h,* mantle; *k,* abdominal portion of the body.

Fig. 2. Animal of *Buccinum undatum*, removed from its shell, and showing the roof of the respiratory chamber everted: *f,* siphon; *b,* the so-called double-gill, the colour-gland of the author; *a, a',* branchia, consisting of many hundreds of parallel leaves; *d,* duct leading from the colour-gland and terminating near the rectum, *e*; *c,* gland of the mucosity, supposed to have a renal function.

Fig. 3. Enlarged view of a single branchial leaflet of the Periwinkle: *a, a,* cartilaginous thick or dorsal edge; *b, b,* folds or secondary plications of the surface of the leaflet; (B), the same in sectional view, showing that the *plicæ* exist on both faces of the leaf; *c, c,* a second set of plicæ; *h, h,* the blood-channels as they course in a parallel order towards the free margin (*g*), at which place they loop round as shown in fig. 5; *d, d,* (fig. 3) indicate the fixed border of the lamina where the afferent and efferent trunks are situated; *j,* the extreme tapering end of the lamina.

Fig. 4. Four branchial leaflets from the gill of *Buccinum undatum*, with a portion of the roof from which they depend: *a, a,* the dorsal or cartilaginous border of the lamina; *a, f,* rows of cilia on the same; *e, c,* section of roof to which they are attached; *d, d,* the flat surface or face of the leaflet, traversed by wavingly parallel blood-channels; *a, b, g,* the free border at which these channels loop, so as to reach the opposite face; *c, c,* the attached base at which the afferent and efferent trunks are placed.

Fig. 5. is a small portion of the free border, *b,* of the last figure, highly magnified, showing the mode in which the blood-channels, *g,* curve round the free border in passing from one face of the lamina to the other.

Fig. 6. A small portion of the epithelium from the face of the lamina.

Fig. 7. The hyaline cartilage which gives rigidity to and is enclosed in the substance of the dorsal border of the lamina.

Fig. 8. Two epithelial ciliated scales from the free margin, *b,* of fig. 4.

Fig. 9. *a, a, a, a, a, a,* six leaflets from the gill of *Purpura Lapillus*: *a′*, shows the hook-like manner in which the dorsal border curves at the point—a contrivance which increases the elasticity of the cartilage in unfurling and tightening the lamina; *c,* marks the course of the blood-channels across the area of the leaf; *b,* is the free or floating border; *d,* the base; *b,* the base of the cartilaginous border.

Fig. 10. is a diagram of the entire gill in *Purpura Lapillus,* showing the general form of the organ, the largest and longest laminæ being in the middle, the smallest at either end.

Fig. 12. The hyaline cartilage from the dorsal border of the gill-leaf of *Purpura Lapillus.*

Fig. 12 *b.* One of the blood-channels from the same, traced at the free border, showing the mode in which it loops.

Fig. 13. Seven branchial laminæ from the gill of *Trochus magus*: *a,* cartilaginous border; *d,* base of the same; *e,* face of the lamina indicating the course of the blood-channels; *b,* free border; *c,* base.

Fig. 14. Seven leaflets from the gill of *Trochus cinerarius*: *a, d,* cartilaginous border; *b,* free border; *c,* denotes the directions of the muscular fibres which are attached to the base of the hyaline cartilage; *e, e,* base.

Plate XI.

Fig. 1. *Limax niger,* showing the roof (*a*) of the respiratory chamber reflected. On its under surface (*b*) is seen a plexus of vessels, which are more distinct on the pericardium (*c*); *c′, c′,* represent the mucous gland; *d,* heart; *g,* vessels distributed over the floor of the respiratory chamber; *e,* orifice of the breathing-chamber; *h,* aorta.

Fig. 2. A small portion of the vascular plexus from the breathing-cavity of the preceding specimen, magnified, exhibiting the tendency to a cellular or locular arrangement (*a*) in the plan of the vessels; *b*, a large circular trunk circumscribing a "cell."

Fig. 2 (*b*). A small portion of the same plexus from another situation.

Fig. 3. *Helix aspersa*, removed from its shell: *a*, *intestinum rectum*; *b*, ventricle of the heart; *c*, auricle; *d*, *d'*, main pulmonary artery; *k*, secondary vessels of the pulmonary plexus (*h*); *i*, diaphragm which divides the thorax from the abdomen (*j*); *f*, floor of thorax, or respiratory chamber.

Figs. 4 & 5. *Helix aspersa*, out of its shell. Fig. 4 shows the animal in the act of creeping on the foot (*d*), and with the respiratory cavity (*c*) in a state of inspiratory distension: *a*, orifice into the breathing-chamber; *e'*, notch in edge of disk (*e*). Fig. 5 illustrates the same animal, the foot being retracted, the respiratory chamber (*c*) collapsed during expiration, and the orifice (*a*) being open to take in a fresh supply of air; *e*, the disk.

Fig. 6. A portion of the vascular plexus from the roof of the pulmonary chamber of *Helix aspersa*, showing the parallel disposition of the secondary and ultimate vessels.

Fig. 7. Animal of *Lymneus stagnalis* removed from its shell: *a*, siphon in the projected state; *b*, *c*, respiratory chamber; *e*, heart; *g*. denotes the position of the *intestinum rectum*; *f*, gland of the mucosity; *h*, flattened ciliated tentacles.

Fig. 8. A. Muciparous gland of *Buccinum undatum*: *a*, *b*, *b*, vesicles; *c*, intervesicular stroma; *d*, cells from the interior of vesicles.

B. A group of vesicles, seated on a peduncle, magnified: *e*, a vesicle; *b*, the cells, containing the true secretion with which the vesicles are filled; *f*, ultimate cells.

Fig. 9. Transverse section of the "colour-gland" of *Buccinum undatum*: *c*, lobules into which each lobe (*b*) is subdivided; *a*, section of a large vessel; *d*, axis.

Fig. 10. A *lobule* of the former section magnified: *a*, *a*, vesicles; *b*, intervesicular stroma composed of coloured cells; *d*, a small portion further magnified; *c*, ultimate cells.

[To be continued.]

XXI. — *Notes on Permian Fossils*:—Palliobranchiata. By William King, Professor of Mineralogy and Geology in Queen's University, Ireland (Q. C. Galway); Corresponding Member of the Natural History and Medical Society of Dresden, &c.

[With a Plate.]

Every palæontological fact connected with the Permian system is of the highest interest. Apart from the many philosophical questions pertaining to them, both this geological division and its fossils are more intimately related to one of the great industrial resources of Britain than is generally imagined. The Permian system, in point of fact, is the key to all our covered-up coal-measures; and its organic remains are the wards of that key. Should any one discover a bed containing Permian fossils, the probability is, that it immediately overlies a series of workable seams of coal. Dr. Smith, "the Father of English geology," strongly urged on the "viewers" of Newcastle to sink through the magnesian (Permian) limestone of an adjoining county, being fully convinced they would come on as good coal as occurred in Northumberland. His advice was taken, but not without considerable mistrust; and the result is, that Durham has become one of the principal seats of the colliery trade in Britain.

The North of England, with its valuable treasures of coal, may yet find a powerful rival in the North of Ireland. A few years since, there was much uncertainty prevailing as to the age of a magnesian limestone occurring at Cultra, near Hollywood, on the south shore of Belfast Lough, some referring it to the Permian system*, others to the Carboniferous†. There is now, however, no doubt on the point, since all its organic remains are unmistakeably Permian‡.

But Cultra is not the only locality in the North of Ireland where the Permian system is developed; for in September last it was my lot to discover, in the neighbourhood of Ardtrea in county Tyrone, another deposit of magnesian limestone precisely similar to that occurring at Cultra, and charged with undoubted Permian fossils§. It now only remains for the colliery engineer to sink his boring rods through the magnesian limestone of these localities to ascertain if they contain the usual underlying coal-measures.

Enough has been stated to show that every particular relating to Permian palæontology ought to be carefully noted.

Although the fossils of the Permian system, as developed in Germany and England, have long been known through the researches of Schlotheim, Sedgwick, Phillips and others, yet,

* *Vide* a paper "On the Magnesian Limestone of Hollywood and its associated Rocks," by Mr. James Bryce, in vol. i. of the Journal of the Geol. Soc. of Dublin. Mr. M'Adam expressed himself in favour of the same opinion in a paper which he read at the Belfast Meeting of the British Association.

† *Vide* a paper by Dr. Griffith "On the Lower portion of the Carboniferous Series of Ireland," in the Brit. Assoc. Report for 1843, p. 45, &c., in which the Cultra fossils are identified by M'Coy, according to Mr. Kelly (*vide* Journ. of the Geol. Soc. of Dublin, vol. vii. p. 23), with Devonian species.

‡ This fact was first announced by myself in a paper "On the Permian Fossils of Cultra," which I read at the Belfast Meeting of the British Association; *vide* Repor tfor 1852, p. 53.

§ A paper of mine on this discovery was read at the December meeting of the Dublin Geological Society. I expect it will be published in the next Number of the 'Dublin Natural History Review.'

when engaged with my 'Catalogue' in 1847*, and my 'Monograph' in 1850, I was under the necessity of diagnosing about fifty-three species, none of which had, at the date first named, been met with out of England. The late researches of Dr. Geinitz of Dresden and Baron von Schauroth of Coburg have, however, brought to light about thirty-three of my new species as equally indigenous to Germany. The twenty not yet met with out of England seem to be balanced by about as many species which have not been discovered anywhere except in Germany. Those which I have determined as occurring at Cultra and Ardtrea amount to about thirteen species, all of which, however, are characteristic of both the English and German Permians. The facts just noticed have mainly induced me to publish in the 'Annals' an occasional paper, which, although nominally on Permian fossils, will enable me to discuss a few matters of somei mportance in palæontology.

Family **Productidæ**, J. E. Gray.

Genus Productus, J. Sowerby.

P. Geinitzianus, De Koninck. Pl. XII., figs. 1 & 2.

As I was unacquainted with this species except through the figures and description in De Koninck's 'Monographie' of the genus *Productus* † (*vide* pl. 15. fig. 3 *a, b, c, d,* p. 156 & 157, 1847); and as Geinitz was induced to unite it in his 'Versteinerungen' (*vide* p. 14, 1848), though not positively, with his previously described *Orthis excavata,* I was led to adopt this identification in my Monograph; but having recently fallen in with a specimen by accident, mixed with some examples of *Productus horridus* lately received from Dr. Krantz, I now perceive that De Koninck was correct in regarding it as an undescribed species.

The figures in the 'Monographie' are doubtless faithful copies of the specimens they represent; but the example before me shows that the species is more variable than De Koninck suspected. It is described as having the large valve "divisée dans son milieu par un sinus large et peu profond prenant naissance à une petite distance du crochet;" but this valve can scarcely be said to possess a median depression in the specimen which I have represented under figures 1 & 2 in Plate XII.

* It is well known in Newcastle that this 'Catalogue,' although published in 1848, was ready for publication by the Tyneside Naturalists' Field Club in July 1847.

† I feel it necessary to express my obligations to Dr. de Koninck for presenting me with a beautiful copy of this invaluable work.

Productus aculeatus, according to the figures given of it by De Koninck, seems to be a closely related form, the principal difference being, that the small valve of the present fossil is not radially costulated. *P. granulosus* appears to be another allied form; as is also *P. scabriculus*. In some of these species the spine-bases are elongated, and extended considerably in front of the spines, which are thereby made to appear as if directed backwards or towards the hinge: the same character is exhibited in *P. Geinitzianus*, but it appears to have escaped the notice of De Koninck; or perhaps his specimens did not possess it. The resemblance between *P. Geinitzianus* and *Strophalosia* (*Orthis*) *excavata* clearly led Geinitz to conclude both forms to be identical; but in the latter species the spines are finer, decidedly more numerous, and strikingly arranged in quincunx.

Perceiving no trace of teeth or of an area in the example I have examined, which is about an inch in width, I am led to conclude that the species is a true *Productus*.

De Koninck states that it is a "very rare species." His specimens are from the Zechstein in the neighbourhood of Milbitz. The specimen figured is from Röpsen. It has not yet been made known as occurring in any British formations.

Productus Schaurothianus, n. sp. Pl. XII. figs. 3, 4 & 5.

Lately breaking up a few fragments of dark-coloured Zechstein from Röpsen, I was agreeably surprised to find a few specimens of a small shell, which, at first sight, from its possessing an irregularly impressed or truncated umbone, appeared to me to be a species of oyster. A closer examination, however, convinced me that it was a *Productus*, altogether unlike any I was acquainted with. I therefore embrace the present opportunity of describing it and of dedicating it to my friend Baron von Schauroth, who has within the last few years contributed much towards elucidating the palæontology of the German Permians.

Diagnosis.—General form irregularly hemispherical. *Large valve* irregularly and strongly convex; having a distinct median depression; and marked with longitudinal costules, occasionally dichotomous; its umbone deeply and irregularly impressed or truncated. *Small valve* flattish or slightly concave; wrinkled parallel to its free margin; and marked with nearly obsolete radiating costules. *Hinge-line* about (?) half the width of the valves.

Productus Schaurothianus has much the aspect of some of the so-called Thecidiums of the Jurassic system, such as *T. Deslongchampsii*, David., which has a somewhat similar truncation of the umbone. With this remarkable peculiarity, it is quite an abnormal form of the genus; for no species that I am aware of possesses a truncated beak. I found two or three specimens with a fragment of stone (? clay-slate), to which they adhered, still attached to the truncated surface of the umbone: when chipped out it left a deep groove on the truncation. *Productus Schaurothianus* thus agrees with most species of *Strophalosia*,—a circumstance which might induce some to suppose that it belongs to the last-named genus; but I have failed in discovering any traces of teeth or of an area. Being an attached shell, this species affords another argument against the opinion that the *Producti* adhered to foreign bodies by means of fibres passing out of their anterior opening, as advocated by De Koninck. Attached species, such as the present, evidently adhered to foreign bodies by their umbone in the same way as oysters, &c. I suspect that some species moored themselves by means of their spines, like Strophalosias; while others, such as *Productus giganteus*, remained free, resting on their large convex valve, as is the case with *Pecten Jacobæus*.

The median depression in *Productus Schaurothianus* is seldom exactly in the middle, which causes the large valve to be unequally lobed. The costules number about five in a quarter of an inch at the anterior margin. No spines are visible on either valve. None of the specimens that have occurred to me exceed $\frac{5}{8}$ths of an inch in diameter. I am not aware of its occurring in any other locality than Röpsen.

Genus Aulosteges, Helmerson.

? *Aulosteges umbonillatus*=*Productus id.**, King. Pl. XII. fig. 6.

This singular species appears to be somewhat abundant at Pössneck, where its occurrence was first made known by Schauroth, who has given some characteristic figures of it in his first 'Beitrag †.' I diagnosed it as being "subtriangular marginally," which is an error: it ought to have been described as subquadrate, which may be seen by consulting the figures referred to in the note.

From the circumstance of this species possessing some "appearance of an area," I ventured to state, in my Monograph, that eventually it might be found to belong to Helmerson's

* *Vide* Monograph of the Permian Fossils of England, p. 92. pl. 11. figs. 14–17.

† *Vide* "Ein Beitrag zur Fauna des Deutschen Zechsteingebirges, mit Berücksichtigung von King's Monographie der Versteinerungen des permischen Systems in England." (Aus dem Junihefte des Jahrganges 1853 der Sitzungsberichte der mathem.-naturw. Classe der kais. Akad. der Wissenschaften [Bd. xi. S. 147] besonders abgedruckt.)

genus *Aulosteges*. All the German specimens I have seen assist in lending considerable support to this conjecture; for they show more or less traces of a wide irregular area and a closed fissure*. With regard to its mode of articulation, the following expression may still be taken as correct:—" I can say with safety that it is not furnished with any teeth; it consequently cannot be a *Strophalosia*" (Monograph, p. 92). The conclusion embodied in this sentence is completely confirmed by the form of the reniform impressions, which, on referring to the figure here given (*vide* Pl. XII. fig. 6), will be seen to agree completely with those characteristic of *Productus*, and to be altogether different from those peculiar to *Strophalosia*.

With regard to the genus *Aulosteges*, I possess some good determinable specimens of the typical species from the Permian beds of Mont Grebeni near Orenburg, obligingly presented to me by Col. Helmerson through Sir Roderick Murchison; Mr. Davidson has also kindly favoured me with tracings of Col. Helmerson's figures of the same species, illustrative of his original memoir; I am therefore in a position to speak with more confidence than formerly on the genus. I have no doubt whatever of its being distinct from *Strophalosia*, since it is not furnished with any teeth—structures which are strictly diagnostic of the last-named genus—inasmuch as species may be truly dentigerous, and yet have a concealed or an almost obsolete area, as in *Strophalosia subaculeata*.

There is yet one point to be cleared up in connexion with *Aulosteges*. Do its reniform impressions project decidedly in front of the median plate, as in *Strophalosia*, or no further than about the extremity of this plate, as in *Productus*? † I have represented the interior of the small valve of ? *Aulosteges umbonillatus*, on which it will be seen these structures are situated as in *Productus*: if it could be positively affirmed that this species is a true *Aulosteges*, the reniform impressions would ally the genus more closely with *Productus* than *Strophalosia*.

Genus Strophalosia, King.

Strophalosia parva ‡, King.

This species has not yet been noticed as occurring in Germany; but I have seen a specimen (cast) adhering to the inner surface

* I formerly suspected the closed fissure to be a notch in the area caused by the cardinal process pressing against what I then termed the "flattened (area-like) space."

† *Vide* my Monograph, p. 95. and pl. 11. fig. 10, and pl. 12. figs. 5, 9, 14 & 30, where these differences are described and figured.

‡ *Vide op. cit.* p. 102. pl. 12. fig. 33.

of a *Strophalosia* (?) *Morrisiana* from Pössneck. M'Coy considers it to be the young of *Strophalosia Goldfussi* *; but its hinge-line always appeared to me to be too wide to agree with the "attenuated posterior end" of the latter: some other differences, which I formerly pointed out, appear to separate both forms from each other.

Strophalosia Morrisiana †, King.

In my Monograph it is stated that "two varieties of *Strophalosia Morrisiana* occur in the Permian rocks of Durham. One has the large valve slightly convex, with a very small umbone, and appears to be confined to Tunstall Hill: in the other, which is rather common at Humbleton Quarry, the corresponding valve is more rounded and the umbone more prominent: possibly they are specifically distinct; and it is this idea which causes me to be particular in stating that the Tunstall Hill form must be considered as the type of the species."

As regards the Humbleton variety, I admitted that it was closely related to *Strophalosia Cancrini*, De Verneuil, a Permian species occurring in Russia; M'Coy, however, without giving any satisfactory reasons, states that he entertains "little doubt" of both being the same species ‡. I here speak of the Humbleton variety, because it is the one which I suspect he had before him when making the statement quoted.

My attention having been again drawn to the present species; and as I cannot subscribe to the opinion just stated, I have considered it necessary to reopen the question as to its identity with *S. Cancrini*; more particularly as De Koninck, having examined a specimen from Ust-Joschuga in Russia, and compared it with a Zechstein fossil from Gera in Germany, has expressed himself similarly to M'Coy in his 'Monographie' (p. 108). I regret not having been myself able to examine any Russian type-specimens of *S. Cancrini*; but I think I shall be able, by means of the descriptions which De Verneuil, De Koninck and Count Keyserling have given of it, to substantiate in a great measure the view which I entertain on the question at issue.

Strophalosia Morrisiana, taking the Tunstall Hill specimens as its type, may be described as follows:—*General form* flatly concavo-convex; transversely elliptical. *Large valve* slightly con-

* British Palæozoic Fossils, p. 458.

† Monograph, pp. 100 & 101. pl. 12. figs. 18, 19, 20, 21, 22, 23, 24, 25, 29, 30. Numbers 18 and 19 refer to the type-specimens; the remaining numbers to the Humbleton form, which I designated var. *Humbletonensis*, stating at the same time that "in case it should be found to be a distinct species, the varietal should stand for the specific name."

‡ M'Coy, *op. cit.* p. 457.

vex; evenly rounded; often with one or more contracted longitudinal furrow-wrinkles on the sides, and furnished with a number of long, rather distant, somewhat irregularly arranged, creeping or adpressed spines directed forward: both inner and outer surface marked with nearly obsolete striæ radiating from the umbone; also with numerous well-defined incremental lines: *umbone* slightly affecting the even roundness of the valve; decidedly impressed or truncated; and scarcely curving down to the cardinal edge: *area* a little more in length than half the width of the valve; rather low, but well defined, being in the form of a very obtuse triangle, the sides of which are about equal to $\frac{5}{8}$ths of the length of the base; faintly lineated transversely; and furnished with a narrow deltidium. *Small valve* slightly concave; here and there exhibiting a few nearly obsolete, slightly elongated indented impressions a little raised at their anterior end, which causes them to appear as if produced by a blunt-pointed instrument: both inner and outer surface marked with fine radiating striæ a little more strongly marked than those on the large valve: *nucleus* raised a little above the general surface of the valve: *area* little more than rudimentary.

All the specimens I collected of this species are a little under an inch in width, and about $\frac{3}{4}$ of an inch in length. The small valve I am now strongly inclined to think cannot be considered as spiniferous: probably the nearly obsolete indented impressions may be modified bases of abortive spines. In the Appendix to my Monograph (p. 245) it is noticed, that this species has its small valve furnished with spines; and a reference was made to a cast from Whitley represented under fig. 26. pl. 12, which very distinctly exhibits these structures; but I now regard this specimen as belonging to the species next to be noticed*.

The foregoing description may be considered as an amplification of the diagnosis given in p. 160 of my Monograph;—the latter, however, is incorrect in some respects, caused by my including in it certain characters exhibited by the Humbleton variety.

I am not aware that this species has yet been found anywhere except at Tunstall Hill.

I shall next proceed to tabulate the differences between it and *Strophalosia Cancrini,* taking De Verneuil's figures and descriptions as my guide†.

* *Vide* Monograph. In plate 11. fig. 21. is represented an ideal section of *Strophalosia Morrisiana*, which must be cancelled, as the spinous character is altogether incorrect, and the large valve is too convex.

† Geology of Russia, by Sir R. I. Murchison, De Verneuil and Count Keyserling, pp. 273, 274. pl. 16. fig. 8, and pl. 18. fig. 7.

Strophalosia Morrisiana.	*Strophalosia Cancrini.*
Large valve.	
Slightly convex, and evenly rounded.	Strongly convex, and swelled out on the posterior half.
Transversely elliptical (wider than long).	"A little longer than wide."
Lateral slopes gradually inclined, and marked with longitudinal furrow-wrinkles.	Lateral slopes nearly perpendicular and transversely wrinkled.
Area well defined.	Area so imperceptible as not to be noticed by De Verneuil, Keyserling, or De Koninck.
Umbone very slightly affecting the even roundness of the valve, decidedly impressed or truncated, and scarcely curving down to the cardinal edge.	Umbone decidedly prominent, pointed, and incurved over the cardinal edge.
Hinge-line a little more than half the width of the valve.	Hinge-line not much shorter than the width of the valve.
Obsoletely striated.	Decidedly striated.

There appear to be some other differences, as in the spines, the nucleus of the small valve, &c.; but those tabulated are quite sufficient to demonstrate that both forms are specifically distinct. The specimen of *Strophalosia productoidea* figured by De Verneuil* has more resemblance to *S. Morrisiana* than to *S. Cancrini*: the Devonian species, however, is too convex; and its area is too wide, and not quite high enough for the Permian form.

As regards the variety *Humbletonensis*, I am more than ever inclined to consider it as a distinct species, the possibility of which I was, on a former occasion, impressed with†. At that time I also alluded to its being more closely related to *S. Cancrini* than the typical forms of *S. Morrisiana*; as it appeared to graduate the one into the other. But I am not yet either disposed to admit its identity with the former, or prepared to say positively that it is specifically distinct from the latter. The following description may assist in drawing up a diagnosis, should it hereafter be considered as a species.

General form rather strongly convex; as wide as long, sometimes longer than wide, rarely the converse. *Large valve* rather strongly convex and evenly rounded; occasionally with one or more longitudinal wrinkles on the sides; furnished with numerous long somewhat irregularly arranged spines, creeping and

* Russia in Europe, vol. ii. pl. 18. fig. 4 *e, f*.

† *Vide* Monograph of the Permian Fossils of England, p. 101.

directed forward on the back, erect and bent backward on the sides and adjacent to the hinge; both inner and (?) outer surface marked with numerous fine striæ radiating from the umbone; also with well-defined incremental lines: *umbone* somewhat tumid; occasionally a little impressed, and incurving over or below the cardinal edge: *area* small; scarcely perceptible through the incurvation of the umbone: *teeth* well developed. *Small valve* slightly concave; marked with numerous elongated indented impressions, which are somewhat regularly arranged, and deepest at their anterior end; both inner and outer surface marked with distinct radiating striæ; those on the sides near the hinge dichotomous and arcuated or curving posteriorly; they pass uninterruptedly over the indented impressions *, and are crossed by rather strong incremental lines: *nucleus* raised a little above the general surface of the valve.

I have adhered closely to the order in which the various characters of *S. Morrisiana* are described, so that the differences between the two forms may be readily seen. *S. Cancrini* differs from the present one,—notably in having the large valve still more convex; the umbone pointed and more swelled out behind the hinge-line; and the lateral wrinkles transversely directed; also in having an imperceptible or concealed area, the width of which, too, appears to be greater:—furthermore, it seems to be a much smaller species,—var. *Humbletonensis* being the largest of the three forms: some specimens of the latter are nearly an inch and a half in diameter. De Koninck's figure of his *so-called Productus Cancrini* from Ust-Joschuga would lead one to suppose that its small valve was furnished with spines; but I am almost certain that such do not occur in the present fossil: probably the singular elongated indented impressions may be modified bases of abortive spines similar to those on the corresponding valve of *Productus horridus* †.

It is this variety which exhibits the remarkable trivalved character noticed elsewhere ‡. I am still at a loss to account for it satisfactorily. The extra valve belongs to the small valve. Can the mollusk of some specimens have had the mantle belonging to its small valve separated into two layers or divisions, the innermost one forming the inner valve, and the outermost the outer valve?

I suspect all the specimens described and figured by Geinitz, as *Orthothrix lamellosus* and *Productus Cancrini*, belong to var. *Humbletonensis*. Schauroth represents a specimen from the

* These striæ I formerly described as broken: I was misled by the indented impressions giving them an appearance of the kind.

† *Vide* Monograph, p. 90. pl. 11. figs. 6, 7.

‡ *Vide* Monograph, p. 101. pl. 12. figs. 21–24.

Zechstein-dolomite of Pössneck having the spine-bases following a decidedly linear arrangement*. A specimen before me from Pössneck exhibits *very* faint traces of spines; but the striæ are well displayed. Doubtless the fossil from Gera noticed by De Koninck in his 'Monographie,' p. 108, and identified with *S. Cancrini*, is the same.

Strophalosia excavata†, Geinitz.

Var. *Whitleyensis*‡, King.

Allusion has already been made to the cast of a small valve found at Whitley, clearly exhibiting that it was furnished with spines, and which I formerly regarded as belonging to *Strophalosia Morrisiana*; but as I now feel pretty certain that the last form had not a spiniferous small valve, I am under the necessity of removing the present fossil to the species now entered on; not, however, without a strong suspicion that it will turn out to be specifically distinct, in which case the varietal name here given may be made a specific one. There is also before me a specimen of a large valve from Tunstall Hill, which I formerly considered as a variety of the present species: it agrees so closely with the small valve from Whitley in marginal outline and the number of spines, as to lead me to suspect that both belong to the same variety or species: if so, var. *Whitleyensis* will stand in the same relation to *S. excavata* as var. *Humbletonensis* does to *S. Morrisiana*.

Strophalosia excavata has the large valve tolerably convex; and its spines are crowded, and more or less regularly arranged in quincunx; but var. *Whitleyensis* is much less convex (considering the large valve found at Tunstall); and the spines are not so numerous (and consequently they are more apart); nor have they any marked quincuncial arrangement: further, the area appears to be wider; and the small valve has its nucleus elevated above the general surface, as in *S. Morrisiana* and var. *Humbletonensis*,—a character only slightly seen in *S. excavata*. It was the elevated nucleus that led me to regard the Whitley valve as belonging to *S. Morrisiana*.

Schauroth I perceive records in his 2nd Beitrag § the occurrence of *Strophalosia Goldfussi, S. excavata, S. Morrisiana, S. lamellosa* and *S. Cancrini* in the Permians of Germany. Is it possible that varieties *Humbletonensis* and *Whitleyensis* have been taken for the last two species?

* *Vide op. cit.* fig. 7 *a*.

† Versteinerungen, p. 14. pl. 5. fig. 37, pl. 6. fig. 20.

‡ Monograph, pl. 11. fig. 26.

§ Ein Beitrag zur Paläontologie des deutschen Zechsteingebirges, 1854.

The family *Productidæ*, as will be seen by referring to the table at the end, has been much better represented during the Permian period than was suspected a few years since: in short—of the four known genera, *Productus, Aulosteges, Strophalosia* and *Chonetes* *—we are now acquainted with probably about sixteen Permian species. But what is most remarkable, not a single representative of the family has yet been found in deposits admitted as belonging to a system more recent than the Permian †. We must not, however, jump to the conclusion, that the family *Productidæ* became extinct at the expiration of the Permian period: there are extensive geographical areas in Asia, South America, Australia and other regions, where beds are developed containing representatives of the family; it is therefore advisable to wait until the exact, or at least the proximate age of the beds referred to be determined, before pronouncing that no *Productidæ* lived after the setting-in of the great secondary cycle.

[To be continued.]

XXII.—*On* Scissurella crispata. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Norfolk Crescent, Bath, February 10, 1856.

The memorandum and figure of Mr. Lucas Barrett, which have just appeared in the 'Annals,' vol. xvii. p. 206, N.S., relative to the animal of *Scissurella crispata*, is a valuable contribution to malacological science, as it furnishes data to determine with sufficient precision the natural position of this curious species, on which for many years the greatest contrariety of opinion has existed, and which has not been satisfactorily settled until the present time. And I will further remark, that this uncertainty will always prevail when genera are constituted on shell con-

* Mr. Davidson was the first to work out the affinities of *Chonetes*: he has proved by its reniform (or ovarian?) impressions, that it belongs to the family *Productidæ*. *Vide* Introduction to his 'Monograph of British Fossil Brachiopoda,' 1853. The figure which Mr. Davidson has given of the reniform impressions on the flat valve of a "new species of *Chonetes* from the Devonian beds of Néhou, in France," proves that this genus is more related to *Productus* than to *Strophalosia*, notwithstanding its possessing both teeth and an area. With regard to the so-called *Chonetes comoides*, its reniform impressions, when discovered, will doubtless settle the question whether it be a *Chonetes* or a *Strophalosia*.

† The so-called *Productus Leonhardi* (now the type of the genus *Koninckia*) from the Saliferous rocks of St. Cassian evidently does not belong to *Productidæ* (*vide* Woodward's excellent 'Manual of Mollusca,' p. 231). I suspect, however, that it belongs, or comes near, to the family *Davidsonidæ*, proposed in my Monograph (pp. 81 & 151).

siderations; and they can only be admitted to a provisional position to await the rectifications that may be required by the discovery of the animal architect. Conchological dispositions must ever be the mere arena for surmise and doubtful classification.

Mr. Barrett has not stated his views on the systematic place of *Scissurella*. Whether this has arisen from omission, doubt, or from the idea of this species having already been properly deposited, does not appear. My object is to supply some information on this point.

Mr. Barrett's figure is that of a decided Trochidan animal: this is evident from the ciliated tentacula and lateral vibracula, which latter organs are peculiar to the *Trochidæ*; the four neck-lappets are composed of a lamina on each side, so deeply indented as to cause each to appear as two distinct processes; these appendages are the invariable concomitants of the *Trochi*.

Compare these points with the rough woodcut of the animal of *Trochus serpuloides* of Montagu, published in the 'Annals,' vol. viii. p. 45, N. S., and allowing a margin for specialty-variations, all the generic essentials of the Trochidan animal are incontestably apparent.

The late Professor Forbes is one of the naturalists who has, in his and Mr. Hanley's 'British Mollusca,' rightly placed this species with the *Trochidæ*; but he acknowledges having adopted that position from some notes of Sars; he however speaks with doubt, and hopes the animal will be better known.

Mr. Barrett's discovery shows that the undoubted natural position of *Scissurella* is with the subdiscoidal section of the delicate minute *Trochi*; its congeners are the *Trochus serpuloides*, Mont., *T. Cutleriana*, mihi, and *T. nitens* of Philippi, all the animals of which were first discovered by me, and described as Trochidans. The operculum of these species is circular, with a subcentral nucleus and coarse spiral striæ; that of Mr. Barrett's *Scissurella* slightly differs. They are all mere films, and require a good lenticular power to distinguish accurately their form and sculpture.

The fissure in the centre of the outer margin of the shell of the *Scissurella* originates in the animal specialty of a prolongation of the points of the branchial organ to procure a more free access of the water, and which by its presence, for a time, interrupts at that particular point the testaceous exudation from the mantle, and thus produces a short fissure, which in progress of growth becomes obliterated in consequence of the branchial impediments to the action of the mantle being removed to a new portion of the shell, and in this manner a constant continuation of the fissure is effected. But surely this scission cannot be considered of sufficient value to entitle the animal to represent a distinct Trochidan genus, and to nullify its indisputable generic essentials with the type, *Trochus*, in which we are of opinion it ought to be deposited, instead of burdening science with the new genus *Scissurella*.

There can be no species of *Scissurella* without an operculum, as its animal has now been proved to be a Trochidan, all of which are invariably operculated. When that appendage has escaped notice, it has probably been in consequence of the extreme tenuity of the fabric of its pellicle, and the want of proper optical power.

The ciliated lateral vibracula of the Trochidan animal vary from two to four on each side, but are usually three. They are frequently doubled up, and lie under the flap of the upper lobe of the foot; and, from their slenderness and change of position, are often difficult to detect. This remark is made to meet the possibility of the vibracula in Mr. Barrett's *Scissurella* turning out to be three on each side.

In conclusion I beg to observe, that malacologists are under great obligations to Mr. Barrett for having solved a long-desired question, and it would be well if other observers would imitate him. I will throw out a hint connected with the present inquiry by mentioning, that it is a great desideratum to obtain notes on the living *Trochus subcarinatus* of Montagu (*Adeorbis,* nonnull.), which I have in vain sought for during forty years, and the acquisition of which Professor Forbes particularly recommended to my attention.

It is impossible for a single naturalist, however diligent, to do everything and be everywhere; it is only by the many, seizing the opportunities in their respective localities, that science can be made acquainted with facts to elucidate the unsolved problems in natural history.

I am, Gentlemen,
Your most obedient Servant,
WILLIAM CLARK.

XXIII.—*Further Notices of Piedmontese Mollusca.* By J. GWYN JEFFREYS, Esq., F.R.S.

Scissurella.—Having, in consequence of Mr. Barrett's description of the animal of *S. decussata,* D'Orb. (*crispata* of British authors), in the last number of the 'Annals,' placed under a microscope some *S. elegans,* containing the dried animals, I succeeded in detecting a circular operculum in three out of 145 specimens; and I have also examined the operculum in the Norwegian specimen dredged by Mr. MacAndrew. It resembles the operculum of *Trochus* (sub-genus

Margarita), to which this genus appears to be allied; although in *Scissurella* it is not so multispiral. The slit in adult specimens ends in a foramen, and is not continued to the edge of the shell or aperture, as was remarked by the late Mr. G. B. Sowerby, as well as by Philippi, although D'Orbigny (the founder of the genus) did not notice this peculiarity. Mr. Woodward (who called my attention to the circumstance) is of opinion that the fossil genus *Trochotoma* bears a close relation to *Scissurella*. In the Northern Seas, the species appear to inhabit deep water; but in the Mediterranean they are littoral.

Trochus zonatus.—It seems that this name had been preoccupied by Mr. Wood for another species, and I therefore propose to change my specific name to *Skeneoides*.

Jeffreysia opalina.—I have found a full-grown and characteristic example in some shell-sand sifted from seaweed which I collected at Palmaria; thus adding another British species to my list.

58 Montagu Square, 22nd Feb. 1856.

BIBLIOGRAPHICAL NOTICES.

The Natural History of the Tineina. By H. T. Stainton, assisted by Prof. Zeller and J. W. Douglas. Vol. 1. London. Van Voorst. 8vo. 1855.

In the days of our great-grandfathers, and for many years later, the naturalist was regarded, even by men of cultivated minds, with a singular mixture of pity and contempt, as something very little better than a harmless madman. Thus the renowned Bickerstaff, in his 'Tatler,' indulges in many curious pleasantries at the expense of the naturalists of his day—*virtuosos*, as he calls them; now giving a ludicrous account of his visit to the "ingenious" Don Saltero, in his coffee-house and barber's shop at Chelsea; now administering a sly poke to the Royal Society; and, lastly, furnishing us with the will of a *virtuoso*, who died in consequence of his exertions in pursuit of a rare butterfly. Forming a collection of insects seems to have been regarded in those days as one of the most contemptible of all employments; and, in fact, the smaller the object studied, the greater was the contempt entertained for the student. Nowadays, however, although there may still be a tendency to worship size and strength in the higher animals, the fact, that amongst the agents employed by Nature none are more active and powerful than those little creatures whose operations are carried on in secret, and whose minuteness often screens their very existence from the eye of the careless observer, long since admitted by philosophical naturalists, is gradually dawning upon the popular mind.

Nevertheless entomology appears never to have recovered entirely from the ill-repute in which it was formerly held; and this is perhaps mainly to be attributed to the fact, that so many of its votaries regard entomology as consisting in a handsome cabinet with glazed drawers (if made by Standish so much the better), containing rows of good specimens of insects, each with its appropriate label, and feel far greater pleasure in the possession of a rare insect than in the investigation of the most interesting points in the natural history of their favourites. It is no great wonder, perhaps, that ordinary, plain, common-sense people should find some difficulty in realizing the advantages to be derived from the possession of ever so many dry insects stuck through with pins, and thus be led to consider one of the most interesting branches of natural history as a somewhat contemptible study. The existence of this prejudice against the study of entomology may probably be one great reason why this science is so little in repute even amongst professed naturalists; and we believe that nine out of ten of our best zoologists know less of insects than of any other section of the animal kingdom.

The Lepidoptera, more than any other order of Insects, are the objects of the collector's avidity. The beauty of their forms and colours have rendered them the pets of the "fancy," and of those so-called entomologists who deserve no better name, whose sole happiness consists in possession. Indeed, the well-known tendency of evil communication to corrupt good manners prevails so extensively amongst the British Lepidopterists, that it is not easy to find any who are not more or less imbued with what we must call the spirit of "fancy."

It is therefore with no small gratification that we welcome the appearance in the field of a gentleman who is well known as an earnest and conscientious worker, and who now seems determined to show his brother Lepidopterists that the science of entomology is not synonymous with the art of pinning insects. The group selected by Mr. Stainton, for illustration in the work of which the first volume is now before us, is the extensive tribe or family of the *Tineina*, a group of Moths generally of very small size, but frequently of the most elegant forms and brilliant colours, which present more variety and interest in their œconomy than any of the other sections of the order. Until of late years these insects were comparatively little known, the number of species with which the older naturalists were acquainted being very few; and although many species have been described by modern authors, our knowledge of their natural history is still very defective.

The present volume, which is the first of a long series, contains the natural history of twenty-four species, twenty-one belonging to the genus *Nepticula* and three to *Cemiostoma*. In the larva state these insects are all leaf-miners, that is to say, they feed upon the parenchyma of the leaves without injuring the membranes of either surface. The caterpillars of one or two species, however, live in the bark of the twigs of broom. The egg is laid, with very few exceptions, on the lower side of the leaf, and almost always close to the midrib or one of the stronger nervures; and it is remarkable that those moths which deposit their eggs upon the twigs of broom select the side of one of the projecting angles of the stem for its reception. The form of the mine formed by the larva is very variable: sometimes it runs in every direction through the leaf; in other cases it exhibits more regularity in its arrangement, sometimes taking a serpentine form, sometimes running in spirals, or forming nearly concentric lines on the disk of the leaf, whilst the larva of one species follows the edge of the leaf and carries its little mine into every serrature. The caterpillar of one species, which Mr. Stainton calls *Nepticula viscerella,* forms a curious mine, bending upon itself at short intervals, and thus constituting a series of short, parallel, approximated lines. In most cases the larva has a tendency to enlarge its mine towards the extremity, and thus, when the creature is nearly mature, its dwelling usually forms a broad chamber or blotch beneath the surface of the leaf.

Notwithstanding the apparent convenience of this dwelling-place for the purpose of undergoing its metamorphoses, the caterpillar generally quits its little burrow before passing to the pupa state; and when the time for this operation has arrived, it eats out of the upper surface of the leaf, and spins a beautiful silky cocoon on the footstalk, or the stem of the plant, or even amongst leaves on the ground, where it awaits its further changes. The first-mentioned position is usually adopted by those species which appear in the perfect state in the summer months, whilst those which pass the winter in the pupa state select one of the two latter situations: and it is remarkable that of those species of which there are two broods in the year, the larvæ of the summer brood spin their cocoons on the footstalk of the leaf; whilst those which change to the pupa state in autumn, and pass the winter in that condition, resort instinctively to the protection afforded by the stem of the plant, where they usually place themselves under a projecting bud or twig, for shelter from the inclemency of the winter. When the moth is ready to make its appearance, the pupa pushes its head through the cocoon, and the elegant little creature is thus enabled to spring at once into the air, without struggling through the silky meshes of its dwelling, a proceeding which would probably do no little injury to the delicate scales with which its wings are covered.

Such is the general history of the twenty-four Moths described by Mr. Stainton in the present volume, and probably that of many others, as there are still several species belonging to both these genera with the œconomy of which our author is not acquainted. We must regret that Mr. Stainton has not given us something of this kind in the introductory remarks on each genus, as he could have done it so much better; and it would also have saved him the trouble of repeating the greater part of these particulars in his account of each species, a proceeding which certainly adds unnecessarily to the extent occupied by their history. Indeed it cannot be too much insisted on in these days, when we are so overwhelmed with works on natural history that it is almost impossible to keep pace with the progress of even a single branch of the science, that the author who presents us with the greatest amount of information in the smallest possible space is the one who must be regarded as doing the best service to the cause he professes to have at heart; and we are therefore sorry to see that Mr. Stainton, whose earnest desire for the advancement of Entomology is evident in every page of this book, has divided his history of each species into numerous sections, in such a manner as to extend the space occupied by each to a very unnecessary length, especially in conjunction with another feature, to which we shall refer hereafter. Thus, for example, we have paragraphs under the following titles:—"How noticeable,—Larva;" "How noticeable,—Imago;" and then "Mode of Life," the latter containing everything necessary to be known in the two preceding sections, which might certainly be dispensed with, at a saving of about a page to each species, and a corresponding advantage to the student. Again, we cannot see that the observations placed before the synonyms of each species are distinct in nature from those frequently placed after them, although arranged by our author in separate sections, under the titles of "Synonymy" and "Remarks on the Synonymy;" and we cannot but think therefore that it would have been far better to have amalgamated these remarks under one head.

It will be seen that the above objections apply solely to the plan which Mr. Stainton has seen fit to adopt in communicating his results to the world, and have therefore nothing to do with the intrinsic excellence of his book; nay, this very profusion of labour in the literary department of the work may be taken as an earnest that there has been no lack of energy and perseverance in the prosecution of the preliminary investigations. Indeed, the copious information furnished in Mr. Stainton's book upon every subject connected with the history of these Moths leaves nothing to be desired in this respect; and the eight admirable plates with which it is illustrated furnish capital and most characteristic representations of the Moths, with their larvæ, the mines of the latter, and the cocoons in which the pupæ pass their period of inactivity. The first four of these plates were drawn and lithographed by the late lamented Mr. Wing, whose name is a sufficient pledge for their excellence, and some of the drawings for the remaining plates were also done by him; these have been completed by Mr. C. W. Wing and Mr. Ford, and are also exceedingly good, especially those by the latter artist. Some idea of the industry exerted in working out the natural history of the species may best be gained from the fact, that in some cases these little caterpillars, measuring about 2 lines in length, are taken out of the galleries to sit for their portraits, and restored again with such care to their natural position, that they return at once to their ordinary employment of eating, and finally make their appearance in the perfect state, probably to figure in one of the innumerable pages of the 'Zoologist,' as what Mr. Kingsley would call "another thought of the divine mind rescued from Hela." But we must proceed to the consideration of another curious and important feature of this book, which certainly exhibits an unusual boldness of design throughout.

Ever since Ehrenberg discovered that it was impossible to represent Infusoria properly except upon elephant folio plates, it has become more or less the fashion amongst zoologists to consider that the size of works on natural history should be in an inverse ratio to that of the objects treated of. Our author appears to have adopted this principle, and although he does not attempt to rival the learned Professor of Berlin in the perpendicular dimension of his work, he certainly shows himself determined to expand most portentously in a horizontal direction. Thus the present volume is the first of a *first series of ten*; it contains, as we have already stated, the history of only twenty-four species of these little Moths; and as, according to his own statements, there are now known no fewer than six hundred species of Tineina, we may presume that the work, when complete, will extend to at least five-and-twenty volumes,—a small library in itself.

The process by which Mr. Stainton proposes to fill this enormous space is the same as that adopted by Prof. Ehrenberg for the same purpose, but he has improved upon the original notion. Ehrenberg wrote his book in three languages, German, French and Latin, probably neglecting the English as unworthy of his notice; but Mr. Stainton, writing for the world in general, but for Englishmen in particular, has naturally added English to his list of languages, and his book appears as though intended for the original builders of Babel before they had had time to learn each other's dialects. We are aware that there are such things as Polyglot Bibles, and doubtless theological students may find them advantageous in giving different readings of the same passage; but no such benefit would attend the publication of *Biblia Naturæ* on the same principle, and considering the stature to which they might attain in one language, we have no wish to see them published in half a dozen.

In Ehrenberg's case there was indeed some excuse for the adoption of this plan, as he was putting forth new and startling views, of the truth of which, false as they have since been proved, he probably entertained no doubt, and he might therefore be forgiven, if, with the view of removing every chance of ignorance of facts which he justly thought would change the face of science, he rendered his work more voluminous than it might otherwise have been. But in the present work we can see no such pressing necessity for a polyglot text, whilst, on the other hand, its disadvantages are sufficiently obvious. The bulk of the work is increased to more than four times what is necessary, and we feel convinced that by this expenditure of labour Mr. Stainton will not add greatly to the number of his readers. In the present case any continental entomologist, who, to apply the popular classification of gentlemen, *is* an entomologist, ought certainly to possess sufficient English to enable him to read this book; and as for those who are in the opposite predicament, we suspect it will not be easy to make them believe that there can come any good thing out of England.

It may be thought that these remarks are somewhat ungracious, inasmuch as Mr. Stainton tells us in his preface that this multiplication of the work adds nothing to its price, which merely represents the cost of the plates, and that the book would not have cost a farthing less, if not only the foreign text, but the whole of the letterpress had been suppressed; and truly entomologists have to thank Mr. Stainton for this liberality; but our object in the above observations has been to put it fairly before the author, whether, if he designs making a present to the entomological world, it might not be possible to find one of a more practical character. Nay, we are not sure that the very means adopted by Mr. Stainton to provide for the greater diffusion of his work, may not be found in reality to impede its progress, for many a one seeing a book advertised as in four languages, and ignorant of the peculiar circumstances under which it was published, would be inclined to say to himself,—"I should like it well enough in English, but I don't want a parcel of stuff I can't read."

If, however, Mr. Stainton is resolved, for the sake of uniformity or otherwise, to persist in the adoption of the tetraglot plan, we should certainly recommend him to print his books in four parts corresponding with the four different languages. The present columnar arrangement of the book renders it rather disagreeable to read, as the matter referring to each species, instead of being condensed into two or three pages, is spread out over eight or twelve; and the only advantage we can see in this arrangement is the same as that of the polyglot bibles already alluded to, namely that of furnishing different readings of the same passage. We must confess that we have found this conducive to a more correct understanding of our author's meaning in one or two cases; but nevertheless it is hardly a reason that a writer would urge on his own behalf, and is certainly to be deprecated for the sake of science.

We trust that Mr. Stainton will take the remarks which we have felt called upon to offer, in good part. They have been made entirely from a feeling that energy and perseverance employed in what we consider the unnecessary expansion of a book are to a great extent thrown away, and in the hope that, being made in no unfriendly spirit, they may induce him to take the matter again into consideration before the publication of the next volume of his valuable and interesting work.

Sylloge Generum Specierumque Cryptogamicarum quas in variis operibus descriptas iconibusque illustratas, nunc ad diagnosim redactas, nonnullasque novas interjectas ordine systematico disposuit C. Montagne, D.M. &c. Paris, 1855. 8vo, pp. xxiv & 498.

It is now some five-and-twenty years since Dr. Montagne retired from his labours as Chirurgeon Majeur, and settled at Paris, which was, we believe, the place of his nativity. On his return he found that cryptogamic botany was almost entirely neglected in France, and that the collections made by expeditions sent out into various parts of the world by the government were forwarded to foreign botanists for determination. He had been long attached to botany, and had made considerable collections of phænogamic plants, and he at once formed a resolution that this reproach should no longer be chargeable against his countrymen, and he therefore applied himself diligently to cryptogamic botany. The time was well chosen in many respects, and fortunate in the great improvements which had lately been made in the microscope. There was ample room therefore before him for discovery, and in his own country he found abundant new matter for investigation. With active habits he combined considerable knowledge of various kinds; and his talent as a neat and accurate draughtsman came greatly in aid of his other acquirements. His paper on the novelties in the Cryptogamic flora of France was justly admired, and he soon became known as the great medium of correspondence at Paris on every subject connected with that branch of botany to which he had determined to consecrate his labours. Materials rapidly increased upon his hands, the consequence of which was, that month after month there was a constant flow of new and interesting intelligence from his pen. This, from the very nature of the case, is scattered up and down through a multitude of works of various descriptions, many of them exceedingly voluminous and costly, and they are therefore inaccessible to a great portion of those who wish to consult them. By the advice of Professor Fries, he has therefore determined to collect diagnoses of all the new species which he has published, and they are now united in a handsome volume, accompanied by copious indices, and enriched here and there with interesting notes.

The following extract relative to the motion of *Diatomaceæ* is an example of the sort of matter with which the technical characters are here and there interspersed. In describing a new species of *Navicula*, which forms a part of the organic matter which occurs in the waters of Vichy, he takes occasion to give an extract from a letter of M. Petit :—

"The motion of these *Naviculæ* is well worth attention. It is more or less decided according to the degree of their development. In their more or less rapid progress across the field of view, they appear to have a certain degree of consciousness, so as to avoid any obstacles with which they meet. They advance for the purpose of investigation; they try them with one of their extremities; but they appear to do this with a certain degree of precaution. It seems as though they smell at these obstacles, that they examine them, and try means of avoiding them.

"I may add, in reply to one of your observations, that I am quite certain that the movements of these little creatures do not depend on currents arising from the evaporation of the fluid on the stage, or from any other physical cause, of which it is easy, with a little attention, to convince oneself. These movements are certainly self-dependent; for the creatures wander in different, and frequently opposite directions; and they consist not simply in an agitation without object, but seem to be directed by a sort of instinct. On carefully watching them, we see them turn round obstacles, when they cannot pass above or below them. Sometimes, when they are entangled in a mass of dead organic matter, they put it in motion by their struggles to extricate themselves. You may therefore consider as certain all that I tell you about the spontaneous motions of our *Navicula*, which I scarcely regard as a vegetable.

"This morning I have shown the motions of the *Ulothrix* and *Navicula* to Dr. Seguin, who is used to the microscope, and was much struck with them. He has verified all the information which I have sent you.

"I said in my first letter, that we meet sometimes with large quantities of little *Naviculæ* not yet, as it appears to me, completely developed, and which have not at that time the lanceolate extremities. In this state or stage of growth they possess no motion, which they acquire in proportion as they increase in size, and do not possess their full activity till they have arrived at maturity. What surprises me is, that in spring I find a much larger number than I find now (September). I see none, for instance, in a state of infancy. I may add, that in spring it is principally in a kind of reddish scum, which accompanies the green matter, that I meet with the greatest number of *Naviculæ*, and that now I find less of this scum, which perhaps depends upon the fact that the water in the basin is more agitated in summer,—a time when the water is incessantly pumped up for invalids.

"As regards the marginal striæ, I offer the following remarks:—M. Quatrefages, who has been at Vichy for his health, examined the Algæ with me, and has endeavoured to discover if the *Naviculæ* really possess these striæ. By the help of oblique illumination, we have clearly established their existence, at least in some individuals. We are not certain that they are present in all, for on some we have seen them distinctly on one side only and not on the other, while in other individuals we have not been able to discover them on either. I cannot doubt then, that at least a certain number of *Naviculæ* do not present striæ, though they are perceptible sometimes on either margin, sometimes on one only. M. Quatrefages, equally with myself, has observed the movements which I have described. Finally, the endochrome in the living organism is not green but yellow, exactly, in fact, as you see it in the dead specimens."

Hoping that the worthy author will be indemnified for the considerable outlay which the publication must have cost him, we commend this work to the attention of our botanical friends.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

March 13, 1855.—Dr. Gray, F.R.S., Vice-President, in the Chair.

An Arrangement of the Families of Echinida, with Descriptions of some New Genera and Species. By Dr. John Edward Gray, F.R.S., V.P.Z.S., P.B.S. etc.

MM. Agassiz and Desor have given the generic characters and a list of the species of *Echinida*, but do not divide the genera of the normal division into families. I propose to divide them into the following groups.

The *Echinida acrocystos*, or those which have a vertical dorsal vent, a regular globular body, with an inferior central circular mouth, armed with conical jaws, furnished with five elongate acute teeth, and with the ambulacra forming continuous vertical bands from the mouth to the vent. They may be divided into the following families.

I. *Tubercles of spines perforated; spines elongate; body circular.*

Fam. 1. Cidaridæ.

Ambulacra narrow, formed of double pores; interambulacral plates few, with a single large tubercle; spines thick, solid.

1. *Cidaris.* Tessera even-topped.
2. *Goniocidaris.* Tessera bevelled on the edge.—*G. pistillaris.*

Fam. 2. Diademadæ.

Ambulacra narrow, of one series of double pores; interambulacral plates numerous, with two or more rows of tubercles; spines slender, often tubular.

1. *Astropyga.* Body depressed; ambulacral area with very small crowded tubercles, bearing very thin spines, much smaller than the interambulacral spines and tubercles; interambulacral area with smooth bands.
2. *Garelia.* Body depressed; ambulacral area narrow, with two or four series of small tubercles, and thin spines; interambulacral area with oblique series of large tubercles and spines, but without any smooth band; spines tubular.
3. *Diadema.* Body globular or subdepressed; ambulacral area with the same sized tubercles and spines as the interambulacral area.

II. *Tubercles imperforated.*

Echinidæ, Gray, 1828.

Fam. 3. Arbaciadæ.

Ambulacral area narrow; ambulacra narrow, with a single series of double pores; body circular; spines short, solid.

1. *Agarites.* Upper surface of the interambulacral area without tubercles.
2. *Arbacia.* The upper and lower surface of the interambulacral area covered with tubercles.

Fam. 4. Hipponoidæ.

Ambulacral area as wide as the interambulacral; ambulacra wide, formed of three separate vertical rows of double pores. Body circular; shell thin.

1. *Amblypneustes.* Body high; porous zones not quite regular; mouth small, entire.—*A. ovum.*
2. *Boletia.* Body depressed; porous zones regular, inner separated by a vertical series of tubercles; mouth very large, with five deep slits.—*B. pileolus.*
3. *Hipponoë* (Gray, 1841). Body swollen; two outer porous zones regular; middle one interrupted; mouth small, slightly cut.—*H. Sardica.*
4. *Holopneustes.* Body swollen; two outer porous zones regular; middle one separate or interrupted; mouth small, entire.—*H. porissimus.*

Fam. 5. Echinidæ.

Ambulacral area half as wide as the interambulacral area, with two (or three) close series of double pores, placed in threes; buccal membrane naked; body circular.

A. *With angular pores at the junction of the plates.*

1. *Mespilia.* 2. *Microcyphus.* 3. *Salmacis.* 4. *Temnopleurus.*

B. *Without any pores at the angles of the plates.*

5. *Echinus.* 6. *Psammechinus.* 7. *Heliocidaris.*

Fam. 6. Echinometradæ.

Ambulacral area only half as wide as the interambulacral area; ambulacral pores in groups of four or more, forming an arched series round the ambulacral tubercles.

A. *Body circular.*

1. *Strongylocentrotus.* Spines equal, subulate, short.

B. *Body oblong.*

2. *Echinometra.* Spines subulate, subequal.
3. *Holocentronotus.* Spines of back elongate, subtriangular; of the oral side large, spathulate.
4. *Colobocentrotus.* Spines of the back very short, truncated; of the oral side spathulate.

Dr. Gray described the following species, which he regards as new, from the British Museum Collection.

Genus Cidaris.

* *Spines smooth or granular.*

1. Cidaris ornata.

Depressed. Tubercles of interambulacral area rather distant; spines lanceolate, subulate, depressed, white, red-ringed; base with series of small red spots and with regular longitudinal series of granules; each side with one, and the upper surface of the base with two series of white angular spines; spinules white, with a central red streak.—*Hab.* East Indian Seas.

** *Spines verticillate-spinose.*

2. Cidaris verticillata.

Depressed. Interambulacral tubercles rather far apart; spines of upper surface rather elongate (about as long as the diameter of the body), subulate, smooth; some subulate at the top, others with scattered conical spines, others obliquely truncated, cupped, and spinose at the tip; spines of lower surface shorter, cylindrical, truncated, granular near the tip; those of the oral surface much spotted, truncated, compressed and largely granular near the end.
Hab. —— ?

3. Cidaris annulata.

Orange. Rather depressed. Interambulacral tubercles of moderate size, far apart; spines elongate, subulate, tapering, red and white ringed; suprabasal ring white; with longitudinal ridges. The ridges of the lower half of the spines spinulose and with scattered larger spines; sometimes placed in lines. The dorsal spines sometimes truncated and slightly cupped at the tip; ambulacral spinules narrow, flat.

Hab. West Indies.

4. Cidaris spinulosa.

Interambulacral tubercles small, very far apart; spines elongate, fusiform, red-brown, with close squamose longitudinal ridges and scattered subverticillate acute and small spines; the dorsal spines truncated, cupped and spinose at the end; ambulacral spinules narrow.—*Hab.* —— ?

Genus Astropyga.

5. Astropyga depressa.

Shell depressed, very thin; ambulacra swollen; interambulacral area with a very wide smooth band in the middle and on each side of the upper part; the lower part of the centre of each area with *three* oblique series of larger tubercles; ovarian plate broad, triangular.—*Hab.* —— ?

Genus Garelia.

Ambulacra broad; the pairs of pores crowded, so as to form two, or rarely three, series; ambulacral area narrow, upper part with four series of small, and lower part with two or four series of rather larger tubercles; spines of ambulacral area bristle-like, very slender; interambulacral area with several oblique series of larger tubercles, without any smooth band on the back near the crown; ovarian plates moderate, triangular.

* *Ambulacra convex; area linear; spines elongate, subulate, hollow, covered with whorls of lanceolate scales.*

6. Garelia æqualis.

Ambulacra convex; ambulacral area with two series of tubercles, the outer series rather the largest, rather narrowed below; upper side of ambulacral area with 5·5 oblique series of larger tubercles; ovarian plate elongate trigonal; spines purple, or purple and white ringed.

Var. α. With spines pale, white-ringed.

Var. β. Spines purple; underside obscurely pale banded.

Var. γ. Spines purple, not banded.

Hab. Mauritius.

** *Ambulacra flat; area wide, with four or five series of spines, near vertex narrow, with two series of tubercles below; spines subulate, tapering, longitudinally striated.*

7. Garelia clavata.

Interambulacral area with four oblique series of larger tubercles; ambulacra slightly raised; the upper part of the area near the crown broad; each side with two or four or six series of small tubercles; the lower part narrow, with a single series of rather larger tubercles.

Genus Toreumatica.

* *Transverse sutural grooves wide and deep; back granular.*

8. Toreumatica Hardwickii.

Transverse sutural groove deep, wide; tessera of interambulacral area high, about twice as broad as high, with one large and several scattered unequal smaller tubercles.

Hab. ——? Presented by General Hardwicke.

** *Transverse sutural grooves narrow and small; back equally granular.*

9. Toreumatica granulosa.

Transverse sutural groove narrow and shallow; interambulacral tessera with a subcentral row of large, and numerous nearly equally scattered smaller tubercles. Near the circumference the secondary tubercles become more distinct. Base concave.

Hab. ——?

*** *Transverse sutural grooves indistinct; back equally tubercular.*

10. Toreumatica Reevesii.

Depressed, thin; tessera of interambulacral area with a single series of large, and several unequal-sized smaller tubercles. Under-side rounded, concave in the middle; ambulacral area with two, interambulacral area with three rows of subequal tubercles; holes between tessera distinct, between ambulacral tessera circular and deep.

Hab. China. Presented by J. R. Reeves, Esq.

**** *Transverse sutural grooves indistinct; back with a smooth band, near the suture between the interambulacral areas.*

11. Toreumatica concava.

Depressed, thin; middle between two interambulacral areas on the back smooth; interambulacral tessera with a few unequal tubercles near the ambulacra. Under-side deeply concave, largely tubercular; ambulacral area with two, interambulacral with three series of large tubercles.—*Hab.* China.

BOTANICAL SOCIETY OF EDINBURGH.

January 10, 1856.—Colonel Madden, President, in the Chair.

The following papers were read:—

1. "On some Species of *Epilobium*," by Charles C. Babington, M.A., F.R.S. &c. (See page 236.)

2. "Observations on the Pollen Tube, its growth, histology, and physiology," by P. Martin Duncan, M.B. Lond., F.G.S. &c.

The author details experiments made on *Tigridia conchiflora*. In this plant the style and stigma are at least 4 inches in length, and after the lapse of fourteen hours from the application of pollen-grains, hundreds of pollen-tubes may be seen in the centre of the style, many in the axis of the ovary, and generally one in each micropyle. The following is a summary of the results of many experiments on this plant:—

1. The pollen-tube grows at the rate of an inch in four hours, and under very favourable circumstances (as under great heat and moisture) twice as rapidly.

2. The pollen-tube is not a simple tubular prolongation of the inner membrane (intine) of the pollen-grain, except to a certain distance. It is in reality composed of a series of cells, the first of which is formed from the intine, the second is formed within the papillose cells of the stigma, the third near the axis of the style, and the others at varying distances. The last cell is usually at the spot in the ovary where the tube perforates the cell-wall of the ovary to enter the canal of the micropyle of the ovule. Each cell is divided from that above and below by a more or less perfect involution of the external cell-wall.

3. The pollen-tube passes through the stigma by a regular process of cell-growth. Afterwards cell after cell is added to the tube by a process of division, each cell performing its function independently.

4. No germinal vesicles exist in the embryo-sac of the *Tigridia*; the pollen-tube effuses its contents into the sac with whose granular contents a mixture occurs, and the embryo is evolved out of this mixture.

3. "Notes on the Chaulmoogra Seeds of India," by Charles Murchison, M.D., M.R.C.P.L.

A bland fixed oil from these seeds, furnished by the *Chaulmoogra odorata*, Roxb., is used by the natives of India in various cutaneous diseases.

4. "On the Gutta Percha plant of India," by Dr. Cleghorn.

Records the discovery of it in several parts of Peninsular India.

5. "Notice of the Flowering of *Agave americana*," by Joseph Lister, F.R.C.S.E.

In 1855, at an age of at least fifty years, the Aloe flowered, and afterwards a small offshoot appeared above the earth, which, instead of being a small leafy repetition of its parent, bore no leaves, but two flowers like those produced a few months previously by the central stem. This offshoot consisted of a succulent underground stem, about 10 inches long, connected with the underground part of the main plant. It was also found that there were about a dozen other offshoots struggling upwards through the earth, terminated by pale green buds, which, in the case of two that I dissected, contained rudimentary flowers. Thus the whole constitution of the Aloe appears to have been remarkably affected with a tendency to flowering; and just as the part above ground shot forth a stem with a multitude of flower-buds, so the underground portion, instead of sending out a few sprouts terminating in leaf-buds, produced a dozen or more offshoots ending in flower-buds and destitute of leaves.

6. "On the Flowering of Plants, &c., in the Isle of Wight," by Dr. T. Bell Salter.

7. "List of Plants in flower, in the open air, in the neighbourhood of Ryde, Isle of Wight, in November 1855," by Dr. T. Bell Salter.

MISCELLANEOUS.

On the Earliest Stages in the Development of Pelagia noctiluca. By Dr. A. Krohn.

In the December number of Müller's 'Archiv,' Dr. A. Krohn has given a remarkable positive proof of the existence amongst the *Medusæ* of a direct reproduction, without that intervention of polype-like gemmiparous forms which constitutes what is called the "alternation of generations" in these animals. This mode of reproduction appears to be of exceedingly rare occurrence in the *Medusæ*. It has hitherto been observed only in two species besides the *Pelagia noctiluca*; namely in *Æginopsis mediterranea* (by Müller), and in *Trachynema ciliatum* (by Gegenbaur). After repeatedly observing young *Medusæ*, which, from their general characters, appeared to belong to the genus *Pelagia*, the author, in the winter of 1853–54, met with individuals in a more advanced state, which proved that they were the young of the common Mediterranean *P. noctiluca*; and as in their earlier stage they agreed perfectly with the young of *Medusa aurita*, which had not long been detached from their polype-like nurses, he naturally concluded that *Pelagia noctiluca* did not differ essentially in its mode of reproduction from the other *Medusidæ*. Subsequently, however, Dr. Krohn met with individuals in a far lower stage of development, the youngest of which were of such simple structure that it appeared to him they could not be far from the embryonic state, and he therefore considered it important to ascertain in what form the embryo quitted the egg. With this view he examined numerous females without success, and was therefore compelled to have recourse to artificial impregnation. His first attempts failed, but in the month of April he succeeded in his object. Segmentation commenced in the ova within a few hours after impregnation, and the first free embryo was seen in the thirty-second hour.

The embryos exhibited an unexpected form. They were always considerably elongated, sometimes oval or oblong, sometimes very long, slender, and cylindrical. They measured from $\frac{1}{2}$ to 1 millim. in length; the anterior extremity is closed and rounded, whilst the other appears more or less truncated, and exhibits an extremely small round opening (the mouth), which leads into a well-marked roundish cavity (the stomach), occupying the hinder third of the body. The embryos appear semitransparent, in consequence of a delicate whitish coat, which covers the limpid substance of the body. This is closely set with fine short cilia, by the action of which the little creatures swim pretty rapidly, with a constant rotation upon their longitudinal axis.

The development of the embryo takes place by a gradual widening of the hinder part, which thus acquires a bell-like form, the stomach becomes much larger, and the oral orifice, which was depressed in the embryo, becomes considerably protruded. On the third day, the hinder margin of the bell-shaped umbrella exhibits eight small rounded lobes, at the same time that eight corresponding appendicular sacs are developed from the stomach. Shortly afterwards the marginal lobes increase considerably in length, and acquire a somewhat quadrangular form, with their margins slightly indented; and at these indentations the rudiments of the marginal corpuscles (*ocelli*) make their appearance. At this stage the mouth has become much larger, and makes its appearance at the extremity of a short tubular process,—the rudimentary stalk of the four arms possessed by the perfect animal. The motion of the young animal through the water is slower than at first; but it is still principally effected by the action of cilia, although the umbrella occasionally expands and contracts, producing an undulation of the marginal lobes.

The further progress of the young *Medusa* to the condition in which Dr. Krohn first observed it, consists in the growth of the marginal lobes, and especially of the lappets into which they are divided by the central indentation, the disappearance of the cilia, the appearance of crystalline bodies in the marginal corpuscles, the greater development of the base of the oral tentacles, and the diminution of the height of the umbrella. At this period also the whitish coat of the embryo disappears, whilst the urticating organs are developed.

The author followed the further development of the young *Pelagia* until it had acquired the eight additional ventricular sacs characteristic of the mature animal and the eight marginal tentacles; but he observes, that four of these had attained a length equal to the diameter of the disk, whilst the other four were still rudimentary. The stalk of the oral arms was longer and larger, but the arms themselves were but slightly developed.—W. S. Dallas.

DESCRIPTION OF A NEW SPECIES OF SWIFT.

Cypselus galilæensis, Antinori.

C. cauda brevissima, subfurcata: corpore nigro-virescente, nitore metallico perlucido: fronte dilute albida: gula et regione supracaudali albis: pogonio externo primæ remigis albo limbato.

The third part of last year's 'Naumannia' contains a communication from the Marchese Oratio Antinori, describing this "apparently new Swift," which was discovered by him in Palestine, on the borders of the Sea of Galilee. Two specimens were procured,—*Cypselus apus* and *C. melba*; and *Hirundo daurica, rupestris* and *rustica* were breeding abundantly near the same locality. Its similarity to a South African species (*C. leucorrhous,* Steph. ex LeVaill. Ois. d'Afr. pl. 244. fig. 2) is commented upon; but it is hardly probable that it should be identical with a bird from so different a country. The Indian species that approaches it most nearly is *C. leuconyx*, Blyth; but it appears distinct from that and all other Asiatic species with which we are acquainted. The zoology of the Holy Land—especially 1st ornithology—is, in fact, very little known; and it is much to be wished that, amongst the crowds of English who yearly visit that country, some would turn their attention to this interesting but neglected subject.—P. L. S.

METEOROLOGICAL OBSERVATIONS FOR JAN. 1856.

Chiswick.—January 1. Overcast: cloudy. 2. Foggy: exceedingly fine: slight rain. 3. Fine: uniformly overcast: fine. 4. Cloudy and mild: overcast: rain at night. 5. Rain: densely overcast: rain. 6. Cloudy: rain. 7. Cloudy: foggy: cloudy. 8. Densely overcast: cloudy and cold. 9. Drizzly: rain and sleet: rain at night. 10. Cloudy and cold: clear and frosty. 11. Frosty: cloudy: frosty. 12. Cloudy: sunshine occasionally: cloudy. 13. Clear and frosty: fine. 14. Dry and frosty. 15. Sharp frost: clear: fine. 16. Fine: rain and fog: cloudy. 17. Overcast: cloudy: rain. 18. Slight rain: cloudy. 19. Rain: heavy clouds. 20, 21. Densely overcast: heavy clouds: slight rain. 22. Densely clouded: rain. 23. Low clouds: bright sun at intervals: cloudy and windy. 24. Densely clouded and boisterous: rain: lightning at night. 25. Overcast: fine. 26. Very fine: rain. 27. Fine: frosty. 28. Frosty: overcast: hail-shower: fine. 29. Clear and frosty: fine: sharp frost. 30. Frosty: fine: cloudy and cold: frosty. 31. Clear and frosty: cloudy: frosty.

Mean temperature of the month	38°·43
Mean temperature of Jan. 1855	33 ·45
Mean temperature of Jan. for the last thirty years	36 ·94
Average amount of rain in Jan.	1·690 inch.

Boston.—January 1. Cloudy. 2. Foggy. 3. Fine. 4. Cloudy: rain P.M. 5. Cloudy: rain A.M. 6. Fine. 7. Cloudy. 8. Cloudy: rain P.M. 9, 10. Fine. 11. Fine: snow A.M. 12—16. Fine. 17, 18. Cloudy: rain P.M. 19. Rain A.M. 20. Cloudy: rain P.M. 21. Rain A.M. and P.M. 22. Fine. 23. Rain A.M. 24. Cloudy: rain A.M. 25. Fine. 26. Cloudy: rain A.M. 27. Fine. 28. Fine: rain and snow P.M. 29. Fine. 30, 31. Cloudy.

Sandwick Manse, Orkney.—January 1. Cloudy A.M. and P.M. 2. Damp A.M. and P.M. 3. Cloudy A.M.: damp P.M. 4. Cloudy A.M. and P.M. 5. Damp A.M.: rain P.M. 6. Damp A.M. and P.M. 7. Rain A.M. and P.M. 8. Sleet-showers A.M. hail-showers P.M. 9. Snow-showers A.M.: clear, frost P.M. 10. Snowing A.M.: snow-showers P.M. 11. Snow-showers A.M.: snow-drift P.M. 12. Bright A.M.: thaw, showers P.M. 13. Cloudy A.M. and P.M. 14. Cloudy A.M.: fine, cloudy P.M. 15. Cloudy, frost A.M.: fine, cloudy P.M. 16. Cloudy A.M.: fine, cloudy P.M. 17. Damp A.M.: rain P.M. 18. Clear A.M.: fine, clear P.M. 19. Frost A.M.: rain P.M. 20. Bright A.M.: hail-showers P.M. 21. Bright, frost A.M.: clear, frost P.M. 22. Clear, frost A.M.: clear P.M. 23. Sleet A.M.: clear, fine P.M. 24. Cloudy A.M.: cloudy, fine P.M. 25. Cloudy A.M.: showers P.M. 26. Showers A.M.: sleet-showers P.M. 27. Clear A.M.: showers P.M. 28. Showers A.M.: snow-showers P.M. 29. Snow-showers A.M. and P.M. 30, 31. Bright A.M.: snow-showers P.M.

Mean temperature of Jan. for twenty-nine previous years ...	38°·38
Mean temperature of this month	38 ·00
Mean temperature of Jan. 1855	38 ·16
Average quantity of rain in Jan. for fifteen previous years ...	4·24 inches.

The remarkable depression of the barometer here on the 23rd, 24th and 25th is worthy of observation, coupled with the fact, that the gale which it indicated did not reach Orkney, or the N. of Scotland, while it was violent in England. The first two of these days were really fine here, and marked so in the Register.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* CHISWICK, *near London*; *by* Mr. Veall, *at* BOSTON; *and by the* Rev. C. Clouston, *at Sandwick Manse*, ORKNEY.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. Jan.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	29·872	29·793	29·62	29·62	29·64	46	39	37	43	41	s.	sse.	se.	....	....	....
2.	29·659	29·517	29·38	29·62	29·54	50	36	39	42	43	se.	s.	sse.	·01	....	·04
3.	29·611	29·531	29·28	29·57	29·58	49	39	39	43	43½	s.	s.	se.	·04	....	....
4.	29·647	29·600	29·36	29·58	29·60	47	40	41	44½	42	se.	s.	se.	·07	....	·08
5.	29·520	29·421	29·22	29·55	29·49	49	43	41	43½	43	se.	s.	e.	·11	·58	....
6.	29·310	29·174	29·04	29·48	29·43	48	35	41	43	43	e.	e.	ene.	·12	....	·09
● 7.	29·066	28·970	28·78	29·33	29·33	47	37	42	41	38	ne.	se.	e.	....	....	·09
8.	29·146	29·021	28·72	29·32	29·38	43	32	39·5	36	32	ne.	nnw.	n.	·02	....	·09
9.	29·204	29·158	28·93	29·40	29·45	38	34	37	31½	31½	ne.	sse.	ne.	·23	·04	·04
10.	29·622	29·317	29·15	29·55	29·73	40	25	34	31	30	ne.	n.	ne.	....	....	....
11.	30·071	29·786	29·59	29·95	30·20	38	28	26·5	29	33	ne.	nnw.	nw.	....	·06	....
12.	30·522	30·291	30·07	30·33	30·28	36	21	27·5	35	42	ne.	n.	w.	....	....	·35
13.	30·627	30·544	30·34	30·14	30·15	39	20	22·5	45	46½	ne.	sw.	wsw.	....	....	·13
☽ 14.	30·304	30·029	30·14	30·17	30·08	37	19	20	45	38	ne.	e.	s.	....	....	....
15.	29·954	29·922	29·65	29·68	29·54	41	26	25	35	34	w.	ssw.	calm	....	....	....
16.	29·916	29·839	29·64	29·58	29·56	42	35	32	42½	43	sw.	w.	wsw.	·01	....	·03
17.	29·593	29·460	29·26	29·46	29·40	50	44	37	40½	37	s.	s.	nne.	·02	....	·09
18.	29·461	29·417	29·08	29·42	29·52	51	38	45	44	33½	sw.	sw.	e.	·08	·05	·03
19.	29·250	29·192	28·97	29·35	29·13	51	44	42·5	35	36	sw.	se.	ne.	·10	·10	....
20.	29·103	29·034	28·72	29·02	29·16	40	42	46	39½	34	s.	s.	nw.	·06	·26	·18
21.	29·071	29·026	28·76	29·32	29·40	51	37	42·5	35	35½	sw.	e.	w.	·36	·25	·03
○ 22.	29·515	29·296	29·02	29·46	29·42	42	37	36·5	33	35½	ne.	ne.	se.	·04	·60	....
23.	29·344	29·220	28·87	28·88	28·81	54	45	39	34	37	sw.	s.	sse.	·12	·07	·05
24.	28·992	28·928	28·52	28·51	28·46	52	39	48·5	41½	39	sw.	s.	se.	·13	·05	·14
25.	29·432	29·998	28·63	28·49	28·80	50	35	39	41	41	w.	sw.	w.	....	·04	....
26.	29·473	29·398	29·10	29·06	29·27	51	26	38·5	42	40½	sw.	ssw.	w.	·14	·02	·14
27.	29·811	29·636	29·32	29·42	29·27	47	20	39	41	40	nw.	w.	w.	·02	....	·07
28.	29·737	29·621	29·33	29·25	29·55	42	24	35	34	30	sw.	w.	n.	·08	....	·29
29.	29·696	29·694	29·38	29·60	29·67	38	19	25·5	34	35	nw.	n.	n.	....	·08	·17
☾ 30.	30·031	29·730	29·48	29·77	29·96	38	21	28	36	31	nw.	w.	n.	....	....	·13
31.	30·178	30·075	29·77	30·05	30·06	37	19	33	33	34½	nw.	n.	wnw.	....	....	·07
Mean.	29·636	29·536	29·26	29·481	29·511	44·64	32·22	36·0	38·50	37·51				1·76	2·20	2·33

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 100. APRIL 1856.

XXIV.—*On the Theory of the Fecundation of the Ovum.* By E. Claparède*.

One of the first discoveries which followed the invention of the microscope, or at all events one of those which made the most noise in the world, was the discovery by Ludwig von Hammen of the spermatozoids in the seminal fluid. This was the commencement of a new æra in the physiology of fecundation, an æra however which must unfortunately be characterized rather by the accumulation of fruitless theories, than by the discovery of a great number of facts. These spermatozoids, these mobile particles of the animal semen, were at first raised to the rank of independent beings, as spermatic *animalcula,* and although their title to this place in the series of beings is nowadays pretty generally disputed, this antiquated opinion is still far from being completely banished from the domain of science. The theories took their course, and Gautin did not hesitate to attribute to the animalcula of the human semen, the actual figure of *Homo sapiens.* Others made them penetrate into the ova and form the embryo. Andry †, mixing poetry with matters with which it had nothing to do, related how each spermatozoid arrives in the ovary and penetrates into the egg, by passing through a little door, which it pulls after it and shuts with the assistance of its tail. He even went so far as to represent these little creatures engaging in sanguinary combats at the door of the ovum, and disputing each other's right of entrance with such determination that many lost their arms and legs. Hence arise

* Translated from the Bibliothèque Universelle de Genève for August 1855, p. 284, by W. S. Dallas, F.L.S.

† See Vallisneri, Istoria della Generazione dell' Uomo e degli Animali. 1721.

miscarriages and deformed children. Leeuwenhoeck contented himself with conveying them into the uterus, where they changed their skins like caterpillars and became transformed into men. Lastly, to come to modern times, according to Prevost and Dumas*, the nervous system of the embryo is a product of the zoosperm, whilst the plastic and irritable organs are formed at the expense of the ovum.

For a long period warm disputes prevailed between the *ovists* and the *spermatists*. The principal representatives of the former were Malpighi, Antoine Vallisneri †, Haller ‡ and Bonnet §. Their greatest stumbling-block was the part to be assigned to the seminal fluid. Bonnet and Haller imagined that it might constitute the nourishment of the embryo. It is for this reason, according to them, that a mule has long ears, because the semen of his father, the Ass, contains a large quantity of quintessence of ear, &c. They did not trouble themselves with the obstacles which this opinion might throw in the way of the theory of the inclusion of germs. Some even refused to admit that the spermatozoids were of any importance; like D. Parsons ||, who declared it to be "an extreme nonsense" to believe that those insignificant creatures called spermatic animalcules could contribute in any way to propagation. Daubenton and Needham ¶ only regarded them as a product of the decomposition of the semen; and we owe some gratitude to Bonnet and Gleichen ** for having demonstrated by experiment that the seminal fluid of hybrids was incapable of fecundation because it contained no spermatozoids, which however has not prevented Sir Everard Home †† in our own century from denying their existence entirely.

Nevertheless the spermatists appear to have carried the ridiculous still further than the ovists. As a foretaste we have already given a sketch of Andry's romances. He attributed the nature of the animals to their spermatozoids; thus those of the sheep lived in flocks even while still in the testicle and epididymis. Santanelli regarded them as cylindrical spirits with five points. But the first spermatist was undoubtedly Aristotle ‡‡,

* Annales des Sciences Naturelles, ii.

† *Op. cit. sup.*

‡ Elementa Physiologiæ Corporis humani. Lausannæ, 1757–1766.

§ Considérations sur les corps organisés.

|| Philosophical Observations on the Analogy between the Propagation of Animals and that of Vegetables. 1752.

¶ Notes des nouvelles recherches sur les découvertes microscopiques de l'Abbé Spallanzani. Londres, 1769.

** Abhandl. über die Samen- und Infusionsthierchen. 1788.

†† Lectures on Comparative Anatomy, vol. v. 1828.

‡‡ See his works *Περὶ τῆς γενέσεως* and *Περὶ ζωιῶν μορίων*.

who declares that the actual procreant element is the male, whilst the female element only furnishes nourishment. The ovists, as well as many spermatists, were partisans of the theory of the preformation or evolution of germs, a theory which soon gave place to that of metamorphosis. Bonnet himself appears to have had a tendency this way, for he puts forward the idea, that the air, the water, the earth and every solid body, are magazines containing germs. The same germs, which, passing into plants produce buds and flowers, give birth to embryos when they penetrate into the ovaries of animals *. In reality this is not far from the opinion of Heraclitus, who maintained that the germs were diffused everywhere, and that they were developed as soon as they arrived in the proper sexual organs. Perrault, Needham, Buffon and Treviranus merely worked out this kind of panspermism in various directions, until Oken † imagined that these universally diffused germs were to be found in the Infusoria.

It must be confessed that the imagination of our forefathers was very prolific in the fabrication of theories of generation which often approached pretty closely to the ridiculous, or at all events to the comic. However, all these beautiful edifices crumbled one after the other by their own weight, and of late years there appeared to be a tacit agreement between physiologists, by which they engaged to steer clear of this subject until they had facts before them. But in the absence of facts, it was necessary to rest contented with the general ignorance, which however was soon veiled in a tinsel cloak, by having recourse to a *force*, that *deus ex machinâ* which physicists, chemists, physiologists and other philosophers use and abuse in accounting for that which they cannot explain.

People accordingly admitted a dynamic action of the zoosperm. This arrived at the ovum, without however penetrating into its interior, as Andry's little door did not exist; and by its simple presence, in virtue of a force belonging to its predicate of spermatozoid, fecundation was effected, but no one knew very well how or why. The embryologist Bischoff was one of the principal defenders of this dynamism, which, indeed, was nothing

* The author here appears to have mistaken Bonnet's meaning in some unaccountable manner; his statements seem to have a directly opposite tendency. Thus in stating his hypothesis of the universal diffusion of germs he says, "they only become developed when they meet with suitable matrices, or bodies of the same nature;" and in a subsequent passage he adds, "it is only the germs which contain organic wholes, of the same kind as that into which they are introduced, that are developed there."—W. S. D.

† Die Zeugung. Bamberg, 1805.

but a reproduction of Harvey's * ideas, when he compared the action of the spermatozoids upon the ovum to that of the magnet upon iron, or when, with Osiander and Treviranus, he called it a *contagion*.

The reign of the old theories appeared to be repudiated for ever, and it was scarcely expected that they would soon have raised their heads again to claim the attention of true observers, no longer taking the title of *theories*, but rather that of *facts*, and demanding no other judges than eyes and a sound intellect. This is nevertheless what took place. As early as 1840, a distinguished English observer, Dr. Barry †, in a memoir on the embryogeny of the Rabbit, devoted a chapter to the fecundation of the ovum, and asserted that he had seen this take place under his eyes. According to him the germinal vesicle of the ovum of the Rabbit neither dissolves nor bursts, as was generally supposed; but at a period preceding that of fecundation it becomes filled with cells, which render it opake, and then proceeds in the direction of the periphery, towards the *zona pellucida* (*transparent membrane*). The latter presents *an attenuation or an orifice* at the point approached by the vesicle. This, at least, is what Barry asserts that he has seen several times in perfectly ripe ovules, even *ante coitum*. The form of the orifice in question was sometimes such as to suggest the idea of a rent or *cleft* in the membrane; in other cases it appeared as though there had been a previous attenuation of the membrane. Subsequently ‡ Dr. Barry again described this phænomenon in greater detail. With him the nucleolus of the germinal spot is a peculiar substance which he calls the *hyaline*. In this hyaline resides the *force* (the explanation again leaves nothing to be desired!) which drives the vesicle towards the *zona pellucida*. When the germinal vesicle comes in contact with the membrane of the egg it bursts, and at the same time an opening is formed in the latter (*zona pellucida*). All this is the work of this hyalinic energy! However, an opening, whether formed or not by the action of the hyaline, was observed in 1840 by Barry in the ovum of the Rabbit, and on one occasion he even perceived in this aperture an object "much resembling a spermatozoon." All these phænomena of course take place before the formation of the chorion, that is to say in the ovary, or in the uppermost part of the oviduct. Two or three years afterwards Barry § announced positively that he had seen not only an object "much resembling a spermatozoon," but actually true zoosperms in the ova of

* Exercit. de Generatione Anim. 1651.
† Phil. Trans. 1840.
‡ Müller's Archiv, 1851.
§ Phil. Trans. 1843.

the Rabbit. Important as this assertion was, it did not make much noise in the world. Barry's discovery passed again into the shade and no one took it up on the Continent. Bischoff* contented himself with mentioning it repeatedly as erroneous and describing it as a mere product of the imagination (*Geburt der Phantasie*).

For twelve years Barry's discovery slumbered. At the end of this time one of his countrymen, also a good observer, Dr. Nelson †, of Glasgow, revived the question by publishing an observation analogous to that of Barry, although relating to a very different animal,—an intestinal worm, the Ascaris of the Cat (*Ascaris mystax*). According to Nelson the ova of this worm, at the period when fecundation takes place, are entirely destitute of vitelline membrane, and possess no envelope of any kind. They are, generally, triangular, or rather pyramidal in form, in consequence of their being pressed against one another in the oviduct. Nevertheless their margins are sufficiently well marked, in consequence of the cohesion of the yelk: at one of the angles alone the outline is less distinct, for which reason Nelson gives this angle the name of the "broken edge." After copulation, the spermatozoids, which, in consequence of their form, the author denominates "spermatic cells," penetrate into the oviduct, reach the ova and insinuate themselves into the substance of the vitellus. According to Nelson, this penetration of the spermatozoids into the ovum takes place at any point of the surface, and even at several points on the same ovum at once; but he remarks that the spermatozoids appear to prefer the "broken edge" for this purpose. As soon as they are in the egg, the "spermatic cells" begin to disappear, probably by dissolution, and their place is occupied by a transparent liquid. In this phænomenon consists the whole system of fecundation. The ovum immediately begins to undergo modifications. The vitellus acquires a spotted appearance, previously noticed by Reichert in *Strongylus*, and considered by that anatomist as the result of the formation of cells in the interior of the yelk; the existence of these cells in this *Ascaris* is completely denied by Nelson. The germinal vesicle bursts, and its disappearance is immediately followed by a modification of the granules of the vitellus, which become transparent. After this transformation Nelson proposes to give them the name of embryonal granules. In the interior of the egg, a cell with a nucleus and nucleolus is formed; these are the blastodermic vesicle and spot. Whilst these things are

* Entwickelungsgeschichte des Kaninchencies, 1842,—des Hundeeies, 1845,—des Meerschweinchens, 1852.

† Phil. Trans. 1852, part 2.

taking place, the chorion is formed, and the egg continues advancing by degrees towards the period of its segmentation and the formation of the embryo. The action produced upon the ovum by the spermatozoids is consequently, according to the Glasgow physiologist, of a triple nature:—1. A preservative action, inasmuch as they prevent the destruction and disappearance of the vitelline granules, and their indiscriminate mixture with the elements of the germinal vesicle and spot, which, according to him, inevitably takes place when the ova are not fecundated; 2. A destructive solvent action, in consequence of which the vitelline granules and germinal vesicle are gradually dissolved at the expiration of a certain time; and 3. A transforming action by which the vitelline granules are metamorphosed into embryonic granules.

It was reserved for a third English philosopher to assist in the formation of the new edifice, by the announcement of the entrance of the spermatozoid into the ovum in a third class of animals, namely the Reptiles. Newport* in his first memoir on the reproduction of the Batrachia, had referred to various experiments which he had made with the view of throwing discredit upon the opinion that the spermatozoids could penetrate into the ovum, which he regarded as possessing but little probability. But a year-and-a-half afterwards† he recalled his previous opinion in a remarkable memoir, in which he stated that he had positively seen spermatozoids, not only within the outer membranes of the ovum of the Frog, but actually in immediate contact with the vitelline membrane. The spermatozoids had their heads always directed towards the centre of the ovum and their tails towards its periphery, as though they wished to penetrate still further. The first consequence of the fecundation thus effected, consists, according to Newport, in the formation of a chamber between the vitellus and the vitelline membrane at one extremity of the egg, and the segmentation of the yelk then commences. In a note written subsequently to the communication of his paper to the Royal Society‡, Newport announces that he had actually observed the passage of the spermatozoids through the membranes of the ovum and their arrival in the interior of the vitellus. He remarks that the penetration does not take place through a particular opening, but through any point of the surface of the chorion. "The spermatozoa," he says, "do not reach the yelk of the Frog's egg by any special orifice or canal in the envelopes, but pierce the substance of the envelopes at any part with which they may happen to come into contact."

* Phil. Trans. 1851. † Phil. Trans. 1853, part 2.

‡ Phil. Trans. 1853, part 2. p. 271 (*note*).

These three discoveries of the penetration of the spermatozoids into the ovum were soon to be followed by several others. In fact, we are arriving at the moment when this new theory, or rather, this resurrection of antiquated ideas now founded upon observation, was to excite general interest, and bring into the arena all the distinguished names of which physiology can boast.

Shortly after Newport's discovery, there appeared at Königsberg a work by a M. Keber* of Intersburg,—a work which came forth with the pretension that it would change the face of science, and convulse with astonishment, not only Königsberg, not only Germany or Europe, but the whole world. The work was published in two languages, German and Latin, in order that no one should have an excuse for want of knowledge of the new doctrine, for ignorance of the truth. "I shall prove by innumerable observations," is the pompous announcement of Keber in his preface, "that no animal fecundation takes place but when the spermatozoids penetrate into the ovum, divide in the vitellus and form the nuclei of the cells of the new organism. . . . I feel all the weight of this bold assertion; I know that I am about by this means to place myself in opposition to the Coryphæi of science, and that more than one, offended at hearing such an absurdity, will throw this work aside contemptuously, without reading it, or perhaps at the utmost, will grant it a place in the series of scientific curiosities. But I have carefully and conscientiously convinced myself of the truth of my assertions, upon more than 2000 eggs," &c. Exclaiming, with Aristotle, that one must have more confidence in one's own eyes than in the opinions of others, Keber proceeds, without disturbing himself about the objections which may be raised against him, or dreaming that Aristotle spoke of the eyes of reason and not of those of the imagination.

But let us pass to details, and first of all, to the phænomena which Keber pretends to have observed in the *Naiadeæ* (*Anodonta, Unio*). According to him, the ovum in these Mollusca is not enveloped simply in the cortical membrane (*Schalenhaut* of Baer); but within this there are two others,—the membrane of the albumen and the vitelline membrane, the former separating the albumen from the cortical membrane, the second from the vitellus. The young ova present a cæcal prolongation, which arises from the membrane of the albumen and, piercing the cortical membrane, forms a projection externally. In some cases a fine membrane is perceptible uniting this process with the ger-

* Ueber den Eintritt der Samenzellen in das Ei, ein Beitrag zur Physiologie der Zeugung. 1853.

minal vesicle. When the ova become larger, the extremity of the cæcum opens and a small quantity of albumen passes out from it; this is to serve as a bait to the spermatozoids (!!). The ovum then exactly resembles one of those glass flasks used in chemical laboratories, furnished with a rather short neck. The spermatozoids arrive from all sides, allow themselves to be taken by the bait, and penetrate into the neck of the ovum, or the *micropyle*, to employ a name now received in science. In its frolics the spermatozoid loses its tail, so that only its oval head is found in the neck of the ovum, and this usually occupies a transverse position. It is difficult to describe the ecstasy in which Keber was plunged at this discovery, on the day when he was permitted to see "that which no mortal eye had yet contemplated." Overwhelmed with enthusiasm, and believing himself initiated into the mysteries of creation, he concludes his first chapter by exclaiming (in two languages)—"*And the evening and the morning were the first day*!" (Factumque est vespere et mane dies unus! Da ward aus Morgen und Abend der erste Tag!)!!!

But this is not the whole;—Keber follows the journey of his spermatozoids into the eggs, where he is clever enough to recognize them, sometimes by their form, sometimes by their greenish tint, and sometimes because they begin to jump about (probably they go into convulsions) under the influence of sulphate of strychnine*. The spermatozoid has lost its tail, which greatly facilitates research, seeing that if it was necessary to seek for it in the egg, its delicacy would certainly prevent its being found. But we may be allowed to ask how this spermatozoid is to be distinguished from any other granules, for it is well known the spermatozoids of the *Anodontæ* are far from being of gigantic stature. The idea of a blackish tint being characteristic scarcely needs refutation. The imperfection of our best achromatic glasses still communicates to certain objects a tinge which varies according to the microscope, without taking into account the phænomena of diffraction, which must occur at the edges of a small object situated in the interior of the egg. Henle† indeed speaks of a yellowish tint in the human spermatozoids; but he takes care to add, "in a certain illumination." Besides, as the old proverb says—*De coloribus non est disputandum.* However, Keber pretends to recognize the spermatozoid with certainty and pursues the investigation of its evolution. Week by week he describes the changes which it undergoes, until the moment when it becomes decomposed into granules, which probably

* It is however to be observed that it is precisely this agent that is employed, as well as chloroform and oil of bitter almonds, to deprive the spermatozoids of man and other animals of their mobility.

† Allgemeine Anatomie, p. 949.

afterwards form the nuclei of the embryonal cells. We shall not enter upon these details, as they are rather too romantic. We cannot in any case attach the least credence to them, as long as Keber does not inform us how he succeeded in determining the period at which his supposed spermatozoid entered into the egg.

Keber's discovery is not confined to this. Following in Barry's steps, he pretends to have seen the micropyle in the ova of the Rabbit, and followed the spermatozoids which had just lodged there. His drawings, however, do not agree very well with those of the English anatomist, and it is a curious circumstance that he states that he met with the ovules not only in the uterus and oviduct, but also and especially in the abdominal cavity, in the mesentery, &c. He has even found them sometimes in such numbers in the cavity of the body, that he inquires whether it is not probable that these so-called ova may at a later period reach the uterus by some unknown migration (!). Astonishment will cease when we learn that Keber never saw the ovule of the Rabbit, as has since been proved by Bischoff*. These so-called eggs of the Rabbit, covered with vibratile cilia on their whole inner surface, are a species of hydatic vesicles, furnished with a tubular peduncle, which have been described by Remak† under the name of vibratile vesicles (*Wimperblasen*). They are pretty frequently met with on the mesogastrium and mesometrium of the Rabbit, as well as in the lobes of the thymus gland; and also in the Cat. They are, moreover, found before, during and after the rutting season, and both in young and old individuals. This last mistake is sufficient to detract remarkably from the value of Keber's other observations, especially as he appears to attribute a very peculiar importance to his discovery of the micropyle in the Rabbit, since he has the modesty to compare this discovery, not due to chance, but supported by induction, to that of the planet Neptune by Leverrier and Galle (!!). And yet Keber's conscience was not satisfied as to his fact, for in speaking of these vibratile vesicles, he exclaims, "And if these were not eggs, I should be glad to know what they were!"

Keber's work, notwithstanding all its faults and errors, could not but contain some truths, amongst which we may give the first place to the prediction expressed in his preface, that this volume would astonish many people, and would be arranged by many amongst the curiosities of science. This is a position which it has since attained. Nevertheless, if it had only the

* Widerlegung des von Dr. Keber bei den Najaden, und Dr. Nelson bei den Ascariden behaupteten Eindringens der Spermatozoiden in das Ei. Giessen, 1853.

† Müller's Archiv, 1841 & 1854.

merit of having called attention to the micropyles of the ova of the *Anodontæ*, which are so easily found, that it is sufficient to pass the scalpel over an ovary and place what it takes up under the microscope in order to see them in great numbers, this would be something; but its greatest merit undoubtedly was its energetically inducing the combat. Thus, Bischoff, although apparently a protector of the quarto volume in two languages, inasmuch as it was dedicated to him, could not avoid taking up the pen to put Keber's inexperience into its proper place, not without some brusqueness. It was not so much Keber, he said, as Newport, and especially Nelson, that he came forward to refute; few would be led astray by the verbiage of the former, but the others were philosophers of a much more serious character. Indeed Nelson's observations appeared to have nothing improbable about them, to those who were acquainted with the works of Siebold* and Thaer† upon the Trematode worms, and those of Max Schultze‡ and Leuckart§ upon the Turbellaria. These authors have proved that in these hermaphrodite animals, besides the *vas deferens* which leads from the testicle to the penis, there is a second canal which passes directly to the place where the eggs are formed at the point of union of the canals coming from the vitellogene and the germigene ‖; from which it might be considered probable that the spermatozoids passing through the second deferent canal may be enclosed in the ovum at the moment of its formation, so as to fecundate it at once, although these authors did not observe anything of the kind. Bischoff then took upon himself to refute Barry, Nelson, Newport and Keber. The latter had no strength for the struggle and was soon overthrown. The vibratile vesicles (*Wimperblasen*) which he had taken for eggs gave him the finishing stroke.

Leuckart¶ on his side had undertaken to show how the micropyle is formed in the *Naiades*; he had ascertained that it was nothing but the peduncle which attaches the young ovum to the stroma of the ovary, and which afterwards tears away, still retaining the form of the neck of a bottle. T. von Hessling**

* Müller's Archiv, 1836. † *Ibid.* 1850.

‡ Naturgeschichte der Turbellarien. Greifswald, 1851.

§ Troschel's Archiv, xviii.

‖ Or rather from the ovary and the albumen-gland. J. Müller has in fact proved that the so-called germigene contains perfectly complete eggs, so that the vitellogene must descend again to the rank of albuminogene. Siebold himself, who gave these glands the names of vitellogene and germigene, appears now to have returned to this opinion.

¶ Zusatz zu Bischoff's Widerlegung. He had moreover previously described this formation of the micropyle.—Handwörterb. der Physiol. iv. Article *Zeugung*.

** Zeitschrift für wiss. Zoologie, April 1854.

took upon himself the easy task of proving to Keber that he had never seen zoosperms in the interior of the *Naiades*, that he could not consequently have followed their development for weeks, and lastly, that the tailless spermatozoid so often seen by Keber occupying a transverse position in the micropyle, was nothing but the inner opening of the latter. The membrane of the albumen and the vitelline membrane admitted by Keber, besides the cortical membrane in the *Anodontæ* and *Unios*, having no existence in reality, the neck-like micropyle could not be a prolongation of the former; it belongs in fact to the cortical membrane itself.

Nelson's observations, like those of Barry and Newport, were more difficult to refute; but we need not dilate upon the objections raised against them by Bischoff, as the latter has since recognized his error. We may however refer to the fact, that Bischoff asserted that the spermatozoids which Nelson had seen penetrating into the ova of *Ascaris mystax* were not spermatozoids, but epithelial productions, to which he gives the name of *epithelial conules*. These pseudospermatozoids, or epithelial conules, according to him, are scattered between the papillæ of the mucous membrane of the oviduct, from which they are very easily detached; they are wanting, however, in the lower part of the oviduct (*sphincter* of Bischoff), and exist under the papillæ of the uterus. The vagina presents neither papillæ nor epithelial conules.

In conclusion, Bischoff was very harsh in the tone of his refutation, treating the English anatomists in a somewhat patronizing style, and scarcely honouring the unfortunate Keber with a few strokes of his teeth. What was the astonishment of the learned world, therefore, when a few months afterwards it saw a fresh publication of the embryologist of Giessen with the title —"Confirmation of the penetration of the spermatozoid into the ovum, discovered by Newport in the Batrachia, and by Barry in the Rabbit*." In this work, Bischoff says, with a rather solemn tone, "I have repeated Newport's observations and hasten to state that I have confirmed them in every respect, and that there is no longer any doubt that the spermatozoids actually penetrate into the egg of the Frog. After convincing myself of this fact, I again took up the study of the ovules of the Rabbit, and I do not hesitate in stating that I was wrong in contradicting Barry, and that in this case also there remains no doubt that spermatozoids really penetrate into the ova of these

* Bestätigung des von Newport bei den Batrachiern und Barry bei den Kaninchen behaupteten Eindringens der Spermatozoiden in das Ei. Giessen, 1854.

Mammalia." And elsewhere—"It is consequently proved that Newport has the honour of having discovered this curious and unexpected phænomenon of the penetration of the spermatozoid into the ovum, as the result of its own movements. This has nothing to do with the micropyle or anything of the kind; but these singular organic elements possess the property, by means of their so-called tail, of exerting so considerable a mechanical effect as to enable them to traverse the layer of albumen and the vitelline membrane." Further on again—"I assert therefore that I was wrong in the opposition which I made to Dr. Barry, who is certainly the first who saw a spermatozoid in the interior of an egg in general, and of a mammalian ovum in particular, and to him belongs the honour of this discovery."

Bischoff here attributes to Barry only the discovery of the presence of zoosperms in the ova, and not that of their penetration, because he still denies that this penetration takes place in the manner described by Barry, Nelson and Keber, although he does not dispute the presence of the micropyle in the *Anodontæ*. The penetration of the spermatozoa into the ova of the Rabbit and Frog, as also the presence of the micropyle in those of the *Anodontæ*, when once sanctioned by Bischoff, could not be again called in question; for it certainly must have been a disagreeable task for the celebrated embryologist to retract his opinion, after having declared that the penetration of the zoosperms into the ovum could only be maintained by the merest novices in embryology. We owe him all the more gratitude for having thus placed himself above the suggestions of self-esteem, and publicly confessed his own error.

From the publication of this "Confirmation" we may date the epoch in which the existence of the micropyle has obtained a definite place in our physiological knowledge. Nevertheless, even if we suppose that Barry did not see a true micropyle, the honour of the discovery does not pass to Keber. As we have stated, Leuckart had mentioned the micropyle a little while before him, and given an exact history of its formation precisely in the *Unios* and *Anodons*, a history which he has since completed*. According to him, the ovarian vesicles of the *Naiades* consist of a tolerably thick structureless membrane, on the inner surface of which, instead of a proper epithelium, there is a layer of fatty molecular corpuscles, united by a tenacious albuminous mass. It is in this layer that the germinal vesicle with its characteristic spot is *first* formed. This vesicle, with the mass of albumen which surrounds it, soon forms a swelling or lump on the inner surface of the ovarian vesicle. This gradually in-

* Zusatz zu Bischoff's Widerlegung.

creases in size and acquires a granular consistence; it afterwards becomes the vitellus of the egg. Its surface condenses by degrees into a membrane, the vitelline membrane (cortical membrane of Baer), and this at a time when the mass of the vitellus still adheres to the stroma of the ovary (or rather to the ovarian vesicle) by a tolerably broad base. But this base goes on narrowing more and more, whilst the vitelline membrane continues its formation, until the ovum at last only adheres to the stroma of the ovary by a short peduncle like a neck. A transparent liquid is then formed between the vitellus and the membrane, and the peduncle is detached from the ovary. This point of dehiscence is the micropyle of the *Naiades*.

Leuckart is not the only zoologist who had pointed out the micropyle before Keber. In 1850, J. Müller described a canal traversing the external envelope of the ova of certain *Holothuriæ*, particularly *Thyone fusus* and *Holothuria tubulosa** ; in 1851 he indicated a similar structure in the genus *Ophiothrix*†. In 1852 his son Max Müller described the micropyle in the egg of *Sternaspis thalassoides*‡. All these discoveries had preceded that of Keber, but they had not led their authors to a theory of fecundation, although J. Müller says §—"The comparison of this canal with the micropyle of the ovule of the Phanerogamous plants presents itself so naturally to the mind, that I could not avoid mentioning it here;" and Leuckart ||, in mentioning the micropyle in the *Naiades*, adds—"We might almost suppose that this singular structure has a certain relation with the act of generation." According to J. Müller the micropyles of the ova of the *Holothuriæ* are in the cortical membrane (*Schalenhaut*), besides which there is also a vitelline membrane. Leuckart¶ positively denies the existence of the latter, and gives the name of "vitelline membrane" to that which contains the micropyle. In other respects he describes the formation of the micropyle here exactly as in the *Naiades*;—it is the remainder of the peduncle which attached the ovum to the stroma of the ovary. The formation of the peduncle always depends upon that of the membrane, and as this does not exist at the point of attachment itself, it is clear that there always remains an opening at the place of the peduncle. This is the micropyle.

But Lovén appears to have been the first to perceive the micropyle, for, in a work of his which dates as far back as the year

* Metamorphose der Echinodermen, 4te Abhandl. 1850.
† Monatsbericht der Berliner Akad. 1851.
‡ De Vermibus quibusdam maritimis. Diss. inaug. Berlin, 1852.
§ Ueber die Metamorphosen der Echinodermen, 4te Abhandl. p. 42.
|| Article *Zeugung* in Wagner's Handwörterbuch der Physiol. iv. p. 801.
¶ Zusatz zu Bischoff's Widerlegung.

1848*, I find the description of the mode in which the ova are formed in the *Modiolariæ* and *Cardia,* which agrees exactly with that furnished by Leuckart for the *Anodons.* He also saw that the ova are prolonged into peduncles at the point where they adhere to the ovarian cæca.

The completion of the "Confirmation" of Bischoff was soon furnished by the classical work of Meissner on the anatomy and development of *Mermis albicans*†, a species of Gordius, which when young inhabits the caterpillars of *Hyponomeuta cognatella,* and which afterwards passes into moist earth, where its generative organs acquire their final development and reproduction takes place. In speaking of the formation of the ova, Meissner incidentally mentions the micropyle. This work is important, inasmuch as it sets forth the homology of the male and female sexual organs, and the analogy between the semen and the ova. The male and female generative organs of *Mermis* are, in fact, perfectly similar and consist of a very long vessel, so that it is impossible to distinguish the internal generative organs of the male *Mermis* from those of the female, unless by the microscopic examination of their contents. The upper part of the generative tube or vessel of the male, the part designated by Meissner as the testicle, is filled with round cells, as clear as water, and composed of an extremely delicate enveloping membrane, an enclosed liquid, and of a large pale granulated nucleus, containing a nucleolus. These are the male *germ-cells* (*männliche Keimzellen*) as Meissner calls them. The nucleus of these cells in the course of its development exhibits a fine line on its surface, which soon becomes a groove and afterwards a constriction, until at last the nucleus divides into two. The nucleole does not divide, but remains in one or other of the secondary nuclei (*Tochterkern*). The secondary nuclei become larger and divide in their turn, and the nuclei of the third series thus formed follow their example, and so on, until we find germ-cells of the size of $\frac{1}{100}$ to $\frac{1}{80}$ of a line, containing as many as twelve or sixteen nuclei, which all finally attain the size of the primary nucleus. Each of these nuclei is soon seen to acquire a clear border,—this is a membrane formed by a differentiation of the central and peripheric parts of the nucleus. This membrane is constantly removing further and further from the centre, and in this way the secondary nuclei (*Tochterkern*) are converted into secondary cells (*Töchterzellen*) which completely fill the primary cell. The latter then bursts or becomes absorbed, and the

* Bidrag till Kännedomen om utvecklingen af Mollusca acephala lamellibranchiata. Aftryck ur Kongl. Vetenskaps-Akademiens Handlingar för ar 1848.

† Zeitschrift für wiss. Zoologie, December 1853.

secondary cells are set free. They are frequently distributed on the surface of a sphere of albumen, as is the case in the Annelida and Gasteropoda; for these cells are merely the parent-cells (*Entwickelungszellen*) of the spermatozoa. We shall not follow the further development of the spermatozoa, as its interest here is but secondary, and we shall pass at once to the formation of the ova. The generative organs of the female, like those of the male, are composed of a simple tube or vessel, in which, starting from the cæcal extremity, Meissner distinguishes different parts under the names of *germigene* (*Eierkeimstock*), *vitellogene* (*Dotterstock*), *albuminogene* (*Eiweissschlauch*), oviduct and uterus. Microscopically, the germigene is exactly similar to the testicle, and contains perfectly diaphanous cells with nuclei and nucleoles. These are the female germ-cells, which present no difference from those of the male. The nucleus of each of these cells divides into two, then into four, eight, &c., but there is no simultaneous division of the nucleole. At this point begins the differentiation of the male and female generative organs. At the bottom of the germigene the nuclei approach the wall of the cell containing them and push it before them, forming sacs into which the contents of the cell penetrate, and which by the gradual constriction of their base at last form secondary cells attached by a peduncle to the primary cell. These secondary cells are the future eggs, produced by a sort of exogenous generation of the female germ-cell. At this moment this bunch of cells passes into the vitellogene, the germ-cell or primary cell being in the centre, and the ova suspended like pears at its circumference by means of hollow peduncles. The vitellogene is perfectly passive, that is to say, it does not secrete the substance of the vitellus. This is produced in the germ-cell itself, and penetrates through the peduncles into the secondary cells, that is to say, into the ova. The membrane of the secondary cells thus becomes a vitelline membrane; and the nucleus becomes the germinal vesicle with its characteristic spot. The bunches of ova are placed one behind the other in the vitellogene in such a manner that the germ-cells always occupy the centre and the ova the periphery. The consequence of this arrangement is the formation of an apparent axis in the centre of the vitellogene, an appearance which is owing to the succession of the germ-cells; to this Meissner gives the name of *rachis* or *raphe*. At the moment of their entrance into the albuminogene the ova detach themselves from the germ-cell, and the dehiscence always takes place at the base of the peduncle, which remains attached to the ovum. The ova then become surrounded with albumen.

Meissner did not turn his attention particularly to the fecundation; but, nevertheless,—and this renders his observations of more value,—he remarks, incidentally, that sometimes the peduncle remains widely open, and continues to project externally even after the ovum is surrounded with albumen, so that there remains a means of communication between the vitellus and the external world. We may, perhaps, observes Meissner, compare this structure of the ovum with the micropyle observed by Leuckart, J. Müller and Keber in the *Naiades* and *Holothuriæ*.

However, a few months afterwards, a new paper by Meissner* made its appearance, in which he not only confirms the discovery of a micropyle, but also that of the penetration of the spermatozoa into the ova of very different animals. The greater part of this work relates to the *Ascaris mystax* of the Cat, the same which had formed the subject of Nelson's observations; but he mentions several other species of *Ascarides*, a *Strongylus*, some *Lumbrici*, and the Rabbit. Meissner describes the formation of the spermatozoa and ova in the *Ascarides* as exactly the same as in *Mermis albicans*. The formation of the micropyle is due to the same circumstance. Nevertheless, he does not venture to regard this as a general type of development, for he has himself ascertained that it has exceptions. Thus, in *Strongylus armatus* the raphe, instead of being an apparent axis formed by the succession of germ-cells, is a *true raphe*. In this worm, the ova are a kind of diverticula of a pear-shape, suspended from a single vessel or vitelligenous tube, representing the germ-cells.

Nelson had seen the spermatozoa of *Ascaris mystax* penetrate into the ovum at all parts of its surface, and especially at one angle of this triangular ovum, to which he gives the name of the *broken edge*. Meissner shows, from the mode of formation of these ova, that they possess a vitelline membrane with a single aperture, through which he has himself repeatedly seen one or more spermatozoa penetrate. This opening, the micropyle, coincides exactly in position with the *broken edge* of Nelson. The cases in which the English anatomist thought he saw the penetration take place at other points, are probably to be attributed to errors. The spermatozoa observed by Meissner also coincide with the *spermatic cells* of Nelson, which Bischoff declared to be nothing but epithelial conules. Fecundation takes place at the moment when the ova arrive in the portion of the tube or sexual vessel which has already been denominated the albuminogene. The number of spermatozoa which penetrate by the micropyle is very variable, for Meissner has seen as many as ten in the interior of a single ovum. When fecundation is

* Beobachtungen über das Eindringen der Samenelemente in den Dotter. Zeitschr. für wiss. Zoologie, vi. Sept. 1854.

effected, the ovum completes its development in the manner described by Nelson.

In the *Lumbrici*, which were also studied by Meissner, things go on rather differently. In the ninth and tenth segments of their bodies, these animals possess four vesicles, which were formerly regarded as testicles, and the correct interpretation of which was first given by Von Siebold*, who states them to be seminal receptacles,—a function which also appears to be attributed to them by Van Beneden†.

These vesicles open externally by means of two small apertures, formerly mentioned by Leo‡. They have no communication of any kind with the ovaries, and it is nevertheless in their interior that the mature eggs are found. They probably arrive there from the exterior during copulation, so that in fact these organs should bear the name of common receptacles of the ova and semen, or of sacs of fecundation. The ovarian ova which possess a vitelline membrane and a germinal vesicle have lost these two elements when they arrive in the common receptacles, where they consequently swim completely naked. When there, they are assailed by the spermatozoa, which penetrate in crowds into the substance of the vitellus by a corkscrew-like movement. The united movements of the tails of all these spermatozoa at the surface of the ovum produce an appearance of waves. The segmentation of the ova commences in the receptacles, and they are afterwards extruded in a common capsule.

In this memoir Meissner confirms the discoveries of Barry, inasmuch as he also certainly saw spermatozoa in the interior of the ovum of the Rabbit, although he could not positively convince himself of the presence of the micropyle. This is a fact of great importance. We may always suppose that there is some error in speaking of the ova of *Anodontæ* and *Unios*; we may suppose that the spermatozoa which appear to be within them, may be in reality above or below them. But it is impossible to suppose that an object seen within the *zona pellucida* of the Rabbit may be situated above or below it. The object in question in fact is much too large, and it is impossible that the internal and external surfaces of the *zona pellucida* can be in focus at the same time. The same may be said, with still better reason, of the ova of the Frog, within which, as we have seen, Newport discovered spermatozoa.

* Lehrbuch der vergleichenden Anatomie.

† Report on a paper of Van Beneden's on the *Développement du Lombric terrestre*, in Bull. de l'Acad. Roy. de Belgique, xx.

‡ De Structura Lumbrici terrestris. Regiomonti, 1820.

Another memoir of Meissner's*, which followed immediately upon the former one, extended the results of his observations to two new classes of animals, namely the Insects and the Crustacea. The general result of the facts ascertained by him is, that the spermatozoa which are contained in the *receptaculum seminis* of the female (in Insects) after copulation, penetrate into the vitellus at the moment when the ova descend in the vagina. For this purpose, these spermatozoa are obliged to traverse an opening or micropyle, which exists both in the chorion and the vitelline membrane. He enumerates a long series of insects in which he observed the micropyle, and sometimes also the presence of spermatozoa in the interior of the membranes. The chorion of the eggs of Insects, and particularly of the Diptera, is often adorned with very regular geometrical designs, and the micropyle is very easily found, as it generally occupies the centre of an elegant rosette situated at one of the extremities of the egg. It is a curious circumstance, that this micropyle of the eggs of Insects is so easily seen, that it has been described and figured in a great many instances, although its function was never suspected. It was regarded only as an ornament, but not as an opening. Swammerdamm, Rösel, De Geer, Réaumur, Kirby and Spence, Ratzeburg, Sepp, Léon Dufour, Herold, Hartig and others have described and figured the peculiarities of the surface of the eggs of a great many insects, —peculiarities which all appear to be referable to the existence of the micropyle. Moreover the observations of Meissner alone would be sufficient to lead us to suppose the general diffusion of this structure of the egg in the whole class of Insects, since he has ascertained the existence of the micropyle in Diptera (*Musca, Tipula, Culex*), Coleoptera (*Lampyris, Elater, Telephorus*), Lepidoptera (*Adela, Pyralis, Tortrix, Euprepia, Liparis, Pieris*), Hymenoptera (*Tenthredo, Polistes, Spathius*), and Neuroptera (*Agrion, Panorpa*). Subsequently Leuckart has published a very remarkable work† on the micropyle of Insects, of which, unfortunately, only the first hundred pages have as yet (June 1855) appeared. In this he describes the micropyle in the eggs of at least 200 species, which scarcely leaves room to doubt of the universality of this arrangement in Insects. In a great number of these species he has even directly observed the entrance of the spermatozoa by the micropyle, or at least has found them in

* Beobachtungen, &c. No. ii. Zeitschr. für wiss. Zool., Sept. 1854.

† Ueber die Micropyle und den feinen Bau der Schalenhaut bei den Insecteneiern. Müller's Archiv, 1855. In the 'Handwörterbuch der Physiologie,' article *Zeugung*, Leuckart had already mentioned the micropyle as an attenuated part of the chorion, *which might probably play some part in fecundation.*

the interior of the egg. Leuckart has even arrived at general laws with regard to the structure of the micropyle in the different orders. In the portion of this memoir which has now appeared, only the Diptera, the Hemiptera and the Lepidoptera are referred to. The following is a summary of these laws:—1. In all the *true* Diptera (not including the Rhipiptera) the micropylian apparatus consists of a simple opening, situated at the anterior pole of the egg, or at least in the neighbourhood of this pole. 2. In the Hemiptera the micropyles are almost always more numerous, and not far from the anterior pole. 3. In the Lepidoptera the micropyles are always multiple, forming a variable number (usually four or six) of canals, which rise from a common central fossa situated at the anterior pole, and pierce through the envelopes of the egg in a radiating direction. As regards the Crustacea, Meissner has ascertained the existence of the micropyle in the *Gammarus pulex* of our brooks.

It is curious that Bischoff, after placing himself in the ranks of the defenders of the penetration of the spermatozoa into the ovum, should have again taken up the pen* with a certain degree of asperity to confute the discoveries of Meissner, which appear to form the most brilliant point, and in a manner the crown of their productions. Nevertheless, this does not in any way invalidate the theory of the penetration of the spermatozoa into the ovum, which is now permanently received into the science. Bischoff in fact only questions the description given by Meissner of the formation of the ova, and more especially of the spermatozoa in *Ascaris mystax*. Meissner had regarded as spermatozoa the same corpuscles which Nelson had previously admitted as such, whilst Bischoff persists in regarding them only as epithelial conules. On the other hand, Meissner, in describing the formation of the ova by means of diverticula of a germ-cell, had differed from Nelson, who had seen the young ova totally destitute of vitelline membrane. Bischoff adopts the opinion of Nelson, and positively denies the existence of the germ-cells and their diverticula, *at all events in the Ascaris* of the Cat. But he is greatly embarrassed by his epithelial conules when it becomes necessary to find the true spermatozoa, which, he says, must nevertheless penetrate into the egg. Notwithstanding all this, Meissner, in a subsequent work†, remains faithful to his theory. The future will decide this question, which is only accessory here, seeing the abundance of other materials.

* Ueber Ei- und Samenbildung und Befruchtung bei *Ascaris mystax*. Zeitschr. für wiss. Zool., Feb. 1855.

† Beiträge zur Anatomie und Physiologie der Gordiaceen. Zeitschr. für wiss. Zoologie, May 1855.

The numerous facts to which we have drawn attention prove more than sufficiently that fecundation is effected by an actual penetration of the spermatozoa into the interior of the ova, and that very often, if not always, this penetration takes place through a micropyle. It remains to be seen in what envelope of the ovum this exists, and if it is always possible to explain its formation in the manner of Lovén* and Leuckart, or in that of Meissner. Johannes Müller has, not long since†, indicated a peculiar structure in the external membrane of the ova of certain fishes, especially our river fish,—a structure which has also been investigated by Lereboullet‡. This membrane is pierced by a multitude of little canals, passing from one surface to the other, and dilating into a funnel-like form at each surface, so that the membrane presents a facetted appearance. This structure is particularly remarkable in the Perch (*Perca fluviatilis*), the egg of which has a very thick external membrane; but it is equally striking from its elegant appearance in the Ruffe (*Acerina cernua*) and the Sticklebacks (*Gasterosteus trachurus, lagurus, pungitius*, &c.). This structure appears to have been previously seen by Vogt§, who describes a shagreened appearance of the cortical membrane in the *Coregonus palea*; but he seems not to have remarked that this appearance was due to the presence of a multitude of little canals, of which the number, according to J. Müller, amounts to more than 1,1000 in the egg of the Perch. It is in this membrane that the micropyle is situated‖. It is remarkable that this membrane presents a great analogy in structure with that in which the micropyle is placed in the *Holothuriæ*. This latter is characterized by a sort of striation,—an appearance which is due, according to the opinion of J. Müller, to a multitude of little prisms placed perpendicularly upon the membrane. It is the membrane that Müller regards as the cortical membrane (*Schalenhaut*)¶, and Leuckart as the vitelline membrane**.

* Bidrag till kännedomen om utvecklingen af Mollusca acephala. Stockholm, 1848.

† Ueber zahlreiche Porenkanäle in der Eikapsel der Fische. Monatsber. der Berl. Akad., March 1854.

‡ Ann. des Sci. Nat. 1854.

§ Embryologie des Salmones, in Agassiz, Hist. nat. des Poissons d'eau douce de l'Europe centrale. 1842.

‖ This micropyle, or at least the funnel at the bottom of which it opens, is sometimes so large, that Bruch has found it with the naked eye in the egg of the Trout (*Fario lacustris*) and the Salmon (*Salmo salar*). Zeitschr. für wiss. Zoologie, May 1855. The funnel itself was already known to Von Baer in *Cyprinus blicca*,—Entwickelungsgeschichte der Fische. Leipzig, 1835.

¶ Ueber die Larven und die Metamorphose der Holothurien und Asterien. 1850.

** Zusatz zu Bischoff's Widerlegung, &c.

It must not be supposed that the shagreened envelope of the Fishes' egg is the analogue of the chorion of the Mammalia, or of the shell, or the shell-membrane of Birds. In fact, the chorion and the membrane of the shell are not formed until after fecundation, so that it would be useless to seek in them for a micropyle; the former does not exist in the Graafian vesicles of the Mammalia, nor the latter in the ovisacs of Birds. The shagreened membrane of Fishes, or capsular envelope, exists in the ovarian follicles, and consequently before fecundation, so that the spermatozoa must traverse it to effect that operation. It is therefore furnished with a micropyle, and must be compared with the *zona pellucida* of the Mammalia and the vitelline membrane of Birds. The *zona pellucida* of the mammalian ovum, the vitelline membrane of Birds' eggs, the shagreened membrane of those of Fishes, the envelope with a crystalline structure of the ova of the *Holothuriæ*, the cortical membrane of those of the *Naiades*, the vitelline membrane of those of *Mermis* and *Ascaris*, and the external envelope of the eggs of Insects and of *Gammarus pulex*, are therefore one and the same thing, and may be designated the *membrane of the micropyle**. It is true that the ova of *Gasterosteus* and those of other fishes have an apparently homogeneous membrane beneath the membrane of the micropyle, and, to establish a complete analogy in the ova of other animals, it would be necessary to ascertain the existence of this second membrane in them. Barry † has already asserted, that he observed a membrane between the *zona pellucida* and the vitellus in the Mammalia. The Insects possess a second membrane, furnished like the first with a micropyle. Müller ‡ speaks of a membrane which immediately envelopes the vitellus in the *Holothuriæ*, of which, however, Leuckart § denies the existence. Keber || asserted that in the *Naiades*, besides the cortical membrane, he recognized a vitelline membrane, and even a membrane

* It is true that we do not yet positively know whether the *zona pellucida* possesses a micropyle, although Barry should have seen it, and Meissner once ascertained the presence in it of an opening which did not appear to be torn. There remain the Reptiles, of which the vitelline membrane, to judge from Newport's observations on the ova of the Frog, must be permeated in all parts by the spermatozoa. But this does not appear to be a general rule amongst the Reptiles, nor even amongst the Batrachia, for, according to an unpublished discovery of Meissner's, the ova of the common Tree Frog (*Hyla arborea*) appear to possess a micropyle.

† Researches in Embryology, Third Series. Phil. Trans. 1840. It is his "proper membrane of the substance by which the germinal vesicle is surrounded."

‡ Echinodermen, 4te Abhandlung, 1850.

§ Zusatz, &c.

|| Ueber den Eintritt der Samenzellen in das Ei. 1853.

of the albumen. This however appears to be of but little importance, as it is very possible that this membrane may sometimes be present and sometimes absent. It is only necessary to suppose, that where it occurs it is pierced by a second micropyle, or that the spermatozoa can pass through its tissue. A more important point, in our opinion, is the complicated structure presented by the membrane of the micropyle in the Fishes, the *Holothuriæ*, the Insects*, and probably other animals; for there are many ova in which the micropyle has not yet been discovered, but in which the external membrane presents a shagreened structure, resembling that of the membrane of the micropyle in Fishes. This is the case, for example, in the ova of the *Echinorhynchi*, &c. But this complicated structure is an obstacle to the theory of Meissner upon the formation of the ova, of much greater force than all the objections which Bischoff was able to bring against it. Is it possible to regard a whole so complex as this membrane as a simple cell? There can be no doubt that we must reply in the negative. We must therefore either reject the observations of Meissner upon the formation of the ova of *Mermis*, or, as they have such an impress of truth that it is difficult not to yield to them, admit that the ovum is formed in very different modes in the series of created beings. The latter opinion has nothing improbable about it†.

The penetration of the spermatozoa into the ovum is a fact now acquired to science; but this penetration may take place in very different manners, and we can already distinguish three principal types:—

1. Penetration through a micropyle; a mode of fecundation which appears to be very widely spread, as its existence has already been ascertained in Echinodermata, Worms, Insects, Crustacea and Fishes, and perhaps also in Reptiles (*Hyla*) and Mammalia (the Rabbit).

2. Penetration by all points of the surface of the ovum; observed by Newport in the true Frogs. It is true that we may in this case suspect an error, and that it is possible that a micropyle may some day be discovered in the Frogs; but is it not surprising that such careful researches as those which have been

* It is probable, however, that it is not in the external membrane of the eggs of Insects that we find the analogue of the membrane of the micropyle in other animals. It is probably rather the inner membrane, which is also traversed by the micropyle. Leuckart however believes he has seen instances in which the chorion (or outer membrane) *alone* was traversed by the micropyle.

† More especially as Lovén and Leuckart have shown that the ova are formed in a very different manner in *Modiolaria*, *Cardium*, and the *Naiades*. The multiple micropyle of the eggs of the Hemiptera and Lepidoptera also indicates a very different mode of formation.

made upon the ova of the Batrachia by many authors * have not led to the discovery of the micropyle in them?

3. Penetration directly into the naked vitellus. It is certain, in fact, that the mode of origin of the ova described by Meissner in *Mermis albicans, M. nigrescens,* and several *Ascarides,* is not general even amongst the Nematoid worms. A great many ova only obtain an envelope at a very late period, and are probably fecundated before they possess one, so that they do not require the presence of a micropyle. Meissner himself has seen the spermatozoa penetrate directly, and in crowds, into the ova of the Earthworm, at a period when they are completely destitute of an envelope. As regards these, Meissner supposes that they originally possess a membrane which disappears before fecundation. This is very possible, as we know that a similar disappearance takes place, although at a later period, with the vitelline membrane of the ova of Gasteropoda and Insects (Rathke, Kölliker, Zaddach, Leuckart †).

[To be continued.]

XXV.—*On some species of* Epilobium. By Charles C. Babington, M.A., F.R.S. &c.

[Concluded from p. 247.]

We will now turn our attention to the species allied to *E. alpinum,* which present some difficulty, from there being probably two plants which pass by that name. Of this Dr. Godron was well aware when preparing the account of this genus for the

* Swammerdamm, Biblia Naturæ. Leeuwenhoeck, Arcana Naturæ. Rœsel, Hist. Nat. Ranarum nostratium; Nürnberg, 1758. Spallanzani, Diss. relatives à l'Hist. Nat. des Animaux et des Végétaux, 1789. Prevost and Dumas, Ann. des Sci. Nat. tome ii. Rusconi, Développement de la Grenouille commune; Milan, 1828; and Amours des Salamandres, 1821. Baer, Lettre sur la Formation de l'Œuf, 1829; Repertorium; Müller's Archiv, 1834. Reichert, Entwickelungsleben im Wirbelthierreich; Berlin, 1840. Vogt, Untersuchungen über die Entwickelungsgeschichte von der Geburtshelferkröte; Solothurn, 1842. Bell, British Reptiles. Newport on the Impregnation of the Ovum in the Amphibia, Phil. Trans. 1851 and 1853.

† We might add to these a fourth mode of fecundation, if we admitted, with Remak (Müller's Archiv, 1854), that the spermatozoa are only destined to transport a substance serving to effect fecundation (*die Träger einer samenähnlichen Substanz*). This substance being capable of passing through the little canals of the external membrane of the ova of Fishes, it would not be necessary that the spermatozoid itself should penetrate into the ovum in these animals. But we are already acquainted with the micropyle in many fishes, and it will probably be discovered in the others, which renders this theory very useless.

'Flore de France.' He observes, "L'*E. alpinum* (Fries, Nov. Mant. ii. 20) est, sans aucun doute, une espèce distincte de celle de France et de Suisse. Car la plante de Fries . . . . porte à la base de ses tiges, au lieu de stolons filiformes, des rosettes sessiles de feuilles fasciculées, qu'il compare aux rosettes de l'*E. tetragonum*." (Fl. de Fr. i. 578.) It is a cause of surprise to me that, knowing so much, he did not inquire further into the subject, but has left the French plant in possession of the name of *E. alpinum*, which belongs to that of Lapland. It was the intention of Linnæus to include under that name the plant of the Alps; but it is clear, from his quoting Scheuchzer's work with doubt, that he was not quite satisfied of their identity. In his later writings he has removed the mark of doubt from that reference, and added other synonyms belonging to the alpine plant and also to *E. alsinifolium*. The *E. alpinum* therefore of the 'Species Plantarum' included three plants: namely (1) *E. alpinum* of Fries, which must be accepted as the type of the Linnæan species; (2) *E. alsinifolium* of Villars; and (3) *E. anagallidifolium* of Lamarck, which is the *E. alpinum* of Godron.

Botanists appear to be now pretty unanimous in distinguishing Nos. 1 and 2, but seem to have known nothing concerning the *E. alpinum* of France and the Alps until Godron published the remark that has just been quoted. Had not that accurate and observant botanist directed attention to the subject, it is probable that we might long have continued to be ignorant of the fact that the *E. alpinum* of the north differs materially from that of the south of Europe. It will have been seen from the quotation from the 'Flore de France,' that the chief difference between them is, according to Godron, to be found in the presence or absence of stoles or rosettes. If such a difference of habit really exists, it is probable that botanists will not see much reason for refusing to adopt Dr. Godron's opinion. That this southern plant, if distinguished, ought to bear the name given to it by Lamarck cannot admit of question; for there seems to be no reason for doubting that he had it in view when he published the description and figure of his *E. anagallidifolium*. He states that it is closely allied to the *E. alpinum* of Linnæus, but doubts their identity*.

After stating what I believe to be the characters of the three plants, a few observations will be made upon them.

E. anagallidifolium (Lam.); *joints of the barren stems all long* with small obovate leaves, flowering stem erect from a long rooting

* In the paper already noticed, Dr. Grisebach has arrived at conclusions concerning the allies of *E. alpinum* similar to those independently formed by me, and Dr. Schultz appears to adopt them in his review of it.

base, leaves oblong blunt narrowed below not acuminate stalked, upper leaves lanceolate, buds nodding, *sepals oblong blunt*, seeds obovate pointed below apiculate.

E. anagallidifolium, *Lam. Dict.* ii. 376. t. 278. f. 3; *Griseb. l. c.* 853.
E. alpinum, *Gren. et Godr. Fl. de Fr.* i. 577; *Reichenb. Fl. exsicc.* 1061.

Stem filiform, mostly simple, with two slightly raised lines, usually 3–4 inches long; or prostrate, branched, densely leafy, rooting. Leaves resembling those of *E. alpinum*, glabrous or downy. Flowers pale reddish. Capsules like those of *E. alpinum*, glabrous or downy. Seeds brown, rounded at the top, but with a minute point formed by a slight prolongation of the testa: there appears to be a furrow down the middle of the flat side.

It inhabits the lofty mountains of Scotland. My specimens are from Morne and Lochnagar, Aberdeenshire; Clova, Forfarshire; Ben Vorlich, Dumbartonshire. In Smith's Herbarium there are specimens from Ben Lomond, Stirlingshire; Craig Chailliach and Ben Lawers, Perthshire.

E. alpinum (Linn.); *barren stems short their upper leaves closely placed*, flowering stem erect from a short rooting base, leaves oval or oblong blunt narrowed below not acuminate, upper leaves lanceolate, buds nodding, *sepals linear-lanceolate acute*, seeds lanceolate-obovate pointed below apiculate.

E. alpinum, *Linn. Sp. Pl.* ed. 1. 348; *Eng. Bot.* 2001; *Fries, Herb. Norm.* viii. 44.

Stem filiform, simple, with two slightly raised lines, usually 3–4 inches long. Leaves pale green. Flowers pale. Capsules relatively smaller than those of *E. alsinifolium*, but resembling them. Seeds rather pale, bluntly rounded at the top, but with a minute central point formed by a slight prolongation of the testa, with a keel along the middle of the flat side; but the keel in this plant and the furrow in *E. anagallidifolium* is not ascertained.

It inhabits the lofty mountains of Scotland. All the British specimens that I have seen belong to the smaller of the two forms distributed by Fries; they are from Ben Wyvis, Ross-shire; Drumouchter, Inverness-shire; Ben na Buird, Aberdeenshire; Clova, Forfarshire; Ben Lawers, Perthshire.

E. alsinifolium (Vill.); stoles (yellowish) with small roundish distant scales, stem erect from a long rooting base, *leaves ovate-acuminate repand-dentate* shortly stalked, buds nodding, *sepals linear-oblong, seeds subfusiform.*

E. alsinifolium, *Vill. Dauph.* ii. 511; *Deakin's Florig. Brit.* f. 626.
E. origanifolium, *Reichenb. Fl. exsicc.* 775.
E. alpinum, *Fries, Herb. Norm.* v. 41.

Stem usually simple, rather thick, with two raised lines, 3–12 inches long. Leaves shining, subpellucid, glabrous. Lowest leaves blunt. Flowers large, purplish, few. Capsules very long, upright, long-stalked. Seeds narrowed at both ends, and continued gradually into a great prolongation of the testa at the top, causing the beard (pappus) to appear to be stalked.

It inhabits the lofty mountains of Scotland; the Great Cheviot in Northumberland; Cronkley Fell, Teesdale, Yorkshire; Fairfield, Westmoreland; at and above Aber Waterfall, Caernarvonshire.

It is not easy to describe the great difference in appearance that exists between *E. alpinum* and *E. anagallidifolium*, and therefore they will doubtless seem to the reader to be far more alike than is really the case. I have never seen in *E. alpinum* the remarkable prostrate rooting flowerless shoots which are characteristic of *E. anagallidifolium*, and which are as different from the rather loose rosettes of *E. alpinum* as they are from the stoles of *E. palustre*. The short leafy stems forming the loose rosettes of *E. alpinum* do not become creeping stems nor true stoles. The sepals may perhaps afford a certain distinction between them.

It must be added, that I have no acquaintance with the supposed differences between *E. alpinum* and *E. anagallidifolium* as they appear in the living plant, and that it is often difficult to tell accurately to which of them dried specimens ought to be referred. Well-developed and complete specimens are so very different, that there is little ground for hesitation in admitting two plants as natives of the Scottish mountains which have such markedly different modes of growth as to render it highly probable that they are distinct species. The identification of these plants with the *E. alpinum* of Scandinavia and of the Alps, respectively, does not, I think, admit of doubt. Botanists will do well if they direct their attention to the interesting question of their specific distinctness.

Scottish botanists should look carefully for the *E. lineare* (Mühl.) which is found on the mountains of Scandinavia, and may very probably inhabit those of Scotland. It closely resembles both *E. alpinum* and *E. palustre*. From the former, to which it appears to be the most nearly allied, it may be distinguished by its linear obtuse denticulate leaves; its sepals, although of the same shape, are apparently blunt; its flowers are "white," or "cream-coloured." From *E. palustre* it is at once known by "vegetatio cæspitosa ob rosulas ad basin sessiles," and the total want of the slender stoles of that species.

It is hardly necessary to expend many words upon the differences of *E. alsinifolium* from the two plants above mentioned, for its very differently shaped seeds afford a good distinction, and the appearance of its foliage is very dissimilar. But it is necessary to direct attention to the singular fact, that the plate devoted to the illustration of this species in 'English Botany' represents another plant. Mr. Borrer has kindly favoured me with the use of authentic specimens, named *E. alsinifolium* by the late Mr. Winch, and stated to have been gathered by him on Cheviot. One of them was communicated by the late Mr. Sowerby as the plant figured by him in 'English Botany' (t. 2000); another is stated to be Mr. Winch's plant by the lamented Mr. Edward Forster; and a third is similarly ticketed by Mr. D. Turner. These three specimens all accord well with the plate (Eng. Bot. 2000); but neither they nor it have, as I believe, any claim to the name of *E. alsinifolium*. They are probably only small states of *E. montanum*; indeed, the cultivated specimen from Mr. Turner can scarcely be called small. Mr. Turner was well acquainted with this rather singular fact, for in the 'Botanist's Guide' (ii. 470) he states, under the heading of *E. alpinum*, the name originally applied to the plant by Winch, that he, in common with other botanists, believed the specimens sent to him to be "only a starved state of *E. montanum*." I am inclined to agree with Mr. Turner; but Mr. Borrer, than whom there is no person better qualified to give an opinion on such a subject, thinks that "the clubbed stigma and the angles of the stem tend to a contrary conclusion. These angles are still visible on the specimens, as lines at least, even on the large garden fragment." One thing is clear to both Mr. Borrer and myself, viz. that the specimen sent to Sowerby, and figured by him, was not *E. alsinifolium*. In Winch's Herbarium there is a "small mountain variety of *E. montanum*," which has faint decurrent lines upon its lower joints. The Cheviot plant appears to be chordorhizal, judging from one of the specimens preserved in that Herbarium; and the plate in 'English Botany' represents an underground stole similar to those of *E. alsinifolium*. If we are obliged to allow that hybrids are easily produced between *Epilobia* in a wild state, then we might probably escape from the difficulty by supposing this plant to be one; viz. between *E. alsinifolium* and *E. montanum*, both of which are, I believe, to be found upon the same part of that mountain. On that supposition, the habit and the leaves would result from the latter plant; and the stole, the slight angles upon the stem, and the club-shaped stigma, from the former. Nevertheless there is great reason to think that Winch did gather the true *E. alsinifolium* on Cheviot, for his description of the plant found there, when in cultivation, accords well with that species. His words are, "In winter it is not deciduous, but forms wide-spreading, matted tufts of small leaves, among which the fibrous roots shoot out, as in proliferous plants. The flower-stems are partially decumbent, cylindrical, at first simple, *afterwards much branched*, and furnished with numerous elliptical, slightly toothed, soft leaves; the flowers are few, and the style undivided." (Bot. Guide to Northumb. and Durham, ii. p. v.) One or two points in this description, such as that which I have italicized, refer to the plant which Winch had by some mischance mixed with the true *E. alsinifolium*; but I think, for the most part, it cannot have been taken for that plant. I also think that the *Lysimachia siliquosa glabra minor latifolia* of Ray is really *E. alsinifolium*. It is most unfortunate that the wrong plant should have been figured in 'English Botany,' as that error has probably tended to encourage those who desired to disprove the specific distinctness of *E. alsinifolium*; and it is wonderful how botanists who have had occasion to quote figures of that species, myself amongst the number, have continued to refer to 'Eng. Bot. tab. 2000' as representing it. Dr. Deakin describes and figures the true *E. alsinifolium* (Florig. Brit. ii. 549. f. 626); but part of his remarks seems to have resulted from an inspection of 'English Botany,' for they do not accord with the description that precedes them. The lamented Dr. G. Johnston stated (Bot. of East. Borders, 81), that he found *E. alsinifolium* in the Dunsdale Ravine on the Great Cheviot; and as he most liberally presented his specimens to me, I am enabled to confirm his determination of the plant, thus proving that that species really does inhabit those hills. The specimens more nearly resemble those which I gathered upon Cronkley Fell in Yorkshire than the plant usually found in Scotland, and seem to be what Fries mentions under the name of *E. anceps* as a variety of this species (Mant. ii. 20). I am inclined to refer the specimen gathered and named *E. alpinum* by Dr. Douglas (see Bot. E. Bord. 82) to a small state of *E. alsinifolium*, but its imperfect state renders this determination doubtful.

In the valuable and recently published 'Supplement to the Flora of Yorkshire' (p. 67), Mr. J. G. Baker notices a plant which he found on the "south bank of the Swale near Topcliffe," and describes it as having "subsessile leaves narrowing gradually below . . . . a bisulcate stem, erect buds and dark purple flowers," and states his belief that it is probably the *E. purpureum* of Fries. If his description is correct, and I have no reason to think it otherwise, it seems highly probable that his determination of its name is also right. Mr. Baker kindly presented me with specimens of it, but unfortunately they are only lateral branches of what seems to have been a much-branched plant; they accord well with the descriptions given by Fries

(Mant. iii. 185, and Summa, 178). Mr. Baker's plant appears to have had a hollow "bisulcate" stem (but I do not know that the furrows descend from the dorsal ribs of the leaves, as Fries states to be the case in his plant), much branched and clothed with fine scattered hairs; leaves ovate-lanceolate, suddenly narrowed below into a very short winged petiole, finely and distantly denticulate; lower leaves probably opposite; floral leaves large and more or less alternate; flowers apparently rather large, "dark purple," constantly erect; sepals hairy, broad, oblong, acute or perhaps cuspidate; capsules very long, thick, hairy when young, rising conspicuously above the top of the stem. I have thought it right to introduce this short notice of the suspected *E. purpureum* into the present paper from its appearing to deserve the attention of botanists.

Before closing this communication, it is proper to bring more prominently forwards than has been done by its discoverer, the fact that the *E. rosmarinifolium* (Haenke) is a native of Scotland. Mr. John Robertson, a very intelligent gardener and botanist, has had a 'Flora of Perthshire' in preparation for some years, and would have published it before this time if he had succeeded in obtaining sufficient subscribers to cover the expense*. With the prospectus of this book he circulated in 1852 a "few scraps from the work" itself, and amongst them there is the announcement of his having found this plant upon almost "inaccessible rocks that overhang the Tarf, a mountain-stream in Glen Tilt." He adds, that "it may be readily overlooked from the frequent nibbling of sheep and other animals. . . . . It has also been observed in one or two situations by the Tay, where doubtless it has been carried . . . by the impetuosity of the mountain torrents." The characters for distinguishing it from *E. angustifolium* are—

E. rosmarinifolium (Haenke); stem erect round, *leaves linear not veined*, petals elliptic-oblong not clawed, style equalling the stamens.

E. rosmarinifolium, "*Haenke in*" *Jacq. collect.* ii. 50.

E. Dodonæi, *Sturm, Deutsch. Fl.* fasc. 72. t. 5.

Creeping moderately. Stem often decumbent below. Leaves shortly attenuate at both ends, entire or denticulate, with revolute margins. Flowers rose-coloured or white.

This is a very interesting addition to the flora of Britain, for, as far as I can learn, it had not with certainty been ascertained to grow further north than the Cevennes. Messrs. Hooker and

* Subscribers' names are received by Messrs. A. and C. Black, publishers, Edinburgh. Price 10*s*. 6*d*.

Arnott seem to throw some doubts upon its having been found in Glen Tilt, but do not state the cause of them. My inquiries and those of Mr. Borrer lead us to believe the statement of Mr. Robertson.

In the 'Botanist's Guide' there are two stations given for a plant there called *E. angustissimum,* both of which rest upon the high authority of the late Mr. J. W. Griffith. These places are, "Rocks near Twll dû in Cwm Idwel," and "Rocks of Arran Pen Llyn." It has been generally taken for granted that the plants noticed by Mr. Griffith were small states of *E. angustifolium,* but no botanist has, I believe, recorded his having recently met with the plant of the latter station, and we have therefore no means of knowing what it is. In the autumn of 1855 I gathered what seems to be a small form of *E. angustifolium* upon the rocks rising from the lake called Llyn y Cwn, which is close to Twll dû. It had not flowered, nor did it show any buds, and grows in the narrow crevices of the rock in such a manner that I was unable to obtain a root for cultivation. It should be remembered that the station called "Rocks near Twll dû in Cwm Idwel" by Griffith, is stated by him (Bot. Guide, i. 82) to be the spot named "Hysvae" by Richardson in the 3rd edition of Ray's 'Synopsis' (310), where he found the *Lysimachia Chamenærium dicta, flore Delphini* of Parkinson, and that there is every reason to suppose that Richardson, Griffith and myself have successively gathered the same plant in the same or closely contiguous spots. It is curious that Smith should have taken no notice of these mountain stations.

The true name of the plant found by Mr. Robertson is rather difficult to determine, not from any doubt concerning the species to which it belongs, but on account of some confusion which has happened in the use of the several names of the allied plants. The Perthshire plant is—

E. Dodonæi, Villars (in part), Allioni, Gaudin (in part), Koch;

E. rosmarinifolium, Haenke, Reichenbach, Godron;

E. angustissimum, Willdenow (in part), Bertoloni (not Curtis nor Aiton), Waldstein and Kitaibel.

Bertoloni and Godron appear to be justified by the description given by Villars (Fl. Dauph. iii. 507) in considering that he included under the name of *E. Dodonæi* both the small species which are allied to *E. angustifolium,* and therefore have probably exercised a sound judgement in rejecting that name. But the former author seems to me to have fallen into an error in thinking that the plant now under consideration is the *E. angustissimum* of Aiton (Hort. Kew. ed. 1. ii. 5), and of Curtis (Bot. Mag. 76), for the figure given by the latter author seems to fix that name upon the other species, to which also Reichenbach applies it. If therefore we think it proper to drop Villars's name, the next in antiquity is *E. rosmarinifolium* given by Haenke in 1788. Mr. Borrer has pointed out to me that Dodoens does not deserve the honour of being commemorated in connexion with this plant, the figure of which in his work (Pempt. 85) is only a reprint of L'Obel's cut (Stirp. Hist. 226), and all that he says about it is contained in a single sentence which conveys no valuable information. It is probable that he never saw the plant. It cannot therefore be said that we are depriving him of any credit, justly due to him, when we neglect a name of only partial applicability to our plant and adopt another which belongs to it alone.

P.S.—The time which has elapsed since the communication of this paper to the Botanical Society has allowed plants raised from seeds of *E. Lamyi,* taken from the specimens sent by M. Lenormand, to develope their winter form. The seeds were sown in a pot in the early part of the summer of 1855; they flowered in the autumn, and the flowering stems are now (Feb. 22, 1856) quite dead. Around the base of the old stems there is now a dense mass of rosettes, exactly resembling in all respects those of *E. tetragonum.* The plants have not been defended from the frost, but nevertheless the rosettes are in a healthy condition. Dr. Schultz remarks of the rosettes, that "si la plante n'est pas garantie contre le froid dans une chambre chauffée" (Arch. ii. 53), they perish in the winter; but that if so defended they produce plants that flower, but do not develope any more rosettes. It remains to be seen if such will be the case with the plants in the Cambridge Botanic Garden.

Mr. Borrer informs me that "a plant of *E. Lamyi,* raised from seed sent by Schultz, is (Feb. 9, 1856) showing tufts of leaves as strong as, and (as far as I can see) scarcely distinguishable from, those of *E. tetragonum,* at this time in a north border in my garden, where it must have borne 24 degrees of frost [8° Fahr.]." These facts tend to the conclusion that *E. Lamyi* is not distinct from *E. tetragonum.*

XXVI.—*Note on the Genus* Scissurella. By J. Gwyn Jeffreys, Esq., F.R.S.

It would be a boon to science if Dr. Gray, or some other naturalist who is well versed in general conchology, would enlighten me and probably many more of your readers by assigning a proper position and resting-place to this singular genus. I am by no means satisfied with the general opinion that it belongs to the *Trochidæ*; although I believe it is allied to that family in respect of both the shell and animal. Nearly half a century ago, Colonel Montagu supposed the *S. crispata* of British authors to be the fry of a *Trochus*; but since his time many other species have been discovered in various parts of the world, all of which exhibit the peculiar structure of *Scissurella*; and the recent description by Mr. Barrett of the external organs, as well as my own observation of the operculum in another (although probably not a congeneric) species, have afforded additional data for ascertaining the true relations of the genus. With respect to the presence or absence of an operculum, I may remark that even in the same genus (*Mangelia*) some of the species are operculated, while others are inoperculate. Ciliated appendages, simple filaments or cirrhi* varying in disposition and number, and combined with opercula of different forms (which however are sometimes wanting), occur in *Macgillivrayia* and *Cheletropis* (pelagic mollusks), as well as in *Lacuna*, the *Fissurelladæ* and *Patella*, which are widely separated from the *Trochidæ* and from each other. I submit that the question ought not to be determined upon analogical considerations alone. The orifice in the mantle and shell of *Scissurella* indicates an affinity to *Emarginula* and *Fissurella*, the young of which are well known to be spiral. The slit in *S. striatula*, Ph., does not commence until the animal is half-grown. Its sides or walls are raised above the surface of the shell, and present a prominent ridge; a hollow groove being thus apparently formed for the reception and passage of the excurrent or anal canal. The foramen in which it terminates is oblongo-fusiform, being usually more pointed in front; and it projects like the groove, in this respect resembling an analogous process in the young of *Fissurella*. As Mr. Alder justly remarks, this conformation appears to exhibit the same relation between this species and *Scissurella* as *Puncturella* bears to *Emarginula*. The ribs generally cease when the slit begins to be developed; and it would seem as if that operation altered or interfered with the original secreting power of the mantle, which afterwards was applied as well to the filling-up of that part of the slit which became useless as to the construction of a series of close-set transverse striæ or steps between the sides of the groove. The foraminal termination of the slit I have only observed in this species (*S. striatula*), although a great number of the British species (*S. decussata* or *crispata*) have been examined

* *Obs.* The use of these organs seems to be little known. In *Macgillivrayia* they are supposed to serve for prehension as well as natation; but in the majority of cases they probably perform the functions of supplemental tentacula.

by me. In the first-mentioned species, too, the spire is laterally compressed, as in *Stomatia*, and is not so trochiform as in the others; and if the family of *Scissurelladæ* (as proposed by Dr. Gray in his "List of the Genera of Recent Mollusca") is adopted, I venture to suggest that for the species in question and others which possess a similar organization and form, the generic name of *Schismope* (ab *σχισμὴ, scissura*, et *ὀπὴ, foramen*) would be appropriate*. *Trochotoma, Pleurotomaria* (if indeed *Scissurella* differs from it), and other fossil genera, may then form part of the same family; as no system of classification can be complete in which what are usually termed "extinct" forms are not comprised. Sowerby, in his "Genera of Recent and Fossil Shells," took the characters of *Scissurella* from a species of the Calcaire grossier of Grignon, and not from any of the species described by D'Orbigny, who is not likely to have overlooked the remarkable structure of the scissural foramen. The position given to *Scissurella* by the late Professor Forbes in the 'British Mollusca' (viz. between *Adeorbis* and *Ianthina*), cannot, I think, be right; because the last-mentioned genera belong to very different families. These minor problems in natural history are very interesting; and I hope my friend Mr. Clark will be able next summer to obtain and describe the animal inhabitant of *Adeorbis subcarinata*, and thus increase his valuable stock of observations on the British Mollusca.

58 Montagu Square, St. David's Day, 1856.

P.S. Having submitted the above to Dr. Gray, I have been favoured with his remarks on the subject; which, with his permission, I will subjoin to my communication :—

"British Museum, 6th March 1856.

"My dear Sir,

"I have read your note with much interest; and I have little doubt the genus *Scissurella* belongs to the great group which has been called Scutibranchia, Rhiphidoglossa, or Trochoida, characterized by the structure of the gills, the lateral membrane and tentacles, the peculiar disposition of the teeth and organs of digestion, and by its generally forming a pearly shell.

"This group consists of the genera *Trochus, Rotella, Turbo, Haliotis, Stomatia, Stomatella, Fissurella* and *Parmophorus* of Lamarck: and perhaps, according to the theories of some conchologists, especially such as study the productions of a small region only containing a very few representatives of each family,

* The only recent species with which I am acquainted (*Sc. striatula*, Ph.) is littoral. All the species of *Scissurella* proper apparently inhabit deep water.

these might even be considered as a single natural genus. But to such as study the Mollusca of a larger and more prolific district, and especially the species now contained in collections brought from various climes, such a union of genera seems to me most undesirable, particularly as it prevents that accuracy of observation and discrimination which it is the great advantage of natural history as a branch of education to establish and teach.

"From the study of the animals, shells and opercula of these Lamarckian genera, I have been induced to form the group into the following families, viz. *Rotelladæ, Turbinidæ, Liotiadæ, Trochidæ, Stomatelladæ, Scissurelladæ, Haliotidæ* and *Fissurelladæ*. I believe that *Scissurella* is very distinct from *Trochus*, and intermediate between it and the *Haliotidæ*, but more nearly related to the latter than the former; and this view of its position has been strengthened by Mr. Barrett's description of the animal, as well as by what you say as to the operculum and structure of the shell.

"Though the family of *Scissurelladæ* only contains one, or as you have very properly proposed, two genera, yet they appear to be all that remain of a large number of fossil genera, containing together more than 300 well described and figured species.

"I never believed that *Scissurella* had any relation with *Ianthina*, and the figure and description of the animal distinctly prove that it has not any.

"*Adeorbis*, on the other hand, is clearly a genus belonging to the same great group above mentioned, and is referable, by the exquisite structure of its operculum, to the family *Liotiadæ*, characterized by its horny many-whorled operculum being ornamented with concentric spiral lines of a calcareous pearly substance.

"Ever yours sincerely,

"*J. Gwyn Jeffreys, Esq.*" "J. E. Gray."

XXVII.—*On the House Ant of Madeira*. By Prof. O. Heer, of Zurich. Translated from the original by R. T. Lowe, M.A.

[Concluded from p. 224.]

II. *Description of the House Ant.*

Œcophthora, Heer.

Mandibles very strong, in the females and soldiers with a sharp cutting edge, in the labourers toothed like a saw. Palpi of the tongue and maxillæ *very short* and *two-jointed*; *the* *second joint somewhat longer than the first.* The pergamentaceous stalk or stipes of the maxillæ with a thin membranous, ciliated sheath (case or cover).

Antennæ *in the males seventeen-jointed, the first joint thicker but not longer than the next succeeding joints*; in the females, labourers, and soldiers twelve-jointed, with a rather long shaft and eleven-jointed flagellum, the three last joints of which form a slight, gradually attenuated club.

Wings with three cubital and two discoidal cells; *the middle cubital cell stipitate.*

The tibia in the females, labourers, and soldiers with a pectinate hook.

The back of the metathorax with spines.

The abdominal pedicle two-jointed, the first joint clavate.

The family consists of males, females, labourers, and large-headed soldiers.

This genus belongs to the group *Myrmicidæ*; it differs altogether from *Myrmica*, Latr., by the much shorter two-jointed palpi, by the seventeen-jointed antennæ in the males, and the venation of the wings; in this last point it approaches nearer the genus *Atta*, but in this the maxillary palpi are five-jointed, and the metathorax is unarmed with spines. In the two-jointed palpi our genus agrees with *Pheidole* and *Typhlopone*, Westw.; the latter genus belongs to the group *Poneridæ*, and cannot therefore come into consideration; the former is founded by Westwood on an Indian species, the *Atta providens*, Sykes; but from this, *Œcophthora* differs in the much longer first joint of the tarsus, the anteriorly sharper-toothed mandibles, the maxillary-case produced beneath, by the fusiform second joint of the maxillary palpi, the much less deeply notched upper lip, the differently shaped abdominal pedicle, and the marked division of the neuters into two forms, widely differing in the structure of the head.

Œcophthora pusilla, Heer.

Allied species to it are the *Myrmica omnivora*, L. Latr., *Myrmica nana*, Latr., and *Atta megacephala*, F. Latr., both the latter of which must certainly belong to the genus *Œcophthora*. The *Myrmica omnivora*, Latr., is spread over all tropical America, and also appears in Egypt as one of the pests of the country. More recently it has also spread northwards, and in Kasan as in London does great mischief in houses. From this *M. omnivora*, our Madeira kind is distinguished (over and above the generic characters) by the armed thorax, and by not having both the segments of the node or abdominal pedicle (die beiden Glieder des Knötchens) cylindrical. With the *Myrmica nana*, Latr. (*Formica pusilla*, De Geer, from South America), it agrees in size, colour, and the armed thorax; but in that, the thorax, with the head, is shagreened with numerous little raised points, which is not the case in our species. In the form and size of the head, the soldier of the *Œcophthora* agrees with the *Atta megacephala*, Latr. (from the Isle of France); yet Latreille would surely not have overlooked the peculiar striated sculpture of the head: but since neither the description nor figure gives this, we cannot identify our species with his; and this especially as the female is said to be only a little larger than the neuters,—the difference in ours being so considerable. From this, *A. megacephala*, Latr., the ant so called by Losana (Memorie della Reale Accademia di Torino, xxxvii. p. 328), is distinct; and the description of the species which is found in the gardens of Piedmont agrees in all points of importance with the soldier of the Madeiran ant. On the other hand, the description of the labourer is quite inapplicable, for it assigns to it a larger heart-shaped head. It is also very surprising that Losana should not have remarked that the head of the labourer is quite smooth, and that labourers and soldiers present constant differences, not only in size, but also in the formation of the head.

1. *The Female.*

Pl. III. fig. I. 1, the natural size; fig. I. 2, ten times magnified; fig. I. 3, in profile.

Whole length $3\frac{1}{4}$ lines. Length of the head $\frac{3}{4}$ line, breadth the same. Length of the thorax 1 line, breadth $\frac{3}{4}$ line. Length of the abdomen $1\frac{1}{2}$ line, breadth nearly 1 line. Length of the upper wings $3\frac{1}{4}$ lines, breadth $1\frac{1}{8}$ line.

The head is roundish, and of the breadth of the thorax, as long as broad, with a very slight notch at the base behind. The eyes are rather small, and composed of few lenses. The three ocelli are very distinct, and placed at the base of the head in a triangle. The clypeus is not distinct from the forehead; slightly hollowed out directly over the mouth, where the edge is furnished with a row of punctures. The antennary clefts are somewhat converging forwards, short, but broad and deep, and rather widening forwards, where the forehead, which otherwise is flat, becomes more prominent. The forehead between the antennary clefts is moderately broad, and furnished at its anterior margin with an impressed, triangular, somewhat smoother compartment, which is faintly keeled down the middle. The whole upper side of the head is traversed by fine parallel striæ longitudinally, which reach down nearly to the base of the head; behind the eyes the striæ are fainter, more irregular, and partly obsolete, or passing into dots. The upper lip (labrum) (fig. I. 4) is very small, and depends quite perpendicularly between the mandibles; it consists of two horny plates, a very short but broad basal piece, and a second longer outer piece, which is rounded, and slightly notched anteriorly; in the middle of the notch stands a little papilla. The labrum is beset with a double row of fine bristles, one within the other upon the edge, with two longer, stouter bristles in the centre of the lip. The mandibles (fig. I. 5) are very strong and horny, becoming broader and hatchet-shaped externally; the fore-edge exactly truncate, and produced forwards into a strong tooth, furnished with a narrow horny rim or border extending at the top into a short, not prominent, tooth. This border, which, as the actual cutting-edge, forms the mandibles, is very sharp, but without teeth. The outer edge of the mandible is grooved; the upper surface, on the contrary, even. The maxilla is much smaller. The peduncle (stipes) is pergamentaceous, narrowed at the base, notched at the top, to which is affixed the extremely small two-jointed *palpus*: this is so small, that it does not reach to the point of the sheath. The first joint is cylindric, the second somewhat longer, fusiform, and produced into a fine point. The sheath extends pretty far out beyond the stipes; it consists of a stalk-like basal piece (fig. III. 5. b^3) and a larger membranous very thin upper piece, which is rounded at top and furnished with a crown of hairs; further below the hairs cease, and the edge is naked and extremely thin; but here a border of excessively minute hairs runs obliquely over the surface of the sheath. The labium is very small, as long as the stipes of the maxilla, greatly narrowed at the base, broader outwards and bluntly rounded. The lingual palpi are two-jointed and very short; the first joint obconic, the second fusiform and somewhat longer, bearing two bristles. The mentum is corneous, and slightly hollowed out. The antennæ are moderately long; the first joint (the scape) extends a little beyond the edge of the head, and is scarcely perceptibly thickened outwards: the flagellum is eleven-jointed; its first joint is about twice as long as the next very short one; all are of equal thickness; the three last are considerably larger, though not abruptly distinct from the rest; they are together about the length of the seven preceding joints. All the joints of the flagellum are finely hairy, especially the last three.

The thorax is pretty large. The *prothorax* is very short, and not perceptible from above; laterally, however, the side-piece (Pl. III. fig. I. 3 a^2) forms a pretty broad prominent segment; the *mesothorax* composes the chief part of the thorax (fig. I. 3 b); the *mesonotum* is somewhat larger than the head, rather flat above, nearly circular, but truncate behind, with a transverse impression and row of impressed punctures, and on either side a small black tubercle. The upper side of the mesonotum is quite even, with only a faint longitudinal groove. The scutellum (fig. I. 3 b^2) is attached immediately to the mesonotum; it is abruptly truncate in front, bluntly rounded behind. The side-plate of the middle thoracic segment is of about the same size as that of the anterior, and receives the coxa of the middle leg. The first piece of the metanotum is extremely short (fig. I. 3 c^1); the second piece (its *scutellum*, fig. I. 3 c^2) is indeed longer, but still small and strongly attenuated backwards. On the back it is even; on each side bordered by a raised margin, on which stands a distinct prominent black spinule.

The legs are moderately long, with thick but short coxæ, small trochanters, and femora dilated in the middle. The tibia is considerably shorter than the femur. The anterior tibia is thickest in the middle, slightly rounded forwards on the inner side, where there is placed a moveable proportionably large hook, furnished on its inner side with a membranous border, which is fringed with a row of fine straight setæ (fig. I. 6 *c*), giving it the appearance of a comb. The tarsi are long, and extremely slender and filiform. The first joint is nearly as long as the tibia, but the four following are very short. The fifth is thickened outwards, and provided with two curved very sharp claws (fig. I. 7), between which lies a membranous flap (or lobe). The first tarsal joint in the four hinder legs is straight, but in the anterior pair is very strongly curved at the base, the curve answering to the pectiniform hook, which has a similar curvature. It is also worth notice, that on the parts of the tarsus answering to the hook, the tarsus is clothed with a thick fine felt of hairs; whilst on the other parts of the tarsus, these hairs are longer and less closely set.

The wings extend pretty far beyond the apex of the abdomen. The fore-wings are much narrowed at the base, and attain their greatest breadth at three-fourths of their length. They have a distinct, pretty large stigma. The radial cell, before it, is open, for the *vena scapularis* does not run into the margin. The cubital cells are three, of a similar form to those of the *Attæ*. The inner cubital cell is polygonal and irregular; it is contiguous to the stigma: the second is also closed, somewhat bell-shaped and pedunculate; the cross vein which divides it from the third open large cubital cell is connected with the cross-vein which divides the inner cubital cell from the radial cell, and which issues from the stigma. The inner discoidal cell is rhomboidal and rather small; but the outer discoidal cell is very large and open. The *area interno-media* is divided into two cells, of which the outer one is open, the *vena interno-media* running out free. The hind-wings are considerably smaller than the fore, and the *vena scapularis* is connected already at one-third of their length with the marginal vein; the *v. externo-media* divides very soon into two forks, the outer of which is connected by a little cross veinlet with the scapulary vein, and then proceeds towards the tip of the wing. The *v. interno-media* is extremely short, and opens into the *externo-media*.

The abdomen consists of six segments, the first two of which form a proportionably long pedicle. Of this the first segment is strongly curved like a horn, and clavate. At the point of its insertion into the thorax it is quite thin, but is thickened upwards. This thin pedicle is the cause of the great mobility of the abdomen: when raised perpendicularly up, it shuts on so close to the metathorax (cf. fig. I. 2), that from above only its nearly quadrangular head (*i. e.* the upper end) is visible; but when lowered, its head separates from the metathorax in proportion to the obliquity of its position (cf. fig. I. 3). When the pedicle is raised, the abdomen is lifted up aloft; in the other case it is depressed. The second joint of the node* (the second abdominal segment) is much broader, but much shorter, inserted obliquely into the first, and, seen from above, coroniform. On either side it is furnished with a small tuft of hairs. The body of the abdomen consists of four segments, and is shortly oval, somewhat broader than the head, bluntly rounded before and behind. The first segment, or third of the whole abdomen, is the largest; it is of the same length as the three following together. It is even; only furnished on the back with a faint longitudinal line, and on the hinder edge with a row of punctures and a circlet of hairs; the upper side is pretty thickly clothed with fine short pubescence. The second segment is decidedly shorter, quite smooth and naked, with only a narrow hairy band on the hinder edge, and the edge itself ciliated with longer hairs. The third and still shorter segment presents the same characters; the fourth only projects a very little.

The colour of the insect is a shining brown. The head is chestnut-brown; the fore part lighter, yellow-brown; the edge of the scutum and the fore-edge of the mandibles black. The eyes black, the ocelli whitish. The mesonotum is of the same colour as the head; the metanotum, on the contrary, lighter yellow-brown; the tibiæ and femora are brown, the tarsi and antennæ light yellow. The abdomen is shining; lighter in front, behind blackish-brown: the commencement of the first segment, and sometimes the (whole) first segment and fore-part of the second of the body of the abdomen are yellow-brown; the hinder segment, on the other hand, is dark brown or blackish; but the small last (segment) again lighter yellow-brown. In certain individuals, moreover, the whole body is a lighter brown

* Knötchen—here evidently means pedicle.—Tr.

than in the majority. The wings are hyaline, whitish, with yellowish veins.

2. *The Male.*

Fig. II. magnified ten times. As before mentioned, I found only a single example, which was moreover broken to pieces on the journey, the head and thorax only remaining perfect. In fig. II. 1, the dotted portion (the abdomen) is sketched merely from memory.

Length of the head $\frac{1}{4}$ of a line; of the thorax $\frac{5}{8}$; breadth of the same $\frac{1}{2}$ a line.

It is much smaller than the female, the length of the soldier, and of a coal-black colour; the legs only are light yellow, with however the coxæ and trochanters black. The head is small and nearly circular; its mandibles are small, scarcely perceptible; the palpi, on the other hand, are somewhat longer than in the female. The head is smooth, bearing in front the approximate antennæ; these are long, setaceous, and seventeen-jointed. The first joint is the thickest, the second of the same length, as also the 7–8 following; but thence they become gradually shorter, and more abruptly separated from each other; whence the last seven joints can be much more easily distinguished from one another than the first ten. All the joints (with the exception of the first and last) are cylindric and thickly pubescent. The thorax is considerably broader than the head, bluntly rounded anteriorly; the hinder edge of the mesonotum with a row of longitudinal excavations; the scutellum subtriangular, its edge also beset with impressed punctures; the abdomen oval. In the wings, the inner discoidal cell is larger than in the females. The legs are of finer make than in the females. The femur is thinner, the tibia proportionally longer (fig. II. 2). The hook at the fore part of the tibia (cf. fig. II. 3) is differently formed; it is curved, and also furnished on the inner side with a row of setæ, which are not however attached to a membranous flap (hautlappen*), and are not pectinate. The tarsus is much shorter than in the female; the first joint about the length of the second and third together; the second, third and fourth are of equal length; the fifth is thickened outwards, and with two sharp claws.

3. *The Labourer.*

Fig. IV.—IV. 1, the size of nature; IV. 2, magnified ten times.

Whole length $1\frac{1}{8}$ line; length of head $\frac{3}{8}$ line; breadth the same; length of thorax $\frac{1}{2}$ line, of abdomen $\frac{1}{4}$ line.

* "Hautrande" (membranous border) before, in description of the female.—Tr.

The head is somewhat larger than the abdomen; it is altogether shining, smooth, and naked. The point of insertion of the antennæ is also marked by a pretty deep groove, and the anterior border of the forehead likewise furnished with an impression; on the other hand, the striæ, which in the females as well as in the soldiers are perceived on the head, are wholly wanting. The mandibles (fig. IV. 3) are proportionably longer, but more attenuated at the base than in the female and soldier, acquiring thus a more slender form; the two teeth at the point are longer and much more acute, and the whole inner edge is set with a row of little teeth, varying in number between ten and twelve. These teeth are very regularly placed, and give a serrated appearance to the edge of the mandible. The teeth of both mandibles fit into each other, and make it intelligible how these little animals can hold and carry with their mandibles such considerable loads. The other parts of the mouth are formed as in the female. The antennæ (fig. IV. 4) are much longer in proportion than in the female and soldier; their shaft or pedicle extends conspicuously beyond the head, their base; in other respects their structure is the same. The ocelli are wanting.

The thorax is very narrow; the prothorax (the collar) is very finely granulated. The mesothorax is somewhat widened in the middle; it is quite smooth and shining; on the other hand, the scutellum and the metathorax are very finely granulated (only perceptible under the microscope), the latter furnished on each side with a small spine.

The legs are formed like those of the female, only much smaller (fig. IV. 5, 7); their tarsi are extremely fine, with however sharp claws, between which is seen a membranous lobe (fig. IV. 6). They are finely pubescent.

The second joint of the abdominal pedicle is proportionably longer and more slender than in the female; the abdomen itself very small and shortly oval. The first segment is about half the length of the whole, and is also much greater than the second.

The head is sometimes lighter, sometimes darker brown; the thorax, shaft of the antennæ, femur and tibia light yellow-brown; the flagellum of the antennæ and the tarsi light yellow. The shining abdomen chestnut-brown, lighter at the base and tip.

4. *The Soldier.*

Fig. III. 1, natural size; fig. III. 2 & 3, magnified ten times.

Whole length 2 lines; length of head $\frac{3}{4}$ of a line, breadth full $\frac{5}{8}$ line. Length of thorax $\frac{3}{4}$ line; of abdomen $\frac{1}{2}$ line, breadth the same.

Distinguished from the labourers by the head being twice as large, emarginate at the base and striated, by the shorter and stronger mandibles, which are not toothed on their inner edge, and by the somewhat larger abdomen.

The faintly pubescent head is of enormous size, and much more deeply emarginate at the base than in the female, so that it is nearly heart-shaped. A deep longitudinal furrow traverses it in the middle. The antennal clefts are pretty deep, being bordered anteriorly and towards the forehead by a rather strong prominent rim. The fore-part of the forehead has a deep impression like that of the female. The clypeus is very short, and divided from the head by a faint line. The upper side of the head is finely striated longitudinally, as in the female; these striæ become obsolete behind the middle of the head, so that its hinder part is quite smooth. The eyes are small, and the ocelli are wanting. The trophi are as in the female, as are also the mandibles, except that on their cutting edge stands a pair of very small obtuse denticles furnished with a bristle (fig. III. 4). The antennæ are as in the females; their shaft is much shorter than the head; the three last joints (fig. III. 6, 7) are distinctly separate.

The thorax is similarly formed as in the labourer, except that the mesothorax is much broader in the middle and bears on each side a little tubercle (Härchen) furnished with a bristle, by which structure it is distinguished both from the female and labourer. The scutellum is almost quadrangular; the hinder piece of the metanotum is armed on each side with a sharp spinule, and furnished in the middle with a longitudinal cleft. The whole thorax is sprinkled with scattered or distinct hairs. The legs are larger than in the labourer; otherwise they are of the same form.

The abdomen is much smaller than the head. The first joint of the pedicle is enlarged into a more prominent scale-like protuberance (furnished with a tuft of hairs) than in the labourer; the second joint, on the other hand, is shorter and thicker than in these, and approaches in form that of the female. The first segment of the abdomen is the largest; the second of about the same breadth, but shorter; the third rounded behind; the fourth is very small, and almost withdrawn into the preceding. It is quite smooth and shining, sparingly sprinkled with fine bristles, which at the hinder edge of each segment are longer and set closer together.

The head is sometimes lighter, sometimes darker brown; on the under side always lighter than on the upper. The edge of the clypeus and the anterior edge of the mandibles black; the antennæ and legs are light yellow; the thorax and abdominal pedicle somewhat lighter brown than the head; the abdomen at the base and tip of the same colour; the second and third segments, on the other hand, blackish-brown. At times the dark brown extends further, over even the hinder edge of the first segment; but still more frequently it is more contracted, forming only a dark band over the hinder edge of the second and the (whole of the) third segment.

III. *Conclusion.*

Comparing with each other these four different kinds which compose a colony of *Œcophthoræ*, we find that the males differ altogether from the rest in the structure of the head. The females, soldiers, and labourers approach each other closely in the structure of the parts of the mouth, in the legs, and in the equal number of the abdominal segments; yet the labourer differs much from the female, not only in being so much smaller, but by its smooth head, its serrato-dentate mandibles, different structure of the thorax, owing to the want of wings, as well as by the form of the second joint of the abdominal pedicle. In size, structure of the mandibles, and striated head, the soldier forms a middle link between the female and the labourer; but, on the other hand again, it differs much from both in its excessively large perfectly heart-shaped head, and in the shape of the mesothorax; assuming thus quite a peculiar aspect. These forms are very distinctly marked; and amongst the numberless specimens seen by me of this ant, no intermediate link between the labourer and soldier ever has occurred. In *Atta capitata*, Latr., which I have observed in great numbers on the Guadalquivir at Seville, as well as in several other places in Spain, labourers with small heads, and soldiers with large, occur also; but, between these, transitional forms are found, which is never the case with our *Œcophthora*. That the soldiers cannot possibly be slaves captured from other nests (a circumstance of known occurrence amongst the Amazon-ants), is proved as well by their very constant occurrence in the pupa and perfect state in the nests of the *Œcophthoræ*, whilst they are never found alone, as by their agreement in all essential organs (in their trophi, antennæ, and legs) with the labourers and females. Such a marked distinction between the two neuter forms as in *Œcophthora* has not elsewhere been observed. Something similar, however, seems to be the case in several species of the Southern Hemisphere, only it has not usually been rightly understood. We have seen above, that in the Train and Driver Ants two forms of neuters are found, and also in *Atta capitata*, Latr., which must not be considered as varieties, but as forms, each of which has its own special and peculiar position in the ant-œconomy. Nay, even amongst several of our own species, attentive observation points out two forms of labourers; for example, in *Formica herculeana*, L., and *F. pubescens*, F.; only the difference is not so striking as in the above-cited species. The same too with the Honey-bee; for in the same hive smaller and somewhat bigger labourers are found, of which, according to Huber, the former take care of the brood, the latter produce the wax.

At present it is generally held, that the neuters found amongst all these insects which live together in large families are imperfectly developed females; and one would be led to this view principally by the resemblance of the working-bees to the females (the so-called queens), as well as by the fact, deduced from certain experiments carried on with bees, that in many cases they can make queens out of working-bees' eggs. When indeed a comb full of eggs is introduced from another hive into one without a queen, this last can *sometimes* rear itself a new queen out of it; but this by no means always happens, and I have myself twice employed this method without any result, which shows that queens cannot certainly be reared from *all eggs* laid in the cells of working-bees. Amongst bees the labourer indeed is very like the queen; but with ants the difference is very great: in these, not only are the females much larger and winged, but they have an essentially differently formed thorax; so that it seems quite incomprehensible to me that merely the mode of nutriment should determine such different kinds of individuals, and that it should depend on the labourers whether a female or a labourer should proceed from the same egg. But the explanation is rendered still more difficult by the occurrence of a second form of neuters, differing again as much from the females as from the labourers. In this case we must therefore hold, that ants possess the means of rearing labourers out of some and soldiers out of other eggs,—which appears to us very improbable. Hence we are almost compelled to ascribe the distinction between the females, labourers, and soldiers, not to the skill of the ants in rearing them, but to an original difference; and consequently to admit, that not only in the male and female individuals, but also in the labourers and soldiers, the difference is congenital. This is borne out by the fact that biformed individuals, between labourers and males (cf. Entomologische Zeit. 1851, p. 295), have already been discovered, in which one half exactly represents the male, the other half the labourer; precisely like bisexual individuals in insects, between male and female. Were the neuters undeveloped females, we should not meet with forms like these, but we should rather have forms of transition between neuters and females, which however is never the case. Against this view it may be alleged, I am well aware, that in the animal kingdom only two constantly different kinds of individuals (male and female) are produced by the parent, to which all other aberrations can be reduced. But reference may here be made to the system of alternate generations, which reaches up into the class of insects (in the Aphides and the Psychidean genus *Talæporia*); and that amongst these, individuals are produced immediately from the female parent (the so-called nurses) which are quite different from the neuters. The neuter ants are to be compared with these; from which however they again recede, in never being capable of reproduction.

EXPLANATION OF PLATE III.

Representing the four different forms of *Œcophthora pusilla.*

Fig. I. The Female.—1. Natural size; 2. magnified ten times; 3. side-view; a^1. the *pronotum*; a^2. the side-piece of the *prothorax*; b^1. the *mesonotum*; b^2. the *scutellum*; b^3. the side-piece of the *mesothorax*; c^1. the first segment of the *metanotum*; c^2. the hinder segment of the same, with the spinules; *d*. the first joint of the abdominal pedicle; *e*. the second joint of the same; 4. the *labrum*; 5. the mandible; 6. the fore-leg; *b*. *tibia*; *c*. the pectinate hook; *d*. the tarsus; 7. the claws.

Fig. II. The Male.—1. Magnified ten times; 2. fore *tibia* with *tarsus*; 3. its hook, more highly magnified.

Fig. III. The Soldier.—1. Natural size; 2. ten times magnified; 3. side-view, in the attitude of gnawing a piece of meat; 4. mandible; 5. the rest of the *trophi*; *a*. *mentum*; *b*. *maxillæ*; b^1. the *stipes*; b^2. the palpus; b^3. the sheath; c^1. the tongue; c^2. its *palpi*; 6. the last four joints of the antennæ.

Fig. IV. The Labourer.—1. Natural size; 2. magnified ten times; 3. the mandibles; 4. the antennæ; 5. the fore-leg; 6. the claw-joint of the same; 7. the middle leg.

XXVIII.—*Notes on Permian Fossils*:—Palliobranchiata. By William King, Professor of Mineralogy and Geology in Queen's University, Ireland (Q. C. Galway); Corresponding Member of the Natural History and Medical Society of Dresden, &c.

(Concluded from p. 269.)

Family Rhynchonellidæ, Gray, 1848.

Genus Rhynchonella, Fischer de Waldheim.

In one of Mr. Davidson's usual valuable papers lately published*, he has been led to question the existence of the genus *Rhynchonella* during the Permian period. The query evidently has reference to the uncertainty hitherto prevailing as regards the

* "A few Remarks on the Brachiopoda," Ann. and Mag. of Nat. Hist. Dec. 1855.

generic position of the so-called *Terebratula Geinitziana* discovered by De Verneuil in the Permians of Russia*. This species, or rather a shell occurring in Germany first noticed by Geinitz†, and stated to be identical with it, has lately been placed in *Camarophoria*‡, though the original description given by M. de Verneuil is somewhat in favour of the Russian type being considered a *Rhynchonella*.

Mr. Davidson no doubt was led by his inherent cautiousness to query the Permian existence of *Rhynchonella* from the uncertainty named; but as this genus is well known to characterize both the Carboniferous and the Saliferous systems, this fact alone would have been considered of sufficient force *by some* to warrant their positively concluding that it existed during the Permian period.

Rhynchonella ? *Geinitziana* §, De Verneuil. Pl. XII. figs. 7–11.

It is only lately that any specimens of the German fossil, which Geinitz has referred to the present species, came under my observation; it required, however, but a very brief examination of them to feel convinced that they belong to an undoubted *Rhynchonella*, and a species unsurpassed either in beauty or histological interest. The specimens alluded to were obtained out of the dark-coloured Zechstein of Röpsen, one of the German localities famous for Permian fossils.

Confining ourselves to the species represented by the German specimens, there cannot be any doubt of its being a true *Rhynchonella*; as its large valve is furnished with two well-developed rostral plates, and the opposite or small valve with the usual median one. But what constitutes the peculiar interest of this shell is, that both valves are as distinctly and regularly perforated as those of any *Terebratulidæ*.

But I am assuming that the German specimens belong to the species *Rhynchonella Geinitziana*. Be this as it may, there is no doubt on my mind of their being the same as those procured by Dr. Geinitz at Gera, and identified by him in his 'Versteinerungen' (*loc. cit.*) with the Russian species named. I cannot help thinking, however, that they represent a different species. De Verneuil describes his shell as having its slightly elevated ribs "obsolete or completely effaced near the beak;" and Count Keyserling's testimony is to the same effect, representing them as "sehr obsolete ||;" but all the specimens from Röpsen, although

* Geology of Russia, vol. ii. pp. 83, 84, pl. 10. fig. 5 *a*, *b*.

† Die Versteinerungen des deutschen Zechsteingebirges, p. 12. pl. 4. fig. 41.

‡ Schauroth, Beitrag, 1854.

§ Geinitz, *loc. cit.*

|| Reise in das Petschora-Land, p. 241, 1846.

possessing about the same number of ribs as the Russian type, have the entire umbonal region of both valves distinctly ribbed; besides, the ribs appear to be more flattened. Moreover, I entertain a suspicion that in the Russian shell the small valve is decidedly more rounded posteriorly; and I am also led to suspect that its valves are not so obviously perforated,—a character which I think could not have escaped the observation of M. de Verneuil or Count Keyserling. However, for the present, I am content with having simply pointed out what I consider to be some important differences, leaving it for others to confirm or overthrow my suspicions.

The Röpsen shell is subpentagonal; and, compared with most species of the genus, it may be said to have slightly convex valves, both being only somewhat tumid posteriorly: the small valve, however, has its anterior half rather strongly elevated, and its sides sloping somewhat rapidly. The mesial sinus, or ridge, terminates in front without giving any very abrupt wave to the anterior margins: the wave is decided, but regular. The ribs amount to about four or five in the sinus, and nine or more on the lateral areas: they are broad, flat, evenly rounded, and separated from each other by a narrow, line-like sulcation. The rostral plates project forward about one-fourth the length of the shell, with rather a strong divarication. The median plate extends a little further along the small valve. The point of the umbone is sharp and somewhat projecting; and the foramen is small. The perforations are large, and separated from each other by an interspace about equalling twice their own diameter: they give the surface of the shell a finely granulated structure; and appear to decrease a little in size as they pass outwardly through the capillary fibres, which are exceedingly fine*. This interesting species has not yet been found out of Germany.

* In my 'Monograph' it is stated, that I noticed the existence of perforations in every species of *Rhynchonella*, as well as other Brachiopods, that had passed under my observation: hence I was led to make the statement —"in short, I doubt their absence in any Brachiopod whatever" (*op. cit.* p. 110, &c.). Dr. Carpenter, in his chapter "On the Intimate Structure of the Shells of Brachiopoda," appended to Mr. Davidson's 'Monograph' of British fossil species of this Class, having deemed it necessary to animadvert somewhat strongly on the above piece of scepticism (*vide op. cit.* pp. 31, 32 & 35—*notes*), I have been induced to make the following observations:—Although Dr. Carpenter's researches, as detailed in his "Report on the Microscopic Structure of Shells," published in the volume of the British Association Meeting for 1844, were generally considered as leading to most important results; yet it is well known that many regarded them as too initiative to be unreservedly accepted in all their totality. Not that Dr. Carpenter was in any respect to blame; for it was conceived, that fossilization had so obliterated the tissue of many shells as to render a detection of it an impossibility; and it was also conceived that some shells

Genus Camarophoria, King.

Camarophoria globulina, Phillips*.

The occurrence of this species in Germany has not yet been recorded except by Professor M'Coy, who states that he found numerous specimens of it from Glücksbrunn in Count Münster's collection (now in the Cambridge University Museum) under the manuscript name *Terebratula bisinuata*†.

Camarophoria multiplicata, King‡.

Schauroth records the occurrence of this species in the lower Permians of Germany, without, however, stating its locality. Geinitz represents two specimens in his 'Versteinerungen' (pl. 4. figs. 48, 49) apparently the same. M'Coy unites it with *C. Schlotheimi*; but I must still adhere to the opinion that both are specifically distinct on the grounds stated in my Monograph.

* King's Monograph, p. 120. pl. 7. figs. 22–25.
† British Palæozoic Fossils, p. 443.
‡ Monograph, p. 121. pl. 7. figs. 26–32, pl. 8. figs. 1–7.

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were more prone than others to become thus altered. In the genus *Rhynchonella*, it is true, no one had, that I am aware of, discovered any perforations; but after carefully examining a number of fossil species I was led to believe, that certain very minute dark points, which I observed here and there dispersed over the surface of their valves, were the remains of orifices belonging to extremely minute perforations. I may have been deceived as to the nature of much that my "Stanhope" revealed to me; but will any one absolutely say that I was so in all cases, now that it is known that perforations do indisputably exist in *Rhynchonella? Geinitziana*? A few words as to *Rhynchonella psittacea*—the only species, from its occurring in the recent state, that was likely to settle the question raised by my remarks. I did not examine this species; but I was acquainted with Dr. Carpenter's account of its histology, which account, since I am compelled to defend myself, I must say seemed to me a very faulty one. Had I been imbued with the same spirit which Dr. Carpenter manifested when writing his animadversions, I might have severely criticised it; but I valued his general observations too highly to indulge in any criticisms of the kind. Dr. Carpenter's description of the shell-tissue of *Rhynchonella psittacea* is so far from correct, that I naturally inferred he must have been equally in error in concluding it to be without perforations. Referring to Dr. Carpenter's first "Report," paragraphs 37 & 38, it will be seen that the tissue of this species is described as consisting of sharply folded "laminæ of extreme tenuity;" and it is stated that the "sharp foldings" produce an appearance as if the laminæ were "traversed by a very regular series of lines." In paragraph 36, this conformation is described as "a peculiar variety of the *plicated membranous* structure." Now I may be permitted to state that this is quite an erroneous description of the shell-tissue of *Rhynchonella psittacea*; since it does not consist of "laminæ of extreme tenuity" with "sharp foldings;" but of *closely packed fibres* precisely analogous to the "capillary fibres" or "fibrous tissue," noticed in my 'Monograph' as con-

Family Spiriferidæ, King, 1846.

Genus SPIRIFER, J. Sowerby.

Spirifer Permianus, King*.

Schauroth has found this well-marked species in the Zechstein dolomite of Pössneck: it is represented under fig. 6 in his 1st 'Beitrag.'

Genus MARTINIA, M'Coy.

Martinia Clannyana, King†.

This small species, which is extremely rare in the North of England, appears to be rather abundant in the Zechstein dolomite of Pössneck, where it was first discovered by Schauroth. It is noticed and figured by him in his 'Beitrag' of 1853. I procured from Dr. Krantz several examples, most of which are

* Monograph, p. 133. pl. 9. figs. 18–24.
† Monograph, p. 134. pl. 10. figs. 11–13.

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stituting the valves of those Brachiopods which I examined. Dr. Carpenter's own testimony, which appeared about seven or eight years after the publication of his first "Report," and three years subsequent to the appearance of my notices, will bear me out in the correction just made: "In all the recent *Terebratulidæ* and *Rhynchonellidæ*, and in all the fossil specimens of those groups, as well as of *Spiriferidæ*, *Strophomenidæ* and *Productidæ*, in which there is no indication of metamorphic action, the shell is found to consist of *flattened prisms, of considerable length, arranged parallel to each other with great regularity*" (vide chapter "On the Intimate Structure of the Shells of Brachiopoda," p. 25). The italicization of the concluding portion is my own. It is remarkable that Dr. Carpenter has nowhere, in the chapter from which the above extract has been taken, made the least allusion to "laminæ of extreme tenuity" with "sharp foldings;" nor has he at all acknowledged that others had previously discovered the so-called "flattened prisms" or "capillary fibres," as they are termed in my 'Monograph'! Surely, if my "*doubt*" as to the absence of perforations "in any Brachiopod whatever," warranted the ignoring of the little I have done in the matter, this ought not to have been the case with what has been done by the Vicomte D'Archiac, who undoubtedly was the first to signalize the "fibro-capillary structure" of the Palliobranchs (vide "Rapport sur les fossiles du Tourtia," in Mém. Soc. Géol. de France, 2 sér. vol. ii. 1847). A few days ago I felt myself justified in laying claim to this discovery; for, although I had heard that D'Archiac had written something on palliobranchiate histology, as noticed in the Appendix to my 'Monograph' (p. 244), yet I was not aware that he had ascertained the existence of the fibrous structure until only within the last few days. * * * But let me not forget to acknowledge that I was in error in doubting the absence of perforations "in any Brachiopod whatever:" the account which Dr. Carpenter has given of *Rhynchonella psittacea* in his late chapter is quite conclusive on this point; but I cannot help thinking, from their occurring in *R.? Geinitziana*, that perforations will yet be found in congeneric species supposed, or stated, to be without them.

nearly twice the size of the English specimens that have occurred to me: they show a very distinct area in the small valve, with a well-marked deltidial fissure: the deltidium of the large valve is also open. In my diagnosis, this species is described as "nearly smooth;" but two of the Pössneck specimens, particularly one of them, show the surface of the valves to have been crowded with very fine short inclined spines: when these are removed, the surface has very much the appearance of being perforated like some fossil Terebratulas.

Martinia Winchiana, King*.

Morris in his 'Catalogue of British Fossils,' 2nd ed., unites this species with the last, a step that would seem to be warranted by the spiniferous character just noticed. But the spines of the present species appear to be much coarser, judging from the very imperfect casts before me: further, the umbone of the large valve appears to be more incurved, and the area not so well defined. Schauroth figures a specimen from Pössneck, which he identifies with *Martinia Winchiana,* on account of its being covered with spines; but possibly it may be only a specimen of the last species—a suggestion I would make with less doubt if the figure did not show the umbone to be more incurved and the area less defined than in *M. Clannyana.*

Other Permian Palliobranchiata.

Spirifer alatus, Schlotheim.—This species is considered by many who have noticed it as being inseparable from the *S. undulatus* of Sowerby; but I would urge on those who entertain this view to study the young forms, particularly the specimens represented in my 'Monograph,' pl. 9. figs. 10 & 16, which I consider respectively as representing the young of these two species.

Spirifer multiplicatus, Sowerby, and *S. Jonesianus,* King.—Morris, I perceive, unites these species: perhaps he has had an opportunity of examining specimens which graduate them into each other. Neither species has yet been observed in Germany.

Epithyris elongata, Schlotheim. — Specimens occasionally occurring at Glücksbrunn show this to have been a prettily coloured species. Two specimens before me exhibit several dark bands, inter-radiating with others of a lighter colour almost continuously from the umbone to the margin, and increasing in width in their forward progress: in another the dark bands, reduced to mere lines, are only developed near the margins. In my 'Monograph' it is stated, that "Specimens from the carboniferous limestone of Bolland, often identified with *Tere-*

* Monograph, p. 135. pl. 10. figs. 14–17.

bratula hastata, are in no respect different from the ordinary forms of the present species" (*vide* p. 149). On again examining one of the Bolland specimens here referred to, having the nearest resemblance to *Epithyris elongata,* I perceive that the surface of both valves shows much stronger incremental breaks than I have ever seen displayed on any specimens of the Permian species: the valves, too, appear to be thicker.

Epithyris sufflata, Schlotheim.—I have elsewhere stated, that this species "appears to be identical with a shell found in the mountain limestone of Bolland, probably hitherto considered a variety of *E. sacculus*—a distinct, though closely allied species*." M'Coy supposes that the shell here referred to is identical with his *E. virgoides*†; but this is not the case. The Bolland specimen noticed under the last head as resembling *E. elongata* has more affinity to M'Coy's species. I have been led to re-examine the "shell found in the mountain limestone of Bolland," and I cannot but say, that it agrees most remarkably with some specimens of the Permian species, particularly the testiferous one represented under figure 7, pl. vii. of my 'Monograph.' On the other hand, there are specimens figured on the same plate closely approximating to true forms of *E. sacculus* in its mesial depression and emarginate front. The only difference I perceive between the Bolland shell alluded to and the Permian fossil quoted is, that on the former there are faint traces of a few longitudinal lines on the anterior half of the valves. I perceive nothing of the kind on any of the Permian forms, nor do I recognize any on normal specimens of *E. sacculus.* There appears to be no difference between them in their histological perforations.

I have retained the generic name proposed in my 'Monograph' for those *Terebratulidæ* resembling the two species just noticed, in having rostral plates and a shortish loop. Very few palæontologists appear to agree with me in this respect. I intended making some observations on the question; but as Mr. Davidson is now engaged on species belonging to the same group, to be published in the next part of his 'Monograph of British Fossil Brachiopoda,' and feeling confident that he has much important matter to make known as regards their interiors, I prefer deferring them until the appearance of his work. I may then be able to offer a decided opinion, either in favour of, or against, my former views.

Brachiopods appear, for the most part, to be confined to the lowest deposits of the Permian system. In the North of Eng-

* Monograph, p. 150. † British Palæozoic Fossils, p. 413.

land, scarcely any have been found in beds above what I have termed the "fossiliferous limestone;"—the fossils occurring in the higher members, namely the "brecciated and pseudo-brecciated," and the "crystalline and non-crystalline" limestones*, being principally Gasteropods and Lamellibranchs. The same remarkable fact appears to obtain in Germany; inasmuch as Brachiopods have rarely been noticed hitherto above the true Zechsteins, or dolomites; the overlying beds, namely Rauchwacke, &c., only containing species for the most part identical with fossils occurring in the uppermost North of England Permians†. The consideration of these facts induces me to place the magnesian limestones of Cultra and Tullyconnel in the upper part of the Permian system; as they contain no palliobranchiate fossils. I would likewise place the magnesian limestone of St. Bees' Head on the same parallel, Mr. Binney having discovered therein "casts of *Bakevellia, Schizodus,* and other shells"‡. The marls in the neighbourhood of Manchester, loaded with similar fossils, I am also disposed to consider as the equivalents of the upper synchronous Permians, whether in England or Germany.

Belmont, near Galway, Feb. 20, 1856.

EXPLANATION OF PLATE XII.

Fig. 1. *Productus Geinitzianus,* De Koninck. Large valve a little enlarged: from Gera. 2. Small valve.

Fig. 3. *Productus Schaurothianus,* King. Umbonal view of large valve: twice the natural size: from Röpsen. 4. Front view. 5. Small valve.

Fig. 6. ? *Aulosteges umbonillatus,* King. Interior of small valve, showing muscular impressions *a,* and reniform ditto *b*: a little enlarged. A gutta-percha impression of a specimen from Pössneck.

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* Monograph, Introduction, p. xvii.

† M. Robert Eisel, of Gera, son of Professor Eisel, informs me that *Productus Cancrini* (query, *Strophalosia Morrisiana,* var. *Humbletonensis*) occurs in the Grauer Mergelzechstein of that locality. This deposit, and the overlying Rauchwacke, &c., I consider to be equivalent to the brecciated, pseudo-brecciated, crystalline and non-crystalline limestones of the North of England. The former overlie the highly fossiliferous Zechsteins of Germany; and the latter repose on the English fossiliferous and compact limestones. The presence of a Brachiopod so high in the system, corresponds with the occasional occurrence of *Strophalosia Morrisiana* in the breccia of Claxheugh (*vide* 'Monograph,' p. 102); and it seems to be paralleled by the existence, lately made known by Professor Ramsay, of casts of a Strophalosia-like shell in the sandstones of Exhall, Warwickshire. These sandstones I am disposed to place much higher in the Permian system than Professor Ramsay seems to sanction (*vide* Quarterly Journal of the Geol. Soc., vol. xi. part 1. p. 198).

‡ *Vide* Memoir "On the Permian Beds of the North-West of England," in Mem. of the Lit. and Phil. Soc. of Manchester, vol. xii.

Fig. 7. *Rhynchonella* ? *Geinitziana*, De Verneuil. Umbonal valve: twice the natural size: from Röpsen. 8. Opposite valve. 9. Side view. 10. Rostral plates. 11. View of capillary fibres and perforations: highly magnified.

Table of all the known Permian PALLIOBRANCHIATA.

	Britain.	Germany.	Russia.
1. Lingula Credneri, *Geinitz*	*	*	...
2. Discina speluncaria, *Schlotheim*	*	*	...
3. Productus horridus, *J. Sowerby*	*	*	...
4. —— Leplayi, *De Verneuil*	...	*	*
5. —— Geinitzianus, *De Koninck*	...	*	...
6. —— Hemisphærium, *Kutorga*	...	...	*
7. —— Schaurothianus, *King*	...	*	...
8. Aulosteges variabilis, *Helmerson*	...	...	*
9. ? —— umbonillatus, *King*	*	*	...
10. Strophalosia excavata, *Geinitz*	*	*	...
11. —— Goldfussi, *Münster*	*	*	...
12. —— Cancrini, *De Verneuil*	...	? *	*
13. —— horrescens, *De Verneuil*	...	? *	*
14. —— Morrisiana, *King*	*	? *	...
15. —— var. ? Humbletonensis, *King*	*	*	...
16. —— var. ? Whitleyensis, *King*	*	...	...
17. —— parva, *King*	*	*	...
18. —— ? lamellosa, *Geinitz*	...	*	...
19. Chonetes ? sarcinulata, *Schlotheim*	...	...	*
20. Streptorhynchus pelargonatus, *Schlotheim*	*	*	...
21. Orthis ined., *Keyserling*	...	...	*
22. Rhynchonella Geinitziana, *De Verneuil*	...	...	*
23. —— ? id.	...	*	...
24. Camarophoria Schlotheimi, *Von Buch*	*	*	*
25. —— globulina, *Phillips*	*	*	...
26. —— superstes, *De Verneuil*	...	? *	*
27. —— multiplicata, *King*	*	*	...
28. Spirifer alatus, *Schlotheim*	*	*	...
29. —— undulatus, *Sowerby*	*	*	? *
30. —— Permianus, *King*	*	*	...
31. —— cristatus, *Schlotheim*	*	*	...
32. —— multiplicatus, *Sowerby*	*	...	...
33. —— ? Jonesianus, *King*	*	...	...
34. —— curvirostris, *De Verneuil*	...	...	*
35. —— Blassi, *De Verneuil*	...	...	*
36. —— rugulatus, *De Verneuil*	...	...	*
37. —— Schrenki, *Keyserling*	...	...	*
38. Martinia Clannyana, *King*	*	*	...
39. —— ? Winchiana, *King*	*	? *	...
40. Cleiothyris pectinifera, *J. de C. Sowerby*	*	*	*
41. —— Roissyi, *L'Eveillé*	...	...	*
42. Epithyris elongata, *Schlotheim*	*	*	*
43. —— sufflata, *Schlotheim*	*	*	*
44. —— Qualeni, *Fischer de Waldheim*	...	...	*
45. Thecidium productiforme, *Schauroth*	...	*	...

XXIX.—*Remarks on the Genera* Tanystoma, Nematura, *and* Anaulus. By W. H. Benson, Esq.

Mr. H. Adams having kindly brought to my notice the previous employment of the term *Tanystoma** for a genus of Coleoptera, and of *Nematura* for a genus of Birds, it appears advisable that fresh names should be given to those testaceous groups.

The term *Tanystoma* was assigned, in the February Number of the 'Annals' for the present year, to a curious Anostomatous form from Burmah. The designation *Hypselostoma*, having reference to the uplifted position of the mouth of the shell, is now substituted for the former appellation.

Nematura was described in 1836, in the 5th volume of the 'Journal of the Asiatic Society of Calcutta,' from the shell and animal of a single species, *N. Deltæ*, which I had found at low tide in the mud of the river Hooghly opposite to Calcutta. The genus has since that time been increased by several species, from other parts of the Eastern World, and some yet remain to be described. The name has been adopted, in systematic and other works, as referring to a genus of Testacea; but Fischer having first employed the term, in 1813, in another department of zoology, I propose to designate the shell as *Stenothyra*, a title expressive of the contracted structure of the aperture.

Pfeiffer's description of *Anaulus* in the 'Proc. Zool. Soc.' for 1855, p. 105, does not indicate the course of the canal or tube, which terminates in the outer portion of the double peristome in *A. bombycinus*, as well as in his new species *A. Lorraini*, from Pulo Penang, described in a paper read to the Zoological Society at a recent Meeting. In the latter species, the opening, at first sight, might be supposed to be altogether outside of the peristome, but on a closer inspection is found to be embraced by a portion of it. In both species the canal or tube is sutural and internal, and can be traced externally along the last whorl, at the extremity of which it ascends more rapidly in *A. Lorraini* than in the original species.

In a specimen of *A. Lorraini* I was unsuccessful in an attempt to penetrate the canal with a bristle; but in one of *A. bombycinus* I have succeeded in passing a hair, through the canal, into the concavity of the spire. Mr. H. Adams informs me that *Megalomastoma Chrysallis*, Pfr., is also an *Anaulus*, with a similar sutural tube, a fact which was ascertained from an accidental perforation at some distance from the aperture. He further stated that the anterior opening was partly concealed by the reflected portion of the peristome.

* Motschoulsky.

The use of the tube seems to be the preservation of a communication with the external air when the aperture is closed by the operculum. The following addition to Pfeiffer's description of *Anaulus* will be necessary:—

"Canali suturali interno profunde in caverna spiræ desinente, utrinque pervio."

Cheltenham, 13th March 1856.

XXX.—*New Researches in Vegetable Embryogeny.* By M. Tulasne*.

Dr. Hermann Schacht, a German phytotomist well known by numerous and important works, some months ago† allowed himself to be persuaded, that the doctrine of the generation of plants which he has embraced, namely that of M. Schleiden and the pollinists, was then peremptorily established and proved. His belief was founded upon some observations recently made by a young botanist of Berlin, M. T. Deecke, who, as was asserted, by an extremely fortunate dissection of the ovule of the *Pedicularis sylvatica,* had put it beyond a doubt, that the vegetable embryo is actually produced in the extremity of the pollen-tube itself, after the introduction of the latter into the embryonal sac. Two of the botanists most competent to judge of this difficult question, MM. Hugo von Mohl and W. Hofmeister ‡, have strongly protested against allowing the memoir and anatomical preparations of M. Deecke the demonstrative value which was attributed to them; and although their criticisms have called forth long replies from MM. Schacht and Deecke, supported upon new observations §, there would certainly be cause for astonishment if their confidence in the correctness of their opinions had not been somewhat shaken, and their conviction had really remained entire.

The passage of every creature from non-existence to existence, its entrance into life, is a phænomenon too mysterious for us to flatter ourselves that we shall ever be able to understand exactly all its circumstances. Nevertheless, as the questions at issue between M. Schleiden and his opponents are questions of fact, antecedent to any doctrinal interpretation, and capable of being judged by our eyes, we need not despair of some day seeing less diversity of opinion amongst the botanists who occupy themselves

* From the Comptes Rendus, Nov. 12, 1855, p. 790.

† See the 'Flora,' 1855, part 10.

‡ See Annales des Sciences Nat. 4 sér. iii. pp. 209 & 219.

§ 'Flora,' 1855, no. 29, and Botanische Zeitung of Berlin, Sept. 14 & 19.

with embryogeny. At present, far from the hopes of M. Schacht being realized, or nearly so, I think, that if all discussion with regard to the Horkelian theory must be closed, as he would have it, it is by the condemnation and definitive rejection of this theory, rather than by its undisputed admission into science. Now, more than ever, I feel certain that it is founded upon a mistake; upon that error in which I formerly shared for a moment, which consists in taking the suspensor of the embryo for the pollen-tube inserted in the embryonal sac. During the past summer I have made a great number of dissections to establish the correctness of the results which I published in 1849 in the 'Annales des Sciences Naturelles' (3 sér. xii.); my brother also has devoted considerable time to similar researches, and we have both always been perfectly convinced, that the embryo, whether sessile or stipitate, that is to say, whether provided or not with a suspensor, never, at any moment, had the least real organic continuity with the pollen-tube: the embryo-sac, which is often thickened at its micropylar extremity, receives the close contact of this tube externally (it is even sometimes lodged in a fold of its membrane), but still without ever being torn or perforated by it; then on its inner face, either opposite to, or at some distance from the extremity of this fecundating filament, it gives attachment to the embryo.

In the Labiatæ, which have especially furnished us with subjects for examination this year; in the Pansy, the Almond, the Sloe; in the Caryophyllaceæ, such as the Pinks, the *Holosteum umbellatum*, L., the *Cerastia*, &c.; in the Scrophularineæ, the Cruciferæ, the Fir-tree, and a multitude of other plants, the embryo adheres to the generative sac by a very broad circular base, below which it contracts more or less, and again dilates almost immediately. This base of the embryo, when seen in front, looks like a large aperture in the membrane of the sac; but this is only an appearance, notwithstanding the opposite opinion of MM. Schacht and Deecke, for it is not very difficult to ascertain, as I formerly showed, that the sac is completely closed and continuous where the nascent embryo is implanted upon it *. This fact is of great importance, and contributes not a little to gain the cause for the opponents of M. Schleiden. I add, that the basal disk of the embryo is frequently of much greater diameter than the pollen-filament, even when the extremity of the latter, as is often the case, is thickened and enlarged: this circumstance is not more favourable to the Horkelian theory than the absence of a perforation in the membrane of the sac, and

* See our memoir already quoted in the 'Annales des Sciences Naturelles,' 3 sér. t. xii. pl. 3–7, and especially pl. 5. fig. 10.

MM. Schacht and Deecke do not appear to have taken it into account.

Although amongst the gamopetalous plants with personate corollas, great dissimilarities separate the Scrophularineæ from the Labiatæ, if we consider especially the structure of the fruit and seed, yet the study of the ovule and of the generation of the embryo reveals analogies between these two families which cannot be mistaken. From the simplicity of its structure and the softness of its tissues, the ovule of the Labiatæ, which has hitherto been neglected by embryologists, is generally capable of easy dissection. As in most of the Scrophularineæ, the embryo-sac presents vesicular inflations and appendages of very various kinds both at its extremities and on the sides. The anterior inflation, or that near the micropyle, usually projects from the nucleus, and is sometimes sufficiently elongated even to pass the apex of the ovule; it is obovate and of middling size in *Lamium*; of the same form, but more developed, in the Motherwort (*Leonurus Cardiaca*); almost globular in various species of *Stachys, Nepeta* and *Teucrium*; of immense size, sac-like and often asymmetrical in *Betonica, Acinos vulgaris*, Pers., *Galeopsis* and *Dracocephalum*. Towards the middle of this cervical inflation is attached a tubular appendage, which is either short and simple (*Lamium, Stachys*), or very long, branched and spirally twisted (*Betonica*). The middle region of the embryonal sac is also usually furnished with a short lateral appendage (*Lamium, Galeopsis, Stachys*), or with a basal one, accompanied by long divergent tubes (*Dracocephalum peltatum*, L.). This same region alone is filled with the perispermic tissue, in the midst of which the nascent embryo is buried. The latter is always borne upon a long and very delicate suspensor, of the same form as in the Scrophularineæ, which is attached to the rounded apex of the sac; but as the very considerable increase of this embryoferous ampulla after fecundation often takes place asymmetrically, and especially at the expense of its lateral appendage, so as to divide it into two very unequal lobes, the suspensor may thus be seen fixed near the more or less deep notch which separates the latter, and consequently removed from the longitudinal axis of the ovule. The pollen-filaments are slender, but appear to be nearly solid, from the dense and very refractive matter with which they are filled. In order to penetrate into the cavities of the ovary, after having descended to the base of the style, they have to traverse the tissue of a portion of the gynobase; then meeting immediately with the funiculus of the upright ovule which exists in each compartment, they rise in the parenchyma of the funiculus itself and only quit it at the level of the micropyle,—hence they can only be seen free for a very short space. Several pollen-filaments often introduce themselves in this manner into each ovuliferous cell, but it cannot be so frequently proved that the micropyle of the ovule gives entrance to more than one of them. Their extremity which comes in contact with the embryo-sac is obtuse and scarcely inflated; it applies itself to the surface of the embryo-sac by twisting in various manners, or lodges itself in a shallow depression which it sometimes causes. The point of insertion of the suspensor of the embryo usually corresponds with the point of contact of the fecundating tube.

The suspensor in the Caryophyllaceæ is far from being of the same tenuity as in the Labiatæ; its diameter on the contrary is very considerable, and it is divided into several very unequal cells. It is attached by a broad base to the apex of the embryo-sac, and sometimes, as in *Alsine media*, L., for instance, is elongated in a remarkable manner at this point, without however quitting the sac, which appears rather to become intimately united with it. The pollen-filament of the Pinks is remarkably voluminous, and contracts such an adherence to the embryo-sac, that it easily resists the dragging inseparable from the dissection of the ovule; its extremity is often bifid, and then sits as it were astride upon the sac above the embryoferous disc. M. Schleiden's theory is here shown to be in fault in a most evident manner.

The unusual development of the suspensor towards the micropyle presented by *Stellaria media*, Sm., occurs also, but in a very exaggerated form, in the genus *Calendula*. In these plants, the suspensor, which is at first entirely enclosed in the embryo-sac, soon becomes formed of two distinct parts: one tubular, always enclosed and continuous with the nascent embryo; the other excessively inflated into an oval or elongated vesicle, the greater part of which is protruded from the sac. M. Schacht does not appear willing to admit that the suspensor may thus grow simultaneously in opposite directions at its two extremities. Would he therefore regard that of *Calendula* as a modified and metamorphosed pollen-filament? There is nothing, certainly, more improbable than such a metamorphosis.

The same author is also in the wrong in calling in the *Viola tricolor*, L., in support of his theory. Whenever we have been able in this plant to see the pollen-filament supporting its kneed extremity upon the embryonal sac, it has been manifest to us that it remained entirely out of the sac, that is to say, that between it and the more or less enlarged embryonal vesicle, the embryoferous membrane was always extended, in the form of an uninjured diaphragm.

The same circumstances may also be easily observed in *Helian-*

themum. Although very short, the suspensor, in these plants, bends in a remarkable manner in the middle, and is most frequently attached to the embryo-sac, beside the point touched externally by the twisted extremity of the pollen-tube.

XXXI.—*On the Tracheal System of Insects.* By Thos. Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

To the Editors of the Annals of Natural History.

Gentlemen,

May I request that you will allow me the favour to announce in your Journal the results of a series of minute dissections which I have recently performed on the *Tracheal System of Insects and Myriapods.* In consequence of a letter on this subject from the late Mr. Newport, published in the 'Annals' of last year, calling in question the accuracy of my statements, I have ever since felt anxious to repeat the observations upon which those statements were made. That I have now done, and with the utmost care. I find, that not only are the results then stated true in every particular, but that they fall far short of indicating the real distinction between the "membranous capillary tracheæ," and those larger trunks in which the "*spiral*" is visible. My recent studies enable me now to state—

1. That the "spiralled" or larger tracheæ are mere conduits, like arteries or veins, and have nothing to do with, take no part in, the ultimate act of respiration.

2. That this function (that is, the interchange of the gases concerned in the respiratory act) has its seat exclusively in the capillary membranous tracheæ.

3. That the peripheric or extreme distribution of the tracheal system is conformable in plan to that of a blood-vascular system; that is, the capillary or membranous tracheæ are always placed intermediately between larger trunks, the branches of which they serve to connect,—standing to the larger trunks in the same relation as the capillaries of a blood-vascular system do to arteries and veins.

4. That the tracheæ can be discovered, in no single instance, to end in cæcal terminations,—always in mutual inosculations.

5. That this anastomotic arrangement establishes a close similarity between the tracheal system of Insects, Myriapods, and the blood-vascular system of the Annulosa,—a homology first theoretically suggested by Mr. Huxley.

6. That the tracheal system, however, is distinguished from the blood system in two striking anatomical particulars: in the

former, the main trunks affect a bilateral position, those of the latter are dorso-abdominal; that, with one doubtful exception, the blood system is closed, while the tracheal system always (that of a few aquatic larvæ excepted) communicates by means of spiracles with the external atmosphere.

7. That the tracheal and blood systems of Insects come into conjunction *only* at the peripheric segments,—the main trunks of each observing separate courses.

8. That the periphery of the circulating fluid system of Insects is constructed in exact conformity with the Crustacean model, the blood flowing in *imparietal* channels, in and through which the capillary tracheæ are conducted, floating in the nutritive fluid.

I remain, Gentlemen,
Your obedient Servant,
THOMAS WILLIAMS, M.D.

BIBLIOGRAPHICAL NOTICES.

Insecta Maderensia; being an Account of the Insects of the Islands of the Madeiran Group. By T. VERNON WOLLASTON, M.A., F.L.S. London: 4to, pp. 634, plates 13.

SOME persons are singularly qualified for producing a work on the natural history of a country. To give one instance:—Otho Fabricius, a Danish clergyman, spent some years of his life in Greenland, and thus acquired an intimate knowledge of that Arctic land, which modern discovery begins to show must be an immense archipelago bound by one great band of ice. When he left Denmark, with but little knowledge of natural science, but ardently desirous of studying the works of Him, whose word "*ut Missionarius ordinatus, ab honoratissimo Collegio de cursu Evangelii promovendo,*" it was his calling to proclaim, Fabricius took with him, in 1768, that natural-history cyclopædia of the time, the 'Systema Naturæ' of Linnæus, and, urged by those who ordained him, to study Arctic natural history at his leisure hours, he returned in six years with great materials for a Physical, Geographical and Historical History of Greenland. In May 1779 he wrote the preface of a portion of this work, the 'Fauna Grœnlandica,' which was accordingly published next year, and the character of which may be best given in the words of Cuvier: "Ouvrage précieux par l'extrême exactitude des descriptions." It is the work of a diligent, observing man, limited by climate to a highly interesting, but comparatively narrow, field. He has but few books to distract him, and but few bibliographical researches to make.

Mr. Wollaston, though he went to a tropical climate, was singularly happy in having such an atmosphere as envelopes an ocean-girt island of limited size, 250 miles distant from a continent with a distractingly large fauna and flora. When he went, Mr. Wollaston was regarded by naturalists as one of our ablest entomologists. The more minute the *Coleopteron*, the more he seemed to love it; for beetles he searched the bogs and lakes and mountains of Ireland and Scotland, and surveyed his native land from Newcastle to the Chesil-bank—the said bank being a most prolific "field" under the eye of such an "explorer." Mr. Wollaston did not confine himself to collecting, neither did he leave the "minims of nature" to be determined, by comparison merely, with named specimens in the collections of friends or in the great museum of his country. He was a scholar and fond of books; a Cambridge M.A., with tastes like his, regards the Latin of Cicero and Tacitus, of Virgil, Horace and Juvenal, as pedantic when introduced into the technicalities of science, and so he looks with sympathy on the energetic, though often unclassical, language of men not generally trained in Halls. Like Gray of Pembroke, Mr. Wollaston, of Jesus College, was a naturalist by taste and by study. He "worked out" descriptions, and thus "served before the mast," before he tried to guide the ship. He was intimate with the structure of his little friends, and saw how wonderfully their hooks and spines and notches and hairs and lobes and appendages are adapted to the peculiar habits and "œconomy" of insects.

Hard study at college demanded relaxation, and his health induced him to seek it in a mild and distant climate. He was happy in knowing a clergyman long resident in Madeira and familiar with some departments of natural history, such as Fishes, Mollusks and Plants, with which he (Mr. Wollaston) was less acquainted, while this friend, the Rev. R. T. Lowe, having great local knowledge, directed him to many a favourite spot. Richly was Mr. Wollaston's teacher in Mollusca rewarded by his indefatigable pupil;—but we must refrain, and proceed to the work on the Coleoptera of Madeira.

The author went to Madeira three times, and so arranged his visits that he got collections in every month of the year. Having collected with the utmost zeal and preserved his treasures with the greatest care and neatness, he brought his insect collections to England, and commenced arranging and classifying them. He had not limited himself, as most British collectors do, to the Coleopterous productions of his native land, but had a knowledge as well as specimens of most of the Coleoptera, indigenous to Europe and the shores of the Mediterranean; in truth he had studied the faunæ of those lands which most closely resembled Madeira in their animal productions. Not wishing to anticipate any one, or to interfere with what had been done before, and which possibly, in the labyrinth and mazes of journals, might have escaped his notice, Mr. Wollaston visited the continental collections, and with great openness submitted his insect treasures to the sight of the various "spécialistes." Like Horace, too, he was in no hurry,—he could afford to wait; and though he did not literally adopt the Horatian maxim and keep his MS. for nine years, he made entomologists impatient, by his very carefulness. And at last the work is out. We might object to its size—*μέγα βιβλίον, κ.τ.λ.*—we could also say that he published so large a work at much too cheap a price, and its plates are printed on too thick paper, though beautifully made and toned; but the Madeira invalid could not hold even an octavo, so a sumptuous quarto is just as "get-at-able," and the collector, among the towering rocks of Madeira, would do well to have with him no pocket manual but one, for he will find it hard work to "carry" himself over much of the ground. The plates have the advantage of having been engraved by an able entomologist, Mr. F. Smith, from the fine drawings of Mr. Westwood, that walking cyclopædia of knowledge in Annulosa. The work is not a mere technical work,—it is filled with passages of great interest to the student of the geographical distribution of animals, and must ever form a prized volume in his library, from its completeness and its excellence. It is curious, too, to know that there is no Tiger-beetle in Madeira, though only a short distance from a continent which produces the *Manticora*, that largest of the family, the pale night-loving *Platychile*, the Algerine *Megacephala*, and perhaps fifty species of true *Cicindela*. It is strange to be told, that in an island with plenty of wood (Madeira *means* "woody") there is no *Buprestis**, and yet in Africa *Buprestidæ* of large size and endless variety, from hairy-tufted *Julodes* and felspar-reflecting *Sternocera*, to minute *Anthaxiæ* and *Agrili*, abound; Madagascar having a peculiar Buprestidous fauna of its own, full of rare magnificence. Africa is a land of *Elateridæ*, from the great *Tetralobus* and *Leptophyllus* with their leaf-plated antennæ, to the genera of smaller size, and yet but one "skip-jack" or "click-beetle" rewarded the assiduity of Mr. Wollaston, and he found that *Elater* in Porto Santo. Africa is the country of Goliath Beetles and of an endless variety of *Cetoniadæ*, which pasture on the sap and sugar and pollen of its flowery vegetation, but this family has only one representative in Madeira, and even that is a very doubtful native. In fact the number of Lamellicorns is so few, that it is strange to one, who would expect *Dynastidæ* and *Lucanidæ* in so tropical and so well-wooded a country. It seems to abound in *Curculionidæ*, and some of the genera of these "snouters" are peculiar to it, such as *Laparocerus*. Its *Heteromera*, its *Ptinidæ*, are abundant. Mr. Wollaston records 539 species of Coleoptera as found in Madeira. These species belong to 228 genera—upwards of 30 of which are not as yet recorded as occurring elsewhere. Of the 13 sections into which the order Coleoptera is subdivided, the *Rhynchophora*, as we have remarked, contain the largest number of species (110), whilst the *Hydradephaga* and *Eucerata* present the smallest, each of them numbering but 8. To Madeira proper belong 478 species, to Porto Santo 155, to the Dezerta Grande 77, to the Southern Dezerta 31, to the Ilheo Chão 23; or to employ Mr. Wollaston's words in another place, "If we choose to regard the Dezertas as one, the group will

* Mr. Wollaston, on a fourth visit, has detected a single species of *Agrilus*, and also one of the family *Pselaphidæ*; we may here say that we have often contemplated, with delight, the fine series of type specimens of "Insecta Maderensia" now preserved in the British Museum.

separate itself into 3 natural divisions; and we shall have, for Madeira proper 478, for the Dezertas 87, and for Porto Santo 155. Only 8 species have been hitherto discovered on *every* island of the cluster—nevertheless 10 more are *all but* universal (if indeed, as is probable, they are not so entirely)." We may transfer to our pages the following note on one of the prime rarities of the place, the highly interesting genus so aptly named *Deucalion* by its describer: a second species from the Salvages, remote rocks in the Atlantic, is described by the author at p. 433, from specimens obtained by his friend T. S. Leacock, Esq. of Funchal.

We may mention, that on an island almost antipodal to Madeira, Lord Howe's Island, the late able Naturalist of H.M.S. 'Herald,' Mr. John Macgillivray, found a third species (*D.? Wollastoni*, n. s.), or rather a species of a closely allied genus, which may prompt, to the mind of some geologist, an idea bearing on the great continent Atlantis, of which the lovely Madeira seems to be one of the few remnants above water. The following extract we copy from p. 430,—it contains all the remarks on *Deucalion*,—as likely to give the general reader some idea of the attractive nature of the book even to him:—

"There is no genus, perhaps, throughout all the Madeiran Coleoptera, more truly indigenous than *Deucalion*. Confined apparently, so far as these islands are concerned, to the remote and almost inaccessible ridges of the two southern Dezertas, it would seem to bid defiance to the most enthusiastic adventurer who would scale those dangerous heights. Its excessive rarity moreover, even when the localities are attained, must ever impart to it a peculiar value in the eyes of a naturalist; whilst its anomalous structure and sedentary mode of life * give it an additional interest in connexion with that ancient continent of which these ocean ruins, on which for so many ages it has been cut off, are the undoubted witnesses. Approximating in affinity to *Parmena* and *Dorcadion*, yet presenting a modification essentially its own, it becomes doubly important in a geographical point of view; and it was therefore with the greater pleasure that I lately received, from T. S. Leacock, Esq., of Funchal, a second representative from the distant rocks of the Salvages (midway between Madeira and the Canaries),—on which we may almost pronounce for certain that an entomologist had never before set foot. Differing widely in specific minutiæ, yet agreeing to an identity in everything generic, they offer conjointly the strongest evidence to the *quondam* existence of many subsidiary links (long since lost, and radiating in all probability from some intermediate type) during the

* "When we consider indeed the apterous nature of *Deucalion*, its subconnate elytra, and its attachment (at any rate in the larva state) to the interior of the stems of particular, local plants, or its retiring propensities within the crevices of rocks, we are at once struck with the conviction that, during the enormous interval of time which has elapsed since the mighty convulsions which rent asunder these regions terminated, it has probably never removed many yards from the weather-beaten ledges which it now inhabits."

period when the whole of these islands were portions (and perhaps very elevated ones) of a vast continuous land.

"In the details of their trophi the genera of this section of the *Eucerata* are so nearly similar, that we must not look, even in otherwise anomalous forms, for any very striking irregularities there. And yet the mouth is not altogether uncharacterized in *Deucalion*, since its laterally-rounded upper lip, long and acuminated palpi (the basal joint of which is broadly sinuated externally, as in *Blabinotus*), together with its unusually produced and deeply bilobed ligula, at once remove it from *Dorcadion*,—from which moreover its largely developed and exceedingly uneven prothorax (a hinder zone of which is suddenly constricted, as though by a wide and tightened belt, and is ribbed with *transverse* plaits), added to its curiously pitted and tubercular elytra, will still further serve to separate it. In some respects perhaps it is more akin to *Parmena* than to *Dorcadion*: nevertheless its comparatively gigantic size, and the contracted, plicate, posterior band of its (otherwise) greatly wrinkled prothorax, apart from the above-mentioned peculiarity of its elytral sculpture (one of the most remarkable features which it possesses), and its freedom from the dense elongated pile which is more or less evident in all the members of the former, will equally distinguish it from that group also.

"Amongst other singularities, a tendency (which I have likewise observed, occasionally, in the *Morimi*) to have one of their elytra a little shorter than the other is strongly indicated in the *Deucaliones*. Thus, of my two examples of the *D. Desertarum* one is very decidedly so constituted; and, out of eight of the *D. oceanicum* it is traceable in no less than three. Like many of their allies in this department of the Longicorns, they are gifted with the capability of making a grating or hissing noise,—the *modus operandi* in producing which (since I have not been able to meet with any explanation of it altogether satisfactory) I have taken some pains to investigate. The solution given by Mr. Westwood, in his admirable 'Introduction to the Modern Classification of Insects' (vol. i. p. 356), would seem to come nearest to the truth, but still it does not quite apply to the species under consideration,—which are moulded, thus far, on one and the same principle. Mr. Westwood states that the sound is generated by the friction of a polished portion of the *scutellum* against the edge of the prothoracic cavity. In *Deucalion, Parmena* and *Dorcadion*, however, there is a narrow space, in the shape of an isosceles triangle (the apex being turned towards the scutellum), which occupies *nearly the entire length* of the mesonotum, and which, from its brightness, appears at first sight to be perfectly smooth. When viewed however beneath the microscope, this longitudinal area is seen to be composed of very fine, transverse, parallel and acute ridges, closely set together after the manner of a file: and it is by depressing and raising the prothorax (an act which alternately exposes and re-covers the upper region of the *extremely cylindrical* mesothorax) that its under side is brought to play against this inner dorsal file,—by which process the stridulation is effected. In order to convince myself of the reality of this, I have relaxed many specimens of the genera in question, and have caused the sound artificially with the greatest ease.

"Hence, we can immediately appreciate the object of the broadly constricted basal margin of the prothorax of *Deucalion*, which is so regulated that it may present a more perfect and continuous surface to the mesothorax,—whilst, by being more tightly drawn as it were over that especial part, it is made likewise to grate more vigorously against the lower file. This transverse, coarctate ring is not expressed at all in *Dorcadion*, and it is but faintly suggested in a few of the *Parmenæ*: so that we should *à priori* have expected that the stridulating power of *Deucalion* would be more effectual than is there the case. And such, on inquiry, we find to be a fact: for so loud is the sound which the *D. Desertarum* is able to accomplish, that the only individual which has come under my notice in a recent state I heard at a considerable distance; and the second example as yet detected was described by the Rev. R. T. Lowe (who obtained it from the extreme summit of the Ilheo Bugio, or Southern Dezerta) as emitting a 'buzzing noise, somewhat resembling that of a Humblebee.' Everything indeed in this strange genus seems designed to give full effect to these, far from unmusical, inter-thoracic notes; for, in addition to the hinder contracted belt already mentioned, the pronotum of *Deucalion* is furnished with an exceedingly deep, rounded, postmedial fovea, which (since it projects beneath) must evidently form an extra instrument of impact to sweep over the mesothoracic file,—when its head (and, simultaneously, its prothorax) is by turns lowered and upraised. In the Salvagian representative this impression is less developed than in the Dezertan one; nevertheless it exists in them both,—conjointly with the other structural characters above enumerated.

"*Deucalion Desertarum*, Wollast.

"Apparently of the utmost rarity, the only two specimens which I have seen having been captured on the respective summits of the Middle and Southern Dezertas. The one from the former was taken by myself, during a week's sojourn in that desolate spot, with the Rev. W. J. Armitage, in January 1849. I extracted it from a crevice of an exposed weather-beaten peak (where it had secreted itself, in company with the *Scarites abbreviatus* and several species of *Helops*) at the immediate point where the great central heights commence to narrow into an almost perpendicular ridge nearly 2000 feet above the sea. Although I searched with the greatest diligence, I could not obtain more; nor indeed was I able to procure it during a subsequent encampment on the island, with the Rev. R. T. Lowe, at the end of May 1850,—even though I visited the identical crag and split open the fissures, both of it and of the hardened volcanic mud in all directions around it. The second example hitherto detected is from the still more perilous steeps of the Ilheo Bugio, or Southern Dezerta, and it is to the Rev. R. T. Lowe that we are indebted for this interesting contribution to the fauna of that almost unapproachable rock. Having, on the 3rd of July 1849, succeeded in reaching the summit, not without much difficulty and at the greatest peril (in the pursuit principally of land mollusca and plants), Mr. Lowe informs me that he met with it beneath a slab of stone, and that he was attracted (as already mentioned) by its remarkable, stridulating noise. So local indeed does this insect seem to be, that it, apparently, has not extended itself even over the Dezerta Grande (where there are no external obstacles to bar its progress); but retains the very position which in all probability constituted its original centre of dissemination at the remote period of time when this ancient continent received its allotted forms. Judging from the slowness with which creatures of such habits must necessarily (under any circumstances) be diffused, it is at least unlikely that the present one could have circulated far, when the now submerged portions of that region began to give way; and hence it is not impossible that the Southern Dezerta with the adjacent part (then united to it) of the Central one may have embraced the *whole area* of its actual primæval range,—the remains of which (though they be now separated by a channel) it still continues to occupy, and from which, even where physically unimpeded, it has never roamed."

We may also quote the following passage from p. 113—of general and great importance on the oft-mooted and much-disputed question of species; it occurs as a note to the description of *Olibrus bicolor*, and refers to the distinctions between it and *Olibrus liquidus*:—

"There can be no doubt but that the present insect and the following one approach each other very closely, and it is not without hesitation that I have treated them as separate. For some time indeed I had considered them to be but modifications of the *O. bicolor*; nevertheless a careful comparison of a very large series of specimens has subsequently induced me to believe that they are truly distinct, since there is no difficulty whatsoever in discriminating them in a general way, even though it is equally certain that about two examples out of every forty which I have examined are doubtful, and might apparently be referred to either. Still, the normal states are so clearly expressed that I cannot regard these occasional links as more than exceptional varieties from either side, and which would fall as unmistakeably into their proper spheres as any of the remainder, were we better able to grasp their exact characteristics, and to appreciate small shades of difference which are not the less real because obscure. Nor must we forget that in our ignorance of even the nature of 'species,' so called, we may sometimes err in attempting to define too rigidly the boundaries of their attributes; for, whilst, as a matter of course, we must unquestionably assume them to be absolutely unconnected (that is to say, to have descended from common parents,—each of their peculiar kind), yet it is difficult to assert positively that creatures which in outward points are thus intimately allied are of necessity *so* opposite in their endowments that they may not now and then intermix, and produce those very aberrations (albeit perhaps not able, themselves, to perpetuate their race) which we are apt to lay hold of, even when occurring thus sparingly, to destroy the specific claims of the insects which have accidentally given them birth. And I should frequently, therefore, be inclined to look upon such-like media as *lapsus naturæ* rather than as connective,—at any rate where they are only of rare experience and exist between forms the limits of which are otherwise clear and unambiguous. With these few remarks, which I have somewhat prolonged, as likely to apply in instances besides the present one, it will be sufficient to add that the *O. bicolor* (which, if my identification of it be correct, would appear to attain a rather larger size in Madeira than the ordinary type) may be distinguished, for the most part, from *O. liquidus*, not merely by its superior bulk, but by its less posteriorly-acuminated outline, by its usually just perceptibly darker and less brassy hue, and by its legs and antennæ being, almost invariably, both of a more diluted testaceous tinge and (proportionably) a trifle longer. It is an abundant insect, during the spring and summer months, in certain parts of Madeira, at rather low and intermediate elevations. In May of 1849, whilst encamped in the Ribeiro de Santa Luzia with the Rev. R. T. Lowe, I captured it in the utmost profusion from amongst the long grass and flowers immediately outside my tent,—and in company with the *O. liquidus*, which thus, at all events, cannot be a *local variety* of it."

The mere British collector who *studies* as well as *names* his insects should get this work, if he has not already got it, on account of the many valuable "clearings" and detailed descriptions of British genera. In this aspect the book is singularly valuable and important, and did space permit, we could refer to many passages in proof. We may perhaps hope to see the other orders described by Mr. Wollaston; and we trust that his present noble and costly contribution will not stand long alone, but will be followed by at least another volume, which will certainly never appear, unless its author be encouraged by the sale of this splendid volume, and unless, too, he conscientiously thinks, that he will be promoting the knowledge of the marvellous works of an Almighty hand. Such a work will then form, so far as the insect portion of the multitudinous Annulosa is concerned, *a point* for the historian of the geographical distribution of animals to reason on; and should Messrs. Lowe and Wollaston ever publish an illustrated volume on the Land Mollusca of Madeira, the zoologist and palæontologist will be supplied with data for reasoning on the extremely difficult but intensely interesting question of the "distribution" and what is called "extinction" of species. Insects, Crustacea—especially the Entomostraca—and Snails (Madeira is a Helico-metropolis) form certainly the most lasting animated features of any land; drought and other circumstances which destroy Mammalia, Birds, Fishes, Reptiles and other orders having hardly any perceptible influence on these enduring works of "Him, who made the worlds."

PROCEEDINGS OF LEARNED SOCIETIES.*

BOMBAY BRANCH ROYAL ASIATIC SOCIETY.

January 10, 1856.—W. E. Frere, Esq., C.S., President, in the Chair.

"Notes on the Infusoria of the Island of Bombay.—Organization." By H. J. Carter, Esq., Assistant-Surgeon H.C.S.

After a few prefatory observations respecting the necessity of studying the more simple, in order to understand the more complicated forms of living beings, the author premises that the freshwater Infusoria of the island of Bombay are, speaking generally, the same as those of Europe. He then observes, that, before communicating a summary of his notes on them, it is desirable that he should make a few observations on their organization, and adopt such terms as might facilitate his descriptions. The definition of these forms the subject-matter of his paper, of which the following is an abstract:—

Pellicula, or Skin.—This term is adopted for the surface-covering of Infusoria, which, with our present microscopic powers, appears to be nothing more than a consolidated portion of the subjacent substance. It has been proposed by Mohl for the surface of the starch-grain, &c., and the author extends its use to the Infusoria. Dujardin likened it to the film which occurs over "flour-paste or glue allowed to cool in the air." Although it cannot be demonstrated when the infusorium is fresh and active, to wit *Amœba*, yet when the latter becomes capsuled, its existence is rendered evident by transformation into the investing cyst.

Diaphane, or Transparent Moving Matter.—This is the colourless material on which the *pellicula* rests; it forms the outer zone of the infusorium, and is characterized in the *Amœbæ,* where its features are most evident, by possessing the transparency and structureless appearance of glass, with an amount of polymorphism unequalled by any other substance in organic creation. It is the agent of progression and prehension of food in those infusoria which are unprovided with cilia for this purpose. The term is derived from its transparency, and has been adopted by the author for convenience of description.

Sarcode, or Abdominal Mucus.—This is a molecular slime which fills the interior of the infusorium, and is characterized by its turbidity when compared with the glassy transparency of the diaphane. All the internal organs are imbedded in it, part of which are fixed and part moveable; it is also the receptacle of the food, which in the *Amœbæ* passes into, and out of it, directly through the diaphane, as they have no apertures of external communication for these purposes. Dujardin applied the term to "the glutinous substance of the interior," and to this the author wishes to restrict its use, adopting "*diaphane*" for the outer portion of the infusorium as above stated, which has heretofore been included under the head of "*sarcode.*" The central part of the *sarcode* appears to be the agent by which its "moveable" contents are rotated, while the outer surface appears to be attached to the diaphane, and follows its motions. In the Diatomeæ, the *sarcode* appears to be separated from the *diaphane* by the siliceous shield or frustule, as in a locomotive species of *Palmoglœa* met with by the author, where the cell-wall corresponds to the frustule, and in *Euglena*, where a layer of spiral fibre appears to be its analogue.

Moleculæ, or small grains.—With these the *sarcode* is completely charged. They are colourless and vary in size, being sometimes hardly visible, while at others they are uniformly large and unmistakeable. Of their use the author is ignorant, but for the sake of distinguishing them from the other organs of the *sarcode*, he has adopted the term above mentioned.

Granules, or large grains.—These are bodies of circular, elliptical, elongated or irregular figures. They are always few in number when compared with the *moleculæ*, and are characterized by their larger size, thick, dark edges, and colourless appearance, except in some Rhizopoda, where they bear a yellow substance like endochrome. They undergo rotation with the other contents of the *sarcode*, and never appear to be discharged. When *ovules* are present, as in *Amœba*, they are easily distinguished by the latter being discoid, circular, transparent at the margin, and generally nucleated. Of the use of the *granules* the author is also ignorant, but being sufficiently constant and remarkable to deserve particular notice, he has proposed this name for them.

Digestive Globules.—These are spherical spaces of the *sarcode* which are filled with food and water, or, sometimes, with water apparently alone. They are formed in a fold of the *pellicula* in *Amœba*, &c., and at the inner end of the buccal tube in *Paramecium aurelia* and *Vorticella*, &c., after which they pass into the midst of the *sarcode*, and are there rotated until their contents are digested and absorbed, or a part of one or both are discharged as unnecessary for nutrition. Where there is a buccal tube, the water and particles of food are forced down together through it, directly into the *sarcode* at its extremity, and here the *digestive globules* are formed, which afterwards pass off into the *sarcode* one after another gradually, like soap-bubbles from a pipe. Their contents then undergo digestion, and if not wholly absorbed, the rest passes out at a distinct anal orifice, which is situated on the surface in *Paramecium aurelia*, &c., and half-way up the buccal cavity in *Vorticella*. In the *Amœbæ*, &c., as before stated, there are no apertures of external communication of this kind, and no cilia; therefore the introduction of food is wholly effected by the *diaphane*. For these temporary stomachal dilatations of the *sarcode* the author has adopted the term above mentioned.

Spherical Cells, or Biliary Organisms.—These are spherical cells which abound in the *sarcode* of some of Ehrenberg's Trachelina, but more particularly in an infusorium of the same family which the author has called *Otostoma*, and in which they have been chiefly studied. They appear to undergo rapid multiplication and decay, and therefore are present in all stages of development. The most remarkable feature about them is, that the largest contain, among their granular contents, several smaller cells filled with a brownish-yellow fluid, which are set free when the parent perishes, and seem to serve some other purpose than that of reproduction. These *spherical cells* appear to the author to be biliary organisms, for they line the stomach of the binocular and blind *Planariæ*, where the large ones have a lash of from forty to fifty cilia projecting from one point of their circumference, which keep up a continued circulation of the gastric contents by their motion, like that observed in the Infusoria. Of the use of these organs, for which the author proposes the term "*spherical cells*," he is unacquainted, further than that there are many points about them which strikingly ally them to the hepatic cells of higher animals.

Vesicula, or "Contracting Vesicle."—This is a vesicular organ presenting a hyaline aspect which appears and disappears rhythmically. Its services are excretory, and in *Paramecium aurelia*, where it is double, each vesicle has a set of radiated lines round it, which lines extend across the body, and consist, respectively, of a chain of fusiform sinuses. In the Rhizopoda especially the *vesicula* obtains a great plurality, and in *Amœba*, sometimes, the *sarcode* appears to be filled with such vesicles, which not only now and then burst into the large one or *vesicula*, but when the latter has discharged itself, frequently burst of themselves externally. In *Paramecium aurelia*, &c., it is attached to the *pellicula*; it also bursts externally in *Amœba*; but in *Vorticella* it is attached to the buccal cavity, and discharges itself close to the anal orifice, as in some Rotifera; in *Astasia* it is close to the oral aperture and never disappears entirely, even if it diminishes now and then in size. It is a distinct organ in *Vorticella* and many of the Infusoria, perhaps so in all, and not a mere accidental dilatation of the *sarcode*. The term "*vesicula*" is proposed for it instead of "contracting vesicle," from the inconvenience of the latter in description.

Nucleus, or Primary Organ.—This is a circular, moon-like body (under the microscope), discoidal, and of a faint yellow colour. It is contained in a transparent capsule, and fixed in the periphery of the *sarcode* in the Rhizopoda, *Astasia, Euglena*, &c. In Ehrenberg's class of Enterodelous Infusoria it is for the most part of a different form. The presence of the capsule in *Amœba* causes it to appear as if surrounded by a narrow pellucid ring, but when the former becomes globular, the nucleus is observed to be fixed to one part of it. After a while the nucleus becomes granular and the capsule globular: it then also enlarges and undergoes deduplicative subdivision, the segments of which do not fall into the capsule, but burst through it, and appear in the form of a botryoidal mass on its periphery. When the granules, which each segment (now become discoid or spherical) contains, become endowed with locomotive power they separate, and make their exit through the proper covering of the segment, while in the body of the parent (which now perishes), or after the segment has left its cavity. At first the *nucleus* appears to be a presiding organ over the development of the cell, after the manner of the *nucleus* of the vegetable cell, but subsequently it takes on this, apparently, generative function.

Ovules. — These are discoid, nucleated cells in *Spongilla* and *Amœba*, but globular in the other freshwater Rhizopoda. The author first pointed out their nature and development in *Spongilla* in 1848, and a repetition of the experiments which led to this conclusion has been followed by the same results. In *Spongilla* they are contained in globular transparent vesicles in the seed-like body or capsule, and each of these globular vesicles, at an early period, has been found to possess all the characters of an *Amœba* in the same condition about to become capsuled; so that the seed-like bodies of *Spongilla* are but an aggregation of ova-bearing sponge-cells, enclosed under one common covering. In *Euglypha* the ovules are globular, and appear around the capsule of the nucleus, not inside it. At an early period, in *Spongilla* and *Amœba*, the *ovule* consists of a discoid, transparent capsule, lined with a film of semi-transparent matter, presenting a glairy, faint greenish-yellow colour; the latter afterwards becomes more opake and defined, and subsequently, in the course of development, may present a central pellucid circular area, in the midst of which is a minute, faint yellow body; the *sarcode* then becomes developed, its granules appear, and the *ovule* becomes more or less polymorphic, while the central body of the pellucid area seems to originate the nucleus. Such are the changes observed in the development of the ovule of the freshwater Rhizopoda. Similar ovules also occur in *Astasia* and in *Euglena*. When the capsule of the *nucleus* has been present in an *Amœba* filled with *ovules* far advanced, it has appeared enlarged, and the *nucleus* hardly perceptible or effete.

Spermatozoids?—This term is applied provisionally to the granules developed from the nucleus, for it not only would appear that in *Spongilla*, *Amœba* and *Euglypha* this development frequently occurs without the most distant sign of the presence of ovules, but in *Euglypha* it is seen to occur both separate and together; that is, the granular development is sometimes present when the ovules (all of the same size and five times the diameter of the granules) are also present around the capsule of the nucleus; so that if the granules passed into ovules, the latter might be expected to be present of different sizes, which in fact is the case in *Spongilla* and *Amœba*.

Impregnation. — Although the congress of two individuals in *Amœba* and *Euglypha* has frequently been seen by the author, yet it is not uncommon to witness three and sometimes four of the latter adhering together by the heads; and whatever bearing this may have on generation, the ovules and granular development of the nucleus are not preparatory to this act in *Euglypha*, but subsequent to it. Should these granules hereafter be found to have a fertilizing influence over the ovules, the process may be extended even to *Cladophora* among the filamentous Algæ, which, consisting merely of a layer of nucleated cells within one large cell, would not appear to require any more organs for reproduction than these cells themselves possess; and among the Diatomeæ and Desmidieæ and filamentous Algæ, such granules presenting a motion distinct from that of the molecules of Brown, are commonly seen, and have been thought by many to be reproductive organs.

In conclusion, the author adverted to the intimate resemblance which existed between the organisms of the animal and vegetable kingdoms at these parts of their scales respectively, insomuch that they would appear to diverge from one common point, at which would stand a being neither vegetable nor animal. *Spongilla* appeared very near this. The author had found that this organism, towards the end of the dry season, developes almost as much starch as plants, yet there is not a particle of starch to be found in the composition of its capsule and ovules. It subsists on nutrition brought into its cell through endosmosis, yet there is no trace of cellulose in its cell-wall. It is endowed with polymorphism; but the protoplasm of the cell in many plants, to say nothing of Algæ, has as much, though it cannot move beyond the cellulose covering in which it is incarcerated any more than the sponge-cell while the latter is enclosed *en masse* within the general *pellicula*. It is true that it possesses the *vesicula*, but Cohn has shown that this exists in even some of the swarm-cells of *Confervæ*. It is not impossible, from the great plurality of the *vesiculæ* in the Rhizopoda (in which class *Spongilla* should be included) and the activity with which they perform their peculiar function, that the excretory currents of the canals should be thus produced. Mr. Bowerbank had discovered cilia on them to assist in this office, but zoospores move about by the aid of cilia, and in the spore or macrogonidium of *Œdogonium* these are very numerous. The *granules* of *Spongilla* contain a yellow colouring material, like endochrome, and when *Spongilla* becomes green, it appears to be caused by a deepening of this colour. So that after all, the difference between the lower organisms of the animal and vegetable kingdoms becomes so slight, that, as Nägeli and Cohn have observed, chemical reagents alone can determine the point; and even then, the transition, in some of them, of one vital product into another during the cycle of their existence, makes them, according to this test, at one time a vegetable and at another time animal; until, it seems, that there must be a point at which both are equally combined.

ZOOLOGICAL SOCIETY.

January 23, 1855.—Dr. Gray, F.R.S., Vice-President, in the Chair.

Characters of six new species of the genus Thamnophilus. By Philip Lutley Sclater, M.A.

1. Thamnophilus transandeanus.

Supra niger; subtus albus; tectricibus alarum superioribus et caudæ inferioribus nigris albo terminatis; cauda nigra rectricibus duabus utrinque extimis macula parva terminali alba.

Long. tota 8·1, alæ 3·7, caudæ 3·2 poll.

Hab. in rep. Equatoriana, Guyaquil. Mus. Brit.

Obs. Similis *Thamnophilo majori*, sed tectricibus subcaudalibus nigris albo terminatis et rectricibus non albo guttatis.

2. THAMNOPHILUS LEUCHAUCHEN.

♂ *Pileo cristato cum lateribus capitis et gutture antico ad medium pectus nigris; nucha, cervice laterali et corpore subtus albis; dorso murino-brunneo; alis caudaque nigris albo limbatis; rectricis unæ utrinque extimæ pogonio externo medio et omnium apicibus albo maculatis; rostro et pedibus nigris.*

♀ *Crista ferruginea; subtus ochracea, gutture nigro striato, lateribus capitis et nucha ochraceis nigro mixtis.*

Long. tota 6·4, alæ 2·8, caudæ 2·5.

Hab. in Peruv. Orient., Chamicurros. Mus. P.L.S.

Obs. Affinis *Th. atricapillo*, Vieill., sed rostro minore, lateribus cervicis et corpore subtus albis neque cinereis, dorso clariore brunneo et gutturali nigro non in ventrem producto distinguendus.

3. THAMNOPHILUS ALBINUCHALIS.

♂ *Supra murino-brunneus; nucha late alba; dorsi medii pennis albo mixtis; capite summo cristato nigro; alis fuscis, tectricibus albo limbatis; cauda nigra, rectricum omnium apicibus et unæ utrinque extimæ margine externo albo maculatis; subtus albus; gutture et pectore antico nigris; capitis lateribus albo mixtis.*

♀ *Supra brunnescentior, capite et cauda tota rufo-ferrugineis; nucha et corpore infra ochraceis.*

Long. tota 6·5, alæ 3·2, caudæ 2·5.

Hab. in rep. Equatoriana, Guyaquil et insula Puna. Mus. Brit.

Obs. Species a *Thamnophilo atricapillo* nucha alba et colore corporis inferi albo nec schistaceo, a *Thamnophilo leuchauchene* dorso albo mixto, crassitie majore, et nucha candidiore distinguenda.

4. THAMNOPHILUS MELANONOTUS.

Niger; interscapularibus albo mixtis; dorso postico cinereo; abdomine cinerascenti-albo; alis nigris albo marginatis; cauda nigra, rectricibus omnibus apice et extima utrinque laterali etiam pogonio externo medio albo maculatis; rostro et pedibus nigris.

Long. tota 6·5, alæ 3·0, caudæ 2·5.

Hab. in Nova Grenada, Santa Martha. Mus. P.L.S.

Obs. Affinis *Thamnophilo atricapillo*, sed dorso nigro.

5. THAMNOPHILUS NIGROCINEREUS.

♂ *Cinereus, capite toto cum dorso summo et gutture nigris; interscapularibus basi albis; alis caudaque nigricantibus, albo limbatis; rectrice una utrinque extima media albo notata; rostro et pedibus nigris.*

♀ *Rufo-brunnea; gula et ventre medio albescentioribus; alarum tectricibus secondariisque et cauda sicut in mari albo notatis.*

Long. tota 5·75, alæ 3·8, caudæ 2·4.

Hab. in Brasilia boreali, Para. Mus. Brit. et P.L.S.

Obs. Similis *Th. nævio* sed multo major; rostro fortiore et gutture nigro.

6. THAMNOPHILUS CÆSIUS.

Lanius cæsius, Cuv. in Mus. Paris.

♂ *Nigro-plumbeus; pileo cristato gulaque nigris; tectricibus alaribus anguste albo limbatis; cauda nigricante unicolore; rostro pedibusque nigris.*

♀ *Grisescenti-brunnea, crista nigricante; capitis lateribus, tectricum alarum marginibus et corpore subtus rufis; rostro nigro, mandibula inferiore basi et pedibus pallidis.*

Long. tota 5·5, alæ 3·25, caudæ 2·25.

Hab. in Guiana Britannica. Mus. Parisiensi et P.L.S.

March 13.—Dr. Gray, F.R.S., Vice-President, in the Chair.

NOTES ON THE HABITS OF SOME INDIAN BIRDS. PART VIII. BY LIEUT. BURGESS.

Family STRUTHIONIDÆ.

Genus OTIS.

OTIS NIGRICEPS (Vigors). BLACK-HEADED BUSTARD.

This fine Bustard is found in flocks, varying in size, in the open plains of the Deccan, preferring the dry grassy and stony grounds to others. It grows to a large size; one fine male which I measured was 7 feet across the wings, and 46 inches from the tip of the beak to the end of the tail. This Bustard may almost be said to breed all the year round. I have had an egg brought to me in February, another on the 4th May, containing a young bird. A gentleman on the Revenue Survey told me that he had seen a young Bustard, covered with down, in the early part of October. I have had a young bird brought to me late in November, as well as eggs in November and December. The female generally lays but one egg. A. F. Davidson, Esq., Superintendent of the Ahmednuggur Revenue Survey, told me a curious habit of the male Bustard. He says, "About breeding time the male is fond of mounting some elevated spot, and then strutting about with the tail erected and spread, the wings drooping, and the pouch in the throat inflated with air, and looking like a large bladder; under the hillock where the male was thus displaying himself were several young ones." In corroboration of this, a boy told me on the 17th May 1850, that about four days previously he had seen a Bustard, with a white-looking bag hanging below the neck. I see in Dr. Jerdon's Catalogue, that he gives an extract from Mr. Elliot's notes to this effect; speaking of the cock Bustard, he says: "He was strutting about on some high ground, expanding his tail, ruffling his wings, and distending his neck and throat, making the feathers stand out like a ruff." I do not find it recorded that the large Bustard of Europe (*O. tarda*) has this habit of showing himself off during the breeding season. The egg of the Black-headed Bustard varies in size; the one sent with this paper measures $3\frac{3}{10}$ths in. in length, by $2\frac{3}{10}$ths in. in width. It also varies in colour; the general colour is a brownish olive, dashed with pale brown. One egg which I had was of a nearly uniform palish blue. The egg now sent was found in a grassy spot on 18th December. As everything relating to this noble bird is interesting, I give a description of a young one brought to me on 28th December 1849. It stood about 10 inches in height; its beak was of a dirty whitish colour, nostrils large; irides clear pale hazel, and eyes very large; back mottled, very much as in the old birds, as also the wing feathers; front of the neck pale yellowish-brown, with a dark streak running down the sides; legs dull yellowish-white, feet the same, knee-joints very thick; there was down on the neck. This was quite a young bird, very feeble on its legs, and barely able to stand. The Black-headed Bustard utters, when frightened, a harsh barking note. Its flight is like that of the Heron, a steady flight, sustained by the continued flapping of its large wings.

Otis Aurita (Lath.). Florikin.

I have not met with the Florikin sufficiently often to allow me to enter into the argument as to whether the Black Florikin is the male bird in its breeding plumage, or a distinct species from the common brown Florikin, but Dr. Jerdon's arguments in his "Illustrations of Indian Ornithology," appear conclusive, that the black and brown are one and the same bird in different states of plumage. But this point might soon be set at rest, by sportsmen and ornithologists in India ascertaining whether the black-plumaged birds are ever met with during the cold weather and spring. That the male of the Little Bustard (*Otis tetrax*) should to a certain extent assume this black plumage during the breeding season, affords strong ground for the supposition that the Black Florikin is the male in his nuptial dress. The Florikin breeds during the end of the monsoon, laying three eggs of a dark olive-green colour, spotted and dashed with light brown, $1\frac{9}{10}$ths in. in length, by $1\frac{5}{10}$ths in. in width, the greatest width being about the centre. The egg now sent was procured with two others early in September. An officer, who was out shooting, put up a Florikin and killed it, and on going to the spot where she rose, found three eggs. I had two specimens of the Florikin sent to me, both males, one in beautiful black plumage on 2nd October, the other in the brown plumage on the 4th February.

Family Columbidæ.

Genus Columba.

Columba œnas. Blue Pigeon.

This Pigeon is very common in the Deccan, inhabiting holes in old forts, walls, temples and wells. It breeds during the cold season, laying two white eggs. Holes and ledges in wells are its favourite resorts for breeding. The egg measures $1\frac{4}{10}$ths in. in length, by 1 inch and nearly $\frac{2}{10}$ths in width, and is of a clear shining white. An egg is sent with this paper; it was taken from a well on the 8th December.

Genus Turtur.

Turtur Cambayensis.

Of this Dove, Dr. Jerdon says in his notes,—"This little dove abounds over most of India, both in low jungles and near villages and cantonments, being found, especially towards the north, in every garden, and frequenting stable-yards, houses, &c." It is, I believe, the same as the small Dove to which—not knowing that it had been previously named—I gave the name of the Vinous-necked Turtle, on account of the colour of its neck. If this be the case, it breeds during the month of March, building its nest in low bushes, and laying two white eggs, rather more than $\frac{9}{10}$ths of an inch in length, by nearly $\frac{8}{10}$ths of an inch in breadth.

Turtur risoria.

This Dove is considerably larger than the last, and is easily distinguished by the white crescent on its neck, like the Wood Pigeon of this country. It abounds in every place; amongst the prickly-pear hedges and thickets near villages, in groves of babool trees, and bushes. Its half plaintive, half laughing note, is heard as soon as it becomes light, and if the trees over your tent happen to be its resort, it is anything but conducive to sleep. This Turtle breeds during the cold season, building in low babool trees; its nest is composed of a few twigs and pieces of grass. It lays two white eggs, $1\frac{2}{10}$ths in. in length, by rather more than $\frac{9}{10}$ths in width.

Order Grallatores.

Family Ardeadæ.

Genus Grus.

Subgenus Anthropoides (Vieillot).

Grus Virgo. Demoiselle Crane.

This Crane visits the Deccan during the cold weather, but sometimes remains as late as May. I saw a large flock of them on the river Seena, near Waterphul, as late as 24th May, and was told that one had been brought into the cantonments of Ahmednuggur as late as 12th June, but I never heard of any remaining to breed. It would be most interesting to find out their breeding haunts, their manner of nesting, and the number and colour of their eggs. The greater portion leave the Deccan at the end of March or beginning of April, and return at the end of November. They feed in the grain fields, retiring to the larger rivers about ten o'clock, where they may be seen standing in large flocks in the shallows.

Genus Ardea.

Subgenus Ardea.

Ardea cinerea (Lath.). Common Heron.

A tolerably common bird in the Deccan, frequenting tanks and rivers. I found two nests in a tall peepul tree on the 27th February;

one contained the egg sent with this paper, the other was a nest just finished, and contained no eggs. This bird is considered, I believe, to be identical with the English Heron; it most probably therefore lays four or five eggs, as Mr. Yarrell states that the English Heron does. The egg is a uniform sea-green colour, $2\frac{4}{10}$ths in. in length, by 1 inch and rather more than $\frac{7}{10}$ths in width.

MISCELLANEOUS.

On the Mode in which the Tachinæ *escape from their Pupa-cases and from closed situations in which they often occur.* By Dr. Reissig.

Amongst the phænomena of insect-life few things are more remarkable than the power possessed by soft, newly-developed flies, such as the *Tachinæ*, of breaking not only out of the hard larva-skin, but also out of the closed situations in which these are generally found, as, for instance, from the galleries and pupa-cells of *Saperda populnea* and *Cryptorhynchus lapathi* in wood, of *Tortrix resinana* in resinous galls, &c.

To explain this process it has often been supposed that the hardened larva-skin is softened by the insect when about to escape by means of fluid, or that the aperture was prepared by the larva before its change to the pupa state. The author however states, that according to his observations neither of these suppositions is correct; the margins of the aperture through which the fly escapes are evidently broken in a manner which could not be the case if the skin were softened by the agency of a fluid, and he was never able to detect any traces of a prepared means of exit. He has therefore come to the conclusion that the dried larva-skin is burst by the fly, and his observations have proved that this is done in the way which he describes as follows:—"The fly when about to escape can convert its head into a most wonderful apparatus, acting in the manner of a hydraulic press, and by this means not only burst its immediate envelope, but also overcome any obstacles which may lie in its way to the open air."

His observations were made on the following species of *Tachina*: *T. gilva*, Hrtg., from *Lophyrus pini*; *T. pilipennis*, Fall., from the resinous galls of *Tortrix resinana*; *T. flaviceps*, Rtzbg., from the pupæ of *Noctuæ*; *T. fera*, Linn., from the dried larva of *Noctua piniperda*, &c.; but especially upon *T. bimaculata*, Hrtg., from the cocoon of *Lophyrus pini*. His results are as follows:—

In *T. bimaculata* he first observed that both at the moment of its escape and for some time subsequently the fly possesses the power of converting the head into a nearly perfect globe, the diameter of which is considerably greater than that of the body.

The surface of the globe consists of the slightly translucent pergamentaceous skin, which is folded together very beautifully in the *Tachinæ* from the eyes to the mouth, and this is extended to the form described by a thin fluid.

The globe is so placed that the eyes form a solid part of it, and thus furnish a support for the whole apparatus.

Besides the two eyes the only visible external organs are: *a*. the last joints of the antennæ; *b*. the two horny, bowed palpiform organs of the mouth; and *c*. the proboscis. Everything else on the head, except the bristles of the antennæ and of the margins of the eyes, disappears, and all the visible organs exhibit a change of position. Thus the antennæ occur on the side of the globe opposite to the eyes, or quite in front. Only the last joint of each projects from the globular head, on the surface of which they form as it were a double hook directed downwards. They still however retain some power of movement, and the fly appears to employ them in various ways. The proboscis is directed obliquely backwards, below the eyes; it also retains some power of motion, and the fly can elongate or contract it at pleasure. It appears to be an important part of the apparatus, serving to press the globular head forwards, or rather to give it a firm support in the pressure which it exerts upon the obstacles before it.

The two horny palpiform organs which lie between the antennæ and the mouth are also of importance in these operations. They form a pair of hooks turned downwards and resting with their convex sides against the globular head, so that as this expands their extremities are pressed into the larva-skin, where they produce the commencement of the transverse cleft of the aperture, which is afterwards completed by the general expansion of the head.

Besides this transverse cleft in the larva-skin, there is usually a second crack running from the apex and dividing the cap which is thrown off, into two nearly equal portions: this is produced by the wedge-like action of the antennæ.

When the expansion of the head has reached its maximum, it is maintained for a few seconds, and then the head again contracts; but if it has not done its business sufficiently, it is again dilated until the desired result is obtained. In this way the author observed that a *Tachina* which he had enclosed in a narrow glass tube, tried more than a hundred times to expel the cork by the expansion of its head.

The expansion of the head commences by a prolongation of the front of the face between the angles of the eyes: this forms a conical point, having the antennæ at its apex. The object of this is sufficiently apparent: the fly can introduce this point into small holes and crevices in the obstacles which interpose between it and the open air; these are then enlarged by the globular expansion of the head, which is doubtless retained in its situation by the action of the antennæ.—*Wiegmann's Archiv*, xxi. p. 189.

On the apparent Absence of a Nervous System in the Nemoptera lusitanica. By M. Léon Dufour.

The author states that in examining numerous specimens of the *Nemoptera lusitanica*, a species of Neuropterous insect abundant in Spain and Portugal, he was unable to find any trace of a nervous system. The head when opened, instead of presenting a distinct brain or cephalic ganglia, only contained a small quantity of an amorphous and liquid pulp. In the thorax also, the large nerves passing into the femora could not be detected. M. Graells of Madrid was likewise unable to discover any traces either of ganglia or nerves.

M. Léon Dufour states that the tracheæ are not plentiful, so that the respiration cannot be very energetic, and the locomotive power of the animal is therefore small. In the structure of the alimentary organs, the *Nemoptera* differs from the *Panorpidæ*, in which family it has usually been placed, and M. Léon Dufour thinks that its food is of a fluid nature.—*Comptes Rendus*, Dec. 31, 1855, p. 1204.

METEOROLOGICAL OBSERVATIONS FOR FEB. 1856.

Chiswick.—February 1. Light clouds: frosty. 2. Cloudy. 3. Frosty: fine throughout. 4. Overcast: slight rain. 5. Very fine: boisterous at night. 6. Densely clouded: boisterous. 7. Uniformly overcast: rain. 8. Densely overcast: fine: cloudy. 9. Exceedingly fine. 10. Cloudy. 11. Foggy: rain: overcast. 12. Rain: fine: rain at night. 13. Rain: showery throughout. 14. Rain: fine. 15. Cloudy: very fine: foggy at night. 16. Foggy: very fine: foggy. 17. Hazy: overcast: foggy at night. 18. Overcast: slight snow. 19. Hazy: cold and raw. 20. Cloudy and cold throughout. 21. Slight rain: small hail occasionally. 22. Overcast: slight rain. 23. Fine throughout: cloudy at night. 24. Fine: overcast: clear and frosty. 25. Overcast throughout. 26. Cloudy: slight rain. 27. Overcast. 28. Very slight drizzle: overcast: cloudy. 29. Foggy: cloudy: frosty.

Mean temperature of the month	41°·54
Mean temperature of Feb. 1855	28 ·01
Mean temperature of Feb. for the last thirty years	38 ·71
Average amount of rain in Feb.	1·543 inch.

Boston.—Feb. 1—3. Fine. 4, 5. Cloudy. 6. Rain A.M. and P.M. 7, 8. Cloudy: rain A.M. 9. Cloudy. 10. Cloudy: rain A.M. 11. Cloudy: rain P.M. 12. Rain A.M. 13. Cloudy: rain P.M. 14, 15. Fine. 16—22. Cloudy. 23, 24. Fine. 25—28. Cloudy. 29. Foggy.

Sandwick Manse, Orkney.—Feb. 1. Cloudy A.M.: showers, thaw P.M. 2. Cloudy A.M.: fine P.M. 3. Fine, bright A.M.: fine, clear P.M. 4. Fine, cloudy A.M.: fine, clear P.M. 5. Fine, drops A.M.: fine, cloudy P.M. 6. Bright A.M.: rain P.M. 7. Bright A.M.: showers P.M. 8. Cloudy A.M. and P.M. 9. Drops A.M.: clear P.M. 10. Bright A.M.: clear, showers P.M. 11. Bright A.M.: clear, fine P.M. 12. Rain A.M.: showers P.M. 13. Bright A.M.: cloudy P.M. 14. Snow-showers A.M.: showers P.M. 15. Rain A.M.: cloudy P.M. 16. Drizzle, showers A.M.: drizzle P.M. 17. Damp A.M. and P.M. 18. Cloudy A.M. and P.M. 19. Cloudy, frost A.M.: clear, fine P.M. 20. Bright A.M.: cloudy, fine P.M. 21. Bright A.M.: clear P.M. 22. Bright A.M.: showers, clear P.M. 23. Bright A.M.: cloudy P.M. 24. Cloudy A.M.: clear P.M. 25. Rain A.M.: showers, clear, aurora P.M. 26. Cloudy A.M.: drizzle P.M. 27. Showers A.M.: fine, cloudy P.M. 28. Drizzle A.M.: damp P.M. 29. Cloudy A.M. and P.M.

Mean temperature of Feb. for previous twenty-nine years ...	38°·01
Mean temperature of this month	40 ·84
Mean temperature of Feb. 1855	31 ·64
Average quantity of rain in Feb. for fifteen previous years ...	3·25 inches.

The storm which raged so violently in the South of Scotland on the 6th and 7th did not reach Orkney or the North of Scotland, but again we had this month as well as during the gale of last month a great fall of the barometer, which stood at 28·49 on the 6th at midnight.

Society at CHISWICK, *near London;*
by Mr. Veall, *at* BOSTON; *and by the* Rev. C. Clouston, *at Sandwick Manse*, ORKNEY.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. Feb.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	30·136	30·051	29·81	29·93	29·84	38	29	25·5	37	38½	w.	w.	wnw.	......	......	·02
2.	30·001	29·968	29·66	29·85	29·91	38	28	29	35	35½	w.	nw.	se.	......	......	·36
3.	30·025	30·011	29·77	29·88	29·84	44	25	31	40	32	se.	se.	calm	......	......	......
4.	29·995	29·952	29·66	29·75	29·72	42	32	34	36½	36	sw.	s.	e.	·01	......	......
5.	30·137	30·093	29·74	29·68	29·42	52	41	36	42½	40½	sw.	ssw.	sse.	·02	......	......
● 6.	29·927	29·612	29·45	29·21	28·75	50	47	47	42½	36½	sw.	sw.	e.	·02	......	·05
7.	29·912	29·662	29·24	29·19	29·18	56	47	47·5	42	40	sw.	sw.	s.	·06	·10	·23
8.	30·038	29·986	29·50	29·34	29·45	50	45	47·5	46½	47	sw.	sw.	ssw.	......	·02	·16
9.	29·972	29·909	29·50	29·42	29·44	60	45	44	45½	44	sw.	sw.	w.	......	·03	·01
10.	29·962	29·923	29·60	29·62	29·75	54	41	46·5	44½	43	s.	sse.	wsw.	......	......	......
11.	29·861	29·810	29·50	29·78	29·81	53	42	46	44	40½	sw.	sw.	e.	·20	·15	·03
12.	29·737	29·375	29·31	29·73	29·60	50	43	47	40	38½	sw.	s.	e.	·05	·42	·09
☽ 13.	29·773	29·685	29·40	29·79	29·79	53	43	45	39	37	s.	s.	e.	·20	·02	·01
14.	29·739	29·709	29·30	29·58	29·51	54	40	47	35	36	sw.	ssw.	e.	·02	·26	·05
15.	29·773	29·726	29·34	29·60	29·77	55	32	41·5	37½	38	sw.	s.	e.	......	......	·71
16.	29·841	29·765	29·47	29·80	29·83	54	32	42·5	39	40	e.	s.	se.	......	......	·06
17.	29·843	29·831	29·58	29·85	29·94	43	34	41	43	40	e.	ese.	sse.	......	......	·28
18.	29·762	29·707	29·55	30·01	30·11	36	33	34	37	34½	e.	e.	ese.	·01	......	......
19.	29·867	29·753	29·54	30·16	30·17	42	32	35	35	31½	ne.	ne.	se.	......	......	......
20.	29·908	29·841	29·62	30·13	30·28	38	32	34	37	38	ne.	n.	calm	......	......	......
○ 21.	30·054	29·916	29·77	30·22	30·02	37	28	33	40½	41	ne.	ne.	wnw.	·01	......	......
22.	30·047	29·976	29·70	29·95	29·90	43	27	34	43½	43	nw.	nw.	wnw.	·01	......	......
23.	30·229	30·017	29·70	30·01	30·08	50	27	37·5	45	45	n.	w.	w.	......	......	·03
24.	30·458	30·362	30·00	30·12	30·16	50	25	36	45	42	sw.	w.	wsw.	......	......	·01
25.	30·467	30·406	30·07	29·88	29·81	47	41	41·5	44½	44½	sw.	w.	w.	......	......	·20
26.	30·369	30·314	29·87	29·94	30·06	57	45	47	46	45½	w.	sw.	w.	·01	......	·05
27.	30·473	30·394	29·99	30·18	30·18	51	42	47·5	46½	46	nw.	wnw.	sw.	......	......	·04
28.	30·183	30·463	30·10	30·22	30·36	49	36	47	47	45½	n.	sw.	wsw.	·01	......	·03
☾ 29.	30·590	30·473	30·13	30·40	30·45	52	28	40	48	45½	ne.	n.	sw.	......	......	......
Mean.	30·037	29·951	29·65	29·835	29·832	48·20	34·89	40·1	41·51	40·17				0·63	1·00	2·42

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 101. MAY 1856.

XXXII.—*On the British Species of* Arctium. By Charles C. Babington, M.A., F.R.S. &c.*

In a former paper (Ann. Nat. Hist. Ser. 1. iv. 253) I endeavoured to show that there were two well-marked species of *Arctium* inhabiting Britain, and then expressed an opinion that neither of them accorded well with the plants figured in 'English Botany.' The names applied to them in that paper were *A. Lappa* and *A. Bardana,* used in the belief that my plants corresponded with those so called by Linnæus and Willdenow. Since that period my attention has at intervals been directed to the genus, and specimens have been often seen that did not well accord with either of those species. A few years since I was favoured by my friend M. J. Lange of Copenhagen with a specimen of a plant called by him *A. intermedium,* and which he believes to be distinct from the described species. On the supposition that this accorded with a plant observed in Britain, and that it was nearly allied to what I had formerly named *A. Bardana,* it is placed in the 3rd edition of my 'Manual' as *A. minus β. intermedium,* and the *A. Bardana* of Smith is incorrectly referred to it. A careful re-examination of the plants has led me to the conclusion that throughout the whole of these researches I have been in error, and that the following remarks present a more correct view of the subject.

We appear to possess five well-marked species of *Arctium* in this country, namely *A. tomentosum, A. majus, A. intermedium, A. minus,* and *A. pubens,* the characters of which I now purpose endeavouring to point out. But before describing the plants it

* Read to the Edinburgh Botanical Society, March 13th, 1856.

is desirable to direct attention to the points upon which it seems probable that stress may be best laid. (1.) The arrangement of the heads presents an easy mode of separating two of the species from the others. This character must be used cautiously, for it is only the top of the central stem of the plant that is to be trusted: it and the branches often have the heads arranged in the same manner, but frequently the central stem bears a corymb and the branches racemes of heads. (2.) The form of the heads is of much value, and their size must not be neglected. (3.) Although the shape of the phyllaries is nearly the same in all the plants, their direction is a little different and the appearance of the heads is thereby changed. The inner row has not this uniformity of shape, but differs considerably in the several plants. These inner phyllaries are always bordered by a broadish membrane which sometimes increases in width towards the top, but in other cases narrows gradually to a rigid point. (4.) The florets consist of two parts, the upper of which is tubular nearly throughout. That part which is below the commencement of the free filaments is slender in all the species; the upper part is always much thicker, varies considerably in form, and its length bears different proportions to that of the lower part. (5.) The phyllaries either fall short of the florets or equal them. In the latter case the corolla alone is to be taken into account, for the anthers and styles are always much protruded.

It is proper to state here the reasons which have led me to retain the name of *Arctium* for this genus instead of following DeCandolle in employing it for the *A. lanuginosum* (Lam.). Linnæus in his first work (Syst. Nat. published in 1731) gave the name of *Arctium* to the plant called *Lappa* by Tournefort, and characterized it as early as the year 1737 (Gen. Pl.). In 1778 Lamarck transferred the name, under the form of *Arction*, to his *A. lanuginosum* without paying the least attention to its previous use by Linnæus, and applied the term *Lappa* to the Linnæan genus. It is doubtless true that the ante-Linnæan botanists did use *Lappa* as a generic name, but it has been well remarked by the Committee of the 'British Association for the Advancement of Science' appointed to consider the nomenclature of zoology, that "Linnæus was the first to attach a definite value to genera, and to give them a systematic character by means of exact definitions; and therefore, although the names used by previous authors may often be applied with propriety to modern genera, yet in such cases they acquire a new meaning and should be quoted on the authority of the first person who used them in this secondary sense" (Report Brit. Assoc. Manchester, 1842, p. 110). Applying this excellent rule, which is just as true in botany as in zoology, to the present case, we find that the Linnæan name has a priority of many years over that which Lamarck adopted from the ante-Linnæan Tournefort. That this was the view taken at the time is shown by the remarks of Villars (Pl. des Dauph. iii. 27) when continuing to use the name of *Berardia*, which he had given in his 'Prospectus' to the *A. lanuginosum* of Lamarck. There does not seem to be any reason for breaking the rule in this instance, for if it should be said that Tournefort's genera are well defined and therefore should not be rejected, then many more of his names ought to have been adopted in preference to those given by Linnæus.

1. *A. tomentosum* (Pers.); *heads subcorymbose long-stalked spherical* and closed in fruit much webbed (purplish), phyllaries falling short of the florets subulate, inner row longest and broad, *inflated upper part of florets* a little shorter than the lower part.

A. tomentosum, *Pers. Syn.* ii. 383 (1807); *Schkuhr, Handb.* iii. 29. t. 227.
A. Bardana, *Willd. Sp. Pl.* iii. 1632 (1800); *Eng. Bot.* t. 2478; *Fries, Nov. Fl. Suec.* ed. 2. 263.
A. Lappa β, *Linn. Fl. Suec.* ed. 2. 278, teste *Fries, l. c.*
A. Lappa, *Sven. Bot.* t. 63; *Fl. Dan.* t. 642.
Lappa tomentosa, *Lam. Dict.* i. 377 (1783); *All. Fl. Ped.* i. 144 (1785); *Gray, Brit. Pl.* ii. 434; *Lindl. Syn.* ed. 1. 154; *DeCand. Prod.* vi. 661; *Koch, Syn.* ed. 2. 463; *Gren. et Godr. Fl. Fr.* ii. 281; *Reichenb. Icon. Fl. Germ.* xv. t. 811; *Fl. Dan.* t. 2423.
Lappa major montana, capitulis tomentosis sive Arctium Dioscoridis, *Raii Syn.* ed. 3. 197. 4; *Pet. Brit. Pl.* t. 23. 6.

Stem and petioles slightly mealy and floccose. Stem 3 to 5 feet high. Leaves cordate-ovate; lowermost very large. Erect central stem and usually most of the branches ending in irregular corymbs of heads; but sometimes many of the branches have fewer heads with a racemose arrangement. Peduncles very long, but rarely a few of the lower heads have only short stalks. Heads large, usually covered with much cobweb-like hair; occasionally a plant with almost glabrous heads is found. Phyllaries purplish-green or greenish-purple, each with a small strongly hooked purplish-yellow rigid point; inner row broad and membranous even near to the end which is purple often quite blunt truncate or emarginate with a straight rigid excurrent nerve or rarely shortly subulate. Florets broadest just above the origin of the free filaments at which point they suddenly enlarge from a slender tube, become inflated and then narrow upwards, very persistent with the ripening fruit when they close the small space left between the ends of the converging phyllaries. Fruit dark brown with blackish blotches, nearly smooth.

It is probable that the long delay that has attended the acknowledgement by name of this plant by English botanists, although it was figured by Sowerby, may have been caused by its inhabiting the eastern districts of England, and being rarely, if ever, to be found in other parts of the country. Experience must prove or disprove this idea. The plant really represented in 'English Botany' not having been seen, any woolly-headed *Arctium* was called *A. Bardana.* The *A. minus,* which possesses many of the characters of *A. tomentosum,* being figured in the same work under the name of *A. Lappa,* the conclusion was arrived at that *A. Lappa* and *A. Bardana* formed only one species. For if tab. 2478 is a representation of the plant commonly called *A. Bardana* in England, then its difference from the specimens generally found and so named would show that there is so great a range of variation in the species as to render it highly probable that the *A. Lappa* of tab. 1228 is another of its states. If the true *A. Lappa* of Willdenow had been figured in that valuable work, no such idea would probably have arisen.

In most respects Sowerby's figure is an excellent representation of *A. tomentosum,* but the drawing was probably taken from a lateral branch, and the relative length of the phyllaries and florets (as shown in the dissected figure) does not appear to be correct. The inflated form of the floret is excellently shown.

The *A. Lappa* (Willd.) not being presented to the notice of our botanists, but that name given by Smith to *A. minus,* caused the erroneous conclusions that only a single variable species existed in Britain, and also, that there were no more species upon the European continent.

Although Fries informs us that the *A. minus* (Schkuhr) is the true *A. Lappa* α. of Linnæus, a statement confirmed by the specimen in his herbarium, still the var. β. (Linn.), which we know on the same excellent authority is the plant called *A. tomentosum* by Persoon and *A. Bardana* by Willdenow, is figured in the 'Svensk Botanik' (tab. 63) and 'Flora Danica' (tab. 643) as *A. Lappa.*

It is proper to direct attention to the fact that Gray (*l. c.*) and Lindley (*l. c.*) correctly identified the plant of Sowerby as *A. tomentosum,* but neither of them seems to have known that there are two other woolly-headed species in this country.

I have not observed this plant out of Cambridgeshire, but it is probably much more extensively distributed.

Flowering in August.

2. *A. majus* (Schkuhr); *heads* subcorymbose long-stalked *hemispherical* and open in fruit *glabrous* (green), phyllaries equalling or exceeding the florets subulate, inner row shorter than

the others, *subcylindrical upper part of florets* more than half as long as the lower part.

A. majus, *Schkuhr, Handb.* iii. 49; *Fries, Nov.* 264; *Wimm. et Grab. Fl. Siles.* iii. 105; *Bab. Man.* ed. 2. 182, ed. 3. 179.
A. Lappa, *Willd. Sp. Pl.* iii. 1631; *Bab. in Ann. Nat. Hist.* Ser. 1. iv. 254; *Man.* ed. 1. 171.
Lappa major, *DeCand. Prod.* vi. 661; *Koch, Syn.* 463; *Gren. et Godr.* ii. 280.
L. officinalis, *All. Fl. Ped.* i. 145; *Reichenb. Icon. Fl. Germ.* xv. 54. t. 812.
L. major Arcium Dioscoridis, *Raii Syn.* ed. 3. 197. 2.
L. major capitulo glabro maximo, *Dill. in Raii Syn.* ed. 3. 196. 1.
Burdock, *Pet. Engl. Pl.* t. 23. 1.

Stem and petioles finely mealy and rather floccose. Stem 3–4 feet high. Leaves cordate-ovate; lowermost very large. Central stem and usually most of the branches ending in irregular corymbs of heads; but sometimes many of the branches have fewer heads and a racemose arrangement of them. Peduncles very long, but occasionally a few of the lower heads are only shortly stalked. Heads very large, quite glabrous or with a very little cobweb-like hair in their youngest state; after the florets have fallen, which they seem to do at an early stage of the growth of the fruit, the head is quite flat and open at the top, often an inch across, and the involucre is almost exactly hemispherical with the outer phyllaries deflexed, the middle ones patent and the inner ones nearly erect. Phyllaries usually all green and subulate; their hooked points yellowish; inner row paler, less gradually subulate than the others but narrowing upwards until near to the point where it narrows quickly, scarcely converging over the fruit: the heads therefore do not appear to be constricted near the top as is the case in the other species. Florets very nearly cylindrical in their enlarged part, rather widening than contracting above the sudden enlargement, deciduous. Fruit yellowish, irregularly rugose.

This is usually not nearly so large a plant as *A. tomentosum*, although it often attains a very considerable size. It is conspicuous on account of its long branches and large heads, which latter much exceed in magnitude those of either of the other species.

The very long peduncles and corymbose heads distinguish it and the preceding from the three other species, but in estimating these characters attention should be paid to the heads forming the termination of the upright central stem of the plant; it has been already remarked that the branches do not always present the same arrangement of the heads. Difficulties may occur when neither *A. majus* nor *A. tomentosum* is known, or when only the lateral branches are examined, but when an intimate acquaintance has been obtained with either of them, it is nearly impossible that any doubt of the distinctness of those species can continue to exist.

The remarks to be found under *A. tomentosum* have shown how differently the name *A. Lappa* has been applied by botanical writers; three out of our five species having been so called. It is therefore desirable that the use of it should cease. It also appears from the remarks of Fries (Nov. 263), that the *A. majus* was certainly not the typical *A. Lappa* of Linnæus; the name therefore cannot be properly employed to designate this plant.

The figure given by Tournefort to illustrate his genus *Lappa* rather represents a head of the *A. tomentosum* than of *A. majus* of this paper. The head named *L. major* by Gaertner is more like my *A. minus*.

A. majus is probably generally distributed in Britain, flowering in August.

My specimens are from Grosmont, Monmouthshire; Mordiford, Herefordshire; Bluntisham, Hunts; Clonakilty, Cork. I have seen it in several other places, but unfortunately my notes concerning them have been lost.

3. *A. intermedium* (Lange); *heads racemose subsessile ovate* closed in fruit slightly webbed, phyllaries equalling or exceeding the florets subulate, inner row lanceolate shorter than the others, subcylindrical upper part of the florets equalling the lower part.

A. intermedium, *Lange, MS. in Herb. Bab. et litt.*; '*Flora of Denmark*;' *Reichenb. fil. in Icon. Fl. Germ.* xv. 54. t. 812.

Stem and petioles floccose. Stem 3–4 feet high. Leaves roundish-cordate, lowermost large. Central stem usually (?) nodding and as well as the branches furnished with many nearly sessile heads arranged in a racemose manner; ending in three heads placed close together. Heads moderately large, narrower than those of *A. majus*, but appearing long from the ascending direction of most of the phyllaries, usually slightly webbed. Phyllaries purplish-green and subulate; their hooked points purplish-yellow; inner row purple at the end, lanceolate acute. Florets cylindrical in their upper half, much resembling those of *A. majus* but with different proportions, apparently persistent. I have not seen the fruit.

This plant may be known from all the others by having its heads nearly sessile; *each branch usually ending in a cluster of three heads.* Its leaves are apparently shorter in proportion to their width. It is distinguished from the following plant by possessing much larger ovate (not spherical and stalked) heads; from *A. pubens* by its closed and nearly sessile heads; from the two preceding by the racemose arrangement of the heads even at the top of the primary stem.

Its distribution is unknown to me, with the exception that I have gathered it near Berwick-upon-Tweed, and Mr. Newbould at Hope in Derbyshire. Mr. Baker states (Suppl. to the Fl. of Yorkshire, 85) that he finds it frequently in Yorkshire, but I have not seen any specimens of his plant.

It flowers in August, but, like all the other species, may sometimes be found in that state in July.

As I do not know that M. Lange has published the characters of his plant, it appears to be desirable to insert the following extract from his letter, dated March 1849:—

" *A. intermedium* calath.: adultis ovatis, squamis exterioribus subulatis viridibus apice stramineis interioribus lanceolatis apice purpureis. It is the highest of all the species. Plant fresh green. Stem and head purple brown tinged, the heads doubly greater than the little form (*A. minus*). It grows principally in woods.

" *A. minus* calath.: adultis depresso-globosis, squamis omnibus subulatis cano-viridibus exterioribus apice stramineis. The plant low, pale and grayish green. Open ground."

It is probable that similar characters to the above are to be found in that botanist's 'Danish Flora,' which I have not seen, and which is written in the language of Denmark.

4. *A. minus* (Schkuhr); *heads racemose* shortly stalked *spherical* slightly contracted at the mouth in fruit slightly webbed (greenish), *phyllaries* falling *short of the florets* subulate, inner row equalling the others, *subcylindrical upper part of the florets* about equalling the lower part.

A. minus, *Schk. Handb.* iii. 49; *Fries, Nov.* 263.
A. Lappa *α*, *Linn. Fl. Suec.* ed. 2. 277, teste *Fries.*
A. Lappa, *Curt. Fl. Lond.* ii. 173; *Eng. Bot.* t. 1228.
Lappa minor, *DeCand. Fl. Fr.* iv. 77; *Koch, Syn.* 463; *Gren. et Godr. Fl. Fr.* ii. 280; *Reichenb. Icon. Fl. Germ.* xv. 53. t. 811.
Lappa major capitulis parvis glabris, *Dill. in Raii Syn.* 197. 3.
Lappa major montana, capitulis minoribus, rotundioribus et magis tomentosis, *Raii Syn.* 197. 5.
Small-headed Burdock, *Pet.* 23. 3.
Small woolly-headed Burdock, *Pet.* 23. 4.

Stem and petioles finely mealy. A smaller plant than either of the preceding. Central stem usually nodding and as well as the branches producing scattered shortly stalked heads forming an irregular raceme, on the lower or later branches the heads are often nearly sessile; the terminal head solitary. Heads about half the size of those of the preceding species and greener than in it; the amount of web very variable. Phyllaries green, sometimes slightly tinged with purple; the hooked points yellow; inner row purple at the end, gradually narrowed into a rigid subulate point but not hooked, alone converging over the fruit; the others mostly patent or a few of the outer ones deflexed. Fruit fuscous with black blotches, rugose towards the top.

The small spherical heads of this plant, about the size of a hazel-nut, readily distinguish it from *A. intermedium*; as do their size, their short stalks, and their racemose arrangement even upon the central inclined stem, from *A. tomentosum*. The very large corymbosely arranged heads of *A. majus* clearly point out that plant as distinct from *A. minus*. The much larger hemispherical and long-stalked heads separate *A. pubens* from it.

Although the typical state of *A. minus* is very different from *A. tomentosum*, it is difficult to find any character by which they may be at all times certainly distinguished. There is a difference in the shape of the florets: those of *A. minus* although thick in their upper part do not enlarge so suddenly as those of *A. tomentosum*, nor do they contract upwards as in it. It is probable that *A. minus* never has corymbosely arranged heads; that they are always small and shortly stalked; that the florets are deciduous so as to leave the tops of the fruits uncovered: that *A. tomentosum* always has its central stem erect and corymbose, although the branches have the heads arranged in racemes; that the heads are usually large and those in the corymb have long stalks; that the florets are usually so persistent as to hide the ripening fruit; that the phyllaries of the innermost row are usually almost wholly membranous and blunt with an excurrent midrib.

A. minus is probably common, but the distribution of all the species requires to be carefully determined.

My specimens are from Madingley, Cambridgeshire; Stoneleigh, Warwickshire; Mordiford, Herefordshire; St. Aubin's, Jersey; and I have ascertained that it grows near Saffron Walden, Essex; Bluntisham, Hunts; Buntingford, Herts; and Swansea, Glamorgan.

Note.—The *A. Bardana* of my former paper (Ann. Nat. Hist. Ser. 1. iv. 255) includes *A. tomentosum* and *A. minus*.

5. *A. pubens*; *heads subracemose stalked hemispherical* and open in fruit much webbed (green); phyllaries equalling the florets

subulate, *inner row equalling the others* and gradually *subulate*, subcylindrical upper part of the florets equalling the lower part.

Stem and petioles thickly clothed with short jointed hairs which shrink into a coarse mealiness. Stem 3 feet high. Leaves large, ovate, lowermost cordate-ovate. The central stem erect, and the branches, ending in irregular racemes of heads. Peduncles rather long, those of the lower heads the longest. Heads as large as those of *A. tomentosum*, much webbed when young but losing much of the web (as is usually the case with the other webbed species) as they advance towards fruit, ultimately appearing to be nearly naked. Phyllaries green, each with a purple-yellow hook; inner row narrowing upwards but rather membranous, purple at the end. Florets very nearly cylindrical in the enlarged part, persistent but not closing the large space between the nearly upright inner phyllaries. Fruit dark brown, very rugose and with a few paler spots towards the top.

I am unable to place this plant satisfactorily under any of the published species, and think that it is distinct from them. It differs from *A. tomentosum* by its subracemose heads with shorter stalks of which *the lower are the longest*, heads hemispherical and open in fruit, inner phyllaries equalling the others and not widened upwards, upper part of the florets not inflated nor broadest at the base: from *A. majus* by its subracemose much webbed heads, inner phyllaries equalling the others, upper part equalling the lower part of the florets: from *A. intermedium* by its hemispherical open heads of fruit upon rather long stalks and the inner phyllaries equalling the others: from *A. minus* by its heads being twice as large, hemispherical and on longish stalks, and the phyllaries equalling the florets.

It is more pubescent than either of the others from having much more numerous and longer jointed hairs upon its stem and leaf-stalks.

The plant is probably not uncommon. I find it in several places in Cambridgeshire, am indebted to Mr. Kirk for specimens found by him at Fillingley and Kenilworth in Warwickshire, to the Rev. W. W. Newbould for some gathered by him at Ecclesall near Sheffield, and observed it myself in the valley of Llanberis in North Wales in August 1855.

Flowering in August.

XXXIII.—*List of the Mollusca observed between Drontheim and the North Cape.* By R. M'Andrew, Esq., F.L.S., and L. Barrett, Esq., F.G.S.

Our observations extended along 700 miles of coast, 300 of which were south and 400 north of the arctic circle, and from the littoral zone to a depth of 200 fathoms. The opportunities for dredging were most favourable, the coast being protected from the Atlantic swell by the numerous islands to the seaward; and the deeply indented fiords supplying many secure anchorages and sheltered dredging grounds. In the following lists the Norwegian distribution of each species is given, the coast being divided into three provinces, so that the extreme southern limit of the arctic species, and the northern limit of the southern species, can be more correctly ascertained.

Gasteropoda.

We met with 103 species of this class; of these 91 belong to the order Prosobranchiata, and 12 to the Opisthobranchiata. The smaller species were extremely abundant, but the larger species of *Buccinum* and *Fusus* were seldom met with.

Prosobranchiata.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
Cancellaria, *Lam.*					
viridula, *O. Fabr.*	30-150	30-150	gravel, sand.	r.	Nord., Fin.
Trichotropis, *Brod.*					
borealis, *Sow.*	5-150	5-100	laminaria, gravel.	a.	Dront., Nord., Fin.
Fusus, *Lam.*					
propinquus, *Alder*......	150	......	sand.	r.	Fin.
antiquus, *L.*	8-70	8-40	gravel, mud, sand.	a.	Dront., Nord., Fin.
islandicus, *Chemn*.......	30-50	......	sand, gravel.	r.	Fin.
norvegicus (young) ...	100	......	sand.	......	Fin.
Trophon, *Montf.*					
clathratus, *L.*	10-100	16-100	gravel, sand, nullip.	a.	Nord., Fin.
Gunneri, *Lovén*.........	8-150	8-150	nullip., weed, gravel	a.	Dront., Nord., Fin.
Barvicensis? *Johnst.*...	70-160	70	gravel.	v. r.	Fin.

Note.—The figures in the first column of this and the following pages indicate the extent of the range at which the species was met with, whether alive or dead; in the second, the greatest and least depth at which it was dredged alive; in the third, the kind of sea-bottom is named; in the fourth, the letters express the degree of frequency of occurrence:—*a.* abundant, generally distributed and plentiful; *f.* frequent; *l.* local, more or less plentiful in a few localities; *r.* rare; and *v. r.* very rare, when but few examples occurred. In the fifth column the northern Scandinavian distribution is given, the coast being divided into three unequal provinces: North Drontheim (Dront.); Nordland (Nord.); and Finmark (Fin.).

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
BUCCINUM, *L.*					
undatum, *L.*	lit.-150	lit.-70	gravel, mud, sand.	a.	Dront., Nord., Fin.
Dalei, *J. Sow.*	100-160	100-160	sand.	v. r.	Fin.
Humphreysianum, *Benn.*	16-150	16-150	nullipora, sand.	v. r.	Fin.
fusiforme, *Brod.*	......	30-160	sand.	v. r.	Fin.
cyaneum, *Brug.*	lit.	lit.	rock, sand.	a.	Nord., Fin.
NASSA, *Lam.*					
reticulata, *L.*	8-15	8-15	mud, stones.	r.	Nord.
incrassata, *Müll.*	5-50	5-50	laminaria, sand.	a.	Dront., Nord., Fin.
PURPURA, *Adans.*					
lapillus, *L.*	lit.	lit.	rock, sand.	a.	Dront., Nord., Fin.
PLEUROTOMA, *Lam.*					
nivale, *Lovén*	30-150	30-150	sand, gravel.	r.	Nord., Fin.
teres, *Forbes*	50	......	sand.	1 sp.	Dront.
BELA, *Leach.*					
turricula, *Montg.*	10-150	10-130	mud, sand, gravel.	a.	Dront., Nord., Fin.
rosea, *Sars*	30	10	mud, sand.	r.	Nord.
rufa, *Montg.*	10-200	10-100	mud, gravel, nullip.	a.	Dront., Nord., Fin.
mitrula, *Lovén*	10	10	sand.	l.	Nord., Fin.
Trevelliana, *Turton* ...	8-200	8-150	gravel, mud.	a.	Dront., Nord., Fin.
DEFRANCIA, *Millet.*					
linearis, *Montg.*	10-40	10-40	nullip., gravel, mud	r.	Dront., Nord.
pyramidalis, *Ström.* ...	50-100	50	sand, gravel.	r.	Nord., Fin.
CYPRÆA, *L.*					
europæa, *Montg.*	30	......	nullipora.	v. r.	Dront.
NATICA, *Lam.*					
nitida, *Don.*	6-50	6-50	null., gravel, lamin.	a.	Dront., Nord., Fin.
Montagui, *Forbes*	3-70	3-70	gravel, nullip., mud	r.	Dront., Nord., Fin.
helicoides, *Johnst.*......	3-60	3-30	gravel, sand.	l.	Dront., Nord., Fin.
pusilla, *Gould*	lit.-150	lit.-150	sand, gravel, weed	l.	Dront., Fin.
clausa, *Sow.*	lit.-150	lit.-150	sand, weed, mud.	a.	Nord., Fin.
LAMELLARIA, *Montg.*					
prodita, *Lovén*	......	30-40	coral, gravel, sand .	l.	Fin.
VELUTINA, *Flem.*					
lævigata, *L.*	1-150	1-50	laminaria, gravel.	r.	Dront., Nord., Fin.
flexilis, *Montg.*	10-40	10-40	laminaria, gravel.	v. r.	Fin.
ODOSTOMIA, *Flem.*					
plicata, *Montg.*	15-70	15-70	sand, gravel.	r.	Dront., Nord., Fin.
CHEMNITZIA, *D'Orb.*					
elegantissima	35-160	40-100	gravel.	f.	Nord., Fin.
rufescens, *Forbes*	50	......	sand.	v. r.	Dront.
EULIMELLA, *Forbes.*					
Scillæ, *Sow.*	15-200	25-100	gravel, mud.	r.	Dront., Nord.
affinis, *Phil.*	?	?	sand.	r.	Nord., Fin.
EULIMA, *Risso.*					
bilineata, *Alder*	15-200	20-100	mud, sand.	a.	Dront., Nord., Fin.
species (new)	?	?			
polita, *L.*	15-70	40	sand.	v. r.	Dront., Nord.
CERITHIUM, *Brug.*					
metula, *Lovén*	20-150	20-150	mud, sand.	f.	Dront., Nord., Fin.
species (new)	?	?			
reticulatum, *Da Costa*	1-40	1-40	mud, laminaria.	f.	Dront.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
TRIFORIS, *D'Arch.*					
M'Andrei, *Adams*	50-100	50-70	sand, gravel.	v. r.	Dront., Nord., Fin.
APORRHAIS, *Da Costa.*					
pes-carbonis, *Brug.* ...	70	......	sand.	v. r.	Nord.
pes-pelecani, *L.*	8-40	8-40	gravel, mud.	a.	Dront., Nord.
TURRITELLA, *Lam.*					
communis, *Risso*	15-40	15-40	mud, gravel.	a.	Dront., Nord.
SCALARIA, *Lam.*					
grœnlandica, *Sow.* ...	15-150	15-45	gravel, sand.	f.	
Loveni, *Adams*	30-50	30-50	gravel.	r.	Dront.
LITTORINA, *Féruss.*					
littorea, *L.*	lit.-10	lit.-5	rock, nullipora.	a.	Dront., Nord.
rudis, *Don.*	lit.-7	lit.	rock.	a.	Dront., Nord., Fin.
littoralis, *L.*	lit.	lit.	rock.	a.	Dront., Nord., Fin.
LACUNA, *Turton.*					
vincta, *Montg.*	lit.-30	lit.-30	laminaria, gravel.	a.	Dront., Nord., Fin.
labiosa, *Lovén*	......	2-5	laminaria.	r.	Dront.
RISSOA, *Flem.*					
calathus, *F. & H.*	5-40	5-10	laminaria, gravel.	f.	Dront.
striata, *Montg.*	8-25	8-25	mud, gravel.	a.	Dront., Nord.
parva, *Da Costa*	lit.-10	lit.-10	weed, gravel.	f.	Dront.
rufilabrum, *L.*	1-10	1-10	laminaria, nullipora	a.	Dront., Nord.
ulvæ, *Penn.*	lit.	lit.	mud.	r.	Dront., Nord.
SKENEA, *Flem.*					
species	15-70	15-40	mud, gravel.	a.	Dront., Nord.
TROCHUS, *L.*					
millegranus, *Phil.* ...	15-50	15-50	nullip., sand, gravel	r.	Dront., Nord.
tumidus, *Montg.*	lit.-30	lit.-30	null., gravel, lamin.	a.	Dront., Nord., Fin.
cinerarius, *Montg.* ...	lit.-30	lit.-30	laminaria, gravel.	a.	Dront., Nord., Fin.
MARGARITA, *Leach.*					
alabastrum, *Beck*	25-150	25-100	gravel, coral.	l.	Dront., Nord., Fin.
helicina, *O. Fabr*.......	lit.-30	lit.-30	laminaria, nullipora	a.	Dront., Nord., Fin.
undulata, *Sow.*	lit.-150	lit.-100	lamin., gravel, null.	a.	Dront., Nord., Fin.
cinerea, *Couth.*	10-150	10-130	gravel, weed, coral.	a.	Dront., Nord., Fin.
SCISSURELLA, *D'Orb.*					
crispata, *Flem.*	40-100	40-80	sand, gravel.	r.	Dront., Nord., Fin.
angulata, *Lovén*	40-100	......	sand.	......	Nord.
PUNCTURELLA, *Lovén.*					
noachina, *L.*	4-150	4-70	gravel, nullipora.	a.	Nord., Fin.
EMARGINULA, *Lam.*					
reticulata, *Sow*..........	1-30	1-30	laminaria, nullipora	f.	Dront., Nord.
crassa, *J. Sow.*	30	......	gravel.	v. r.	Dront.
PILEOPSIS, *Lam.*					
hungaricus, *L.*	......	20	gravel, rock.	v. r.	Dront., Nord.
PATELLA, *L.*					
vulgata, *L.*	lit.	lit.	rock.	a.	Dront., Nord.
pellucida, *L.*	lit.-20	lit.-20	rock, laminaria.	f.	Dront., Nord., Fin.
cæca, *Müll.*	20-100	20-100	gravel, mud.	a.	Dront., Nord., Fin.
ACMÆA, *Esch.*					
virginea, *Müll.*	6-50	6-50	gravel, nullipora.	a.	Dront., Nord., Fin.
testudinalis, *Müll.* ...	lit.-30	lit.-10	nullipora, gravel.	a.	Dront., Nord., Fin.
PROPILIDIUM, *F. & H.*					
fulvum, *Müll.*	15-150	15-100	gravel, nullipora.	a.	Dront., Nord., Fin.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
DENTALIUM, *L.*					
entale, *L.*	4-200	4-200	gravel, nullipora.	a.	Dront., Nord., Fin.
species (new)	70-150	70-150	mud.	r.	Nord., Fin.
species (new)	?	?			
CHITON, *L.*					
Hanleyi, *Bean*	......	35-120	rock, gravel.	r.	Dront., Nord.
ruber, *L.*	......	1-30	gravel, nullipora.	a.	Dront., Nord., Fin.
asellus, *Chemn.*	......	1-130	gravel.	a.	Dront., Nord., Fin.
lævis, *Penn.*	......	30-50	nullipora.	a.	Fin.
marmoreus, *O. Fabr.*	......	7-30	nullipora, laminaria	a.	Nord., Fin.
cancellatus, *Sow.*	......	15-20	gravel.	r.	Nord.
alveolus, *Sars*	......	120-150	rock.	r.	Dront., Nord.
cinereus, *L.*	......	lit.	gravel.	1 sp.	Dront.
OPISTHOBRANCHIATA.					
TORNATELLA, *Lam.*					
fasciata, *L.*	30-35	30-35	mud.	l.	Dront., Nord.
CYLICHNA, *Lovén.*					
alba, *Lovén*	20-150	20-30	mud, sand.	f.	Dront., Nord., Fin.
cylindracea, *Penn.*	20-70	20-40	gravel.	r.	Dront., Nord., Fin.
truncata, *Montg.*	8-100	8-100	mud, sand.	f.	Dront., Nord., Fin.
AMPHISPHYRA, *Lovén.*					
hyalina, *Turton*	......	20-30	mud.	r.	Fin.
SCAPHANDER, *Montf.*					
librarius, *Lovén*	20-150	20-30	mud, sand.	a.	Dront., Nord., Fin.
PHILINE, *Ascanius.*					
scabra, *Müll.*	15-40	15-40	mud, nullipora.	l.	Dront., Nord.
aperta, *L.*	15-20	15-20	nullipora.	r.	Nord.
quadrata, *S. Wood*	40-100	40-100	gravel.	l.	Fin.
APLYSIA, *L.*					
hybrida, *Sow.*	......	lit.-20	rock.	r.	Dront., Nord.
DORIS, *L.*					
Johnstoni, *A. & H.*	......	lit.	rock.	l.	Nord.
DENDRONOTUS, *A. & H.*					
arborescens, *Müll.*	......	lit.	rock.	r.	

PTEROPODA.

Prof. Lovén in his 'Catalogue of the Mollusca of Western Scandinavia' enumerates three species of this order; but we were not fortunate enough to procure a living or dead specimen of either species. We dredged at the entrance of Drontheim fiord three dead specimens of a species of *Cleodora*.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
CLEODORA, species	70	......	sand.	3 sp.	Drontheim.

Brachiopoda.

Five species of this order inhabit the shores of Norway, four of which we procured abundantly, the great depth of water along the coast being favourable to their numerical development; they range from 25–160 fathoms, and are generally distributed along the coast, with the exception of *Crania anomala*, which becomes extremely scarce in Nordland and is not found in Finmark. The species are mostly gregarious, and often when a haul of shells is obtained from clean ground, the specimens of Brachiopoda greatly exceed the other Bivalves and Univalves in number. Very few dead *Terebratulæ* were met with.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
Terebratula, *Brug.*					
cranium, *Müll.*	15-200	25-160	gravel.	l.	Dront., Nord., Fin.
Terebratulina, *d'Orb.*					
caput-serpentis, *L.* ...	30-100	30-100	coral, gravel.	a.	Dront., Nord., Fin.
Rhynchonella, *Fisch.*					
psittacea, *Gm.*	40-150	40-50	gravel.	r.	Dront., Nord., Fin.
Crania, *Retz.*					
anomala, *Müll.*	25-100	25-100	gravel, rock.	a.	Dront., Nord.

Conchifera.

We met with ninety-four species of this class. They are most abundant on sandy and muddy bottoms. We dredged off the Vigten Islands one living specimen of the *Lima excavata*, which was by far the largest bivalve met with. Among the shells brought home were a few specimens which Mr. Woodward has found to be identical with *Limopsis pygmæa* from the Crag, a shell hitherto supposed to be extinct.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
Anomia, *L.*					
ephippium, *L.*	1-160	1-160	nullipora, gravel.	a.	Dront., Nord., Fin.
patelliformis, *L.*	3-28	3-25	gravel, nullipora.	a.	Dront., Nord.
aculeata, *Müll.*	1-70	1-70	gravel, nullipora.	......	Dront., Nord., Fin.
striata, *Lovén*............	50	50	gravel.	l.	Dront.
Pecten, *Müller.*					
opercularis, *L.*	......	3-25	gravel, nullipora.	r.	Dront., Nord.
islandicus, *Müll.*	15-150	20-40	gravel, nullipora.	a.	Dront., Nord., Fin.
pusio, *Penn.*	......	5-20	laminaria.	r.	Dront.
tigrinus, *Müll.*	20-100	20-100	mud, gravel.	f.	Dront., Nord., Fin.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
PECTEN, *Müll.*					
striatus, *Müll.*	3-100	3-50	mud, gravel.	a.	Dront., Nord., Fin.
danicus, *Chemn.*	20-70	......	mud, gravel.	valves	Dront., Nord., Fin.
similis, *Laskey*	15-200	15-50	sand, nullipora.	f.	Dront., Nord., Fin.
grœnlandicus, *Sow.* ...	100-150	150	sand.	v. r.	Nord., Fin.
sp. (new)	70	70	sand.	......	Nord.
sp. (new)	100-150	100-150	sand.	v. r.	Nord., Fin.
sp. (new)	100-150	100-150	sand.	v. r.	Nord., Fin.
LIMA, *Brug.*					
hians, *Gm.*	4-25	4-25	gravel, nullipora.	a.	Dront., Nord.
Loscombii, *Leach*......	8-50	15-25	gravel, nullipora.	v. r.	Dront., Nord.
subauriculata, *Montg*...	15-120	15-120	gravel, sand.	v. r.	Dront.
excavata, *Chemn.*	30-150	120	gravel, rock.	v. r.	Dront., Nord.
LIMOPSIS, *Sassi.*					
pygmæa, *Philippi*	......	70-100	gravel, mud.	v. r.	Nord.
MYTILUS, *L.*					
edulis, *L.*	lit.-40	lit.-40	nullipora, gravel.	a.	Dront., Nord., Fin.
MODIOLA, *Lam.*					
modiolus, *L.*	6-30	6-30	laminaria, gravel.	r.	Dront., Nord., Fin.
phaseolina, *Phil.*	30-160	30-160	gravel.	a.	Dront., Nord., Fin.
sp.?	30	30	mud.	r.	Fin.
CRENELLA, *Brown.*					
decussata, *Montg.* ...	8-150	8-100	sand, gravel.	f.	Dront., Nord., Fin.
discors, *L.*	3-100	lit.-100	rock, gravel.	a.	Dront., Nord., Fin.
nigra, *Gray*	15-150	15-150	mud, sand, gravel.	f.	Dront., Nord., Fin.
marmorata, *Forbes* ...	lit.-100	lit.-100	mud, gravel.	l.	Dront., Nord., Fin.
ARCA, *L.*					
raridentata, *S. Wood*...	20-150	30-150	gravel.	f.	Nord., Fin.
nodulosa, *Müll.*	15-25	15-25	gravel.	r.	Dront.
NUCULA, *Lam.*					
nucleus, *L.*	8-50	8-50	nullipora, gravel.	f.	Nord.
tenuis, *Montg.*	8-100	8-100	gravel, mud.	a.	Dront., Nord., Fin.
corticata, *Moller*	100-150	100-150	sand, mud.	r.	Nord., Fin.
LEDA, *Schum.*					
pernula, *Müll.*	20-160	20-160	gravel, mud.	a.	Dront., Nord., Fin.
caudata, *Don.*	10-160	10-160	gravel, mud.	a.	Dront., Nord., Fin.
lucida, *Lovén*	10-160	10-160	sand, gravel.	a.	Dront., Nord., Fin.
pygmæa, *Munster* ...	120	120	mud.	l.	Nord.
limatula, *Say*	120	120	mud.	v. r.	Nord.
CARDIUM, *L.*					
echinatum, *L.*	20-40	20-40	mud, nullipora.	l.	Dront., Nord., Fin.
edule, *L.*	lit.-25	lit.-25	sand, mud.	a.	Dront., Nord., Fin.
fasciatum, *Montg.* ...	15-100	15-100	mud, gravel.	a.	Dront., Nord., Fin.
nodosum, *Turton*	3-100	3-100	nullipora, mud.	f.	Nord., Fin.
suecicum, *Reeve*	20-150	20-100	gravel, mud.	a.	Dront., Nord., Fin.
elegantulum, *Moller*...	30-40	30-40	mud.	r.	Fin.
LUCINA, *Brug.*					
borealis, *L.*	8-30	8-30	mud, null., gravel.	f.	Dront., Nord., Fin.
spinifera, *Montg.*	50	......	sand.	1 sp.	Nord.
flexuosa, *Montg.*	7-150	7-150	mud, gravel.	f.	Dront., Nord., Fin.
ferruginosa, *Forbes* ...	20-100	20-100	gravel, sand.	a.	Dront., Nord.
Sarsii?, *Phil.*	30-100	......	sand, mud.	valves	Dront., Nord., Fin.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
ARTEMIS.					
exoleta, *L.*	3-10	3-10	nullipora.	v. r.	Nord.
lincta, *Pult.*	8-25	8-25	mud, gravel.	r.	Dront., Nord.
KELLIA, *Turton.*					
suborbicularis, *Montg.*	1-25	1-25	gravel.	r.	Dront.
MONTACUTA, *Turton.*					
substriata, *Montg.* ...	......	20	on *Spatangus.*	r.	Dront., Nord.
bidentata, *Montg.* ...	......	50?	sand.	2 sp.	Nord.
CYPRINA, *Lam.*					
islandica	8-70	8-70	gravel, sand.	a.	Dront., Nord., Fin.
ASTARTE, *Sow.*					
sulcata, *Da Costa*......	15-160	15-160	sand, gravel.	a.	Dront., Nord., Fin.
crebricostata, *F.*........	20-200	20-160	mud, nullip., gravel.	a.	Nord., Fin.
elliptica, *Brown*	4-50	4-50	sand, nullip., gravel.	a.	Dront., Nord., Fin.
arctica, *Gray*	lit.-40	lit.-30	sand, nullip., mud.	l.	Nord., Fin.
compressa, *Montg.* ...	4-50	lit.-50	gravel, sand, nullip.	a.	Dront., Nord., Fin.
VENUS, *L.*					
fasciata, *Da Costa* ...	50	......	sand.	1 sp.	Dront.
striatula, *Da Costa* ...	3-40	3-40	gravel, nullip., sand.	a.	Dront., Nord., Fin.
ovata, *Penn.*	15-100	15-100	nullip., gravel, sand.	a.	Dront., Nord., Fin.
casina, *L.*	15-25	......	gravel.	1 sp.	Dront.
TAPES, *Megerle.*					
pullastra, *Wood*	3-10	......	nullipora.	r.	Dront., Nord.
virginea, *L.*	15-25	......	gravel.	v. r.	Dront., Nord.
MACTRA, *L.*					
elliptica, *L.*	7-150	7-25	nullipora, sand.	f.	Dront., Nord., Fin.
TELLINA, *L.*					
solidula, *Pult.*	4-28	4-25	gravel, mud.	f.	Dront., Nord., Fin.
proxima, *Brown*	20-100	20-100	sand, nullipora.	f.	Dront., Nord., Fin.
fabula, *Gronovius*......	......	3-10	nullipora.	r.	Nord.
PSAMMOBIA, *L.*					
ferroensis, *Chemn.*.......	3-40	3-40	nullipora, gravel.	c.	Dront., Nord.
tellinella, *Lam.*	......	3-25	nullipora, gravel.	r.	Dront., Nord.
GASTRANA, *Schum.*					
fragilis, *L.*	......	......	....	1 valve	Dront.
DONAX, *L.*					
anatinus, *Lam.*.........	15-25	......	gravel.	r.	Dront.
SYNDOSMYA, *Recluz.*					
alba, *Wood*	8-40	8-40	mud.	a.	Dront., Nord., Fin.
prismatica, *Montg.* ...	8-150	8-30	mud.	a.	Dront., Nord., Fin.
intermedia, *Thompson*	8-70	8-70	mud.	a.	Dront., Nord., Fin.
SOLEN, *L.*					
ensis, *L.*	lit.	......	rock.	1 sp.	Nord.
pellucidus, *Penn.*	3-40	3-40	mud,	r.	Dront., Nord.
MYA, *L.*					
truncata, *L.*	lit.-100	lit.-40	mud, sand.	a.	Dront., Nord., Fin.
arenaria, *L.*	20-40	20-40	mud.	r.	Dront., Nord., Fin.
CORBULA, *Brug.*					
nucleus, *Lam.*	8-20	8-20	mud, gravel.	a.	Dront., Nord.
NEÆRA, *Gray.*					
cuspidata, *Olivi*	40-160	40-160	gravel, mud.	f.	Nord., Fin.
costellata, *Desh.*	20-40	20-40	mud.	r.	Dront.

Species.	Range.	Found living at	Ground.	Freq.	Norwegian distribution.
	fathoms.	fathoms.			
NEÆRA, *Gray.*					
obesa, *Lovén*	30-35	30-35	mud.	r.	Fin.
THETIS (EMBLA).					
Korenii, *Lovén*	45-90	70	sand.	r.	Fin.
SAXICAVA.					
arctica, *L.*	lit.-160	lit.-150	gravel, sand.	a.	Dront., Nord., Fin.
THRACIA, *Bl.*					
convexa, *Wood*	8-100	8-100	gravel, mud.	l.	Nord., Fin.
phaseolina, *Lam.*	......	2-25	gravel, sand.	r.	Nord.
PERIPLOMA, *Schum.*					
prætenuis, *Pult.*	......	3-10	nullipora.	v. r.	Nord.
LYONSIA, *Turton.*					
arenosa, *Moller*	......	4-7	nullipora.	r.	Nord.
striata	......	70	sand.	v. r.	Dront.
PHOLAS, *L.*					
crispata, *L.*	lit.	......	sand.	1 sp.	Nord.
XYLOPHAGA, *Turton.*					
dorsalis	......	30-40	wood.	v. r.	Dront.
TEREDO, *Adans.*					
norvegica, *Spengl*.......	......	20-30	wood.	v. r.	Fin.

TUNICATA.

The species of this class were most abundant on clean ground at a depth of 15–50 fathoms. In Grote fiord, on a muddy bottom in 20 fathoms water, a species of *Cynthia* occurred abundantly in masses composed of twenty to thirty individuals. A single specimen of *Pelonæa corrugata* was dredged off the coast of Nordland.

AMOURŒCIUM, *M.-Edw.*
argus, *M.-Edw.*
BOTRYLLUS, *Gaertner.*
polycyclus, *Savigny.*
BOTRYLLOIDES, *M.-Edw.*
albicans, *M.-Edw.*
ASCIDIA, *Baster.*
virginea, *O. F. Müller.*
CYNTHIA, *Savigny.*
limacina, *E. Forbes.*
aggregata, *Rathke.*
PELONÆA, *F. & G.*
corrugata, *Forbes.*

Note.—We have several other species of this class which we think are not described.

POLYZOA.

The number of species collected is about thirteen, of which six at least seem to have been hitherto undescribed. With one exception, those which are known appear to belong to forms met with only in the Arctic or northern part of the temperate zones. The exception, *Retepora cellulosa,* of which however only a fragment occurred, is found in the Mediterranean, and probably in the Southern hemisphere also. One species seems to be identical with a tertiary fossil, *Defrancia stellata* of Goldfuss. The most striking peculiarities in so small a collection are the occurrence in it of no less than four new species of *Eschara,* and of two new (as recent) forms of *Defrancia,* both abundant generic forms in the tertiary and cretaceous formations.

Cellepora, *O. Fabricius.*
cervicornis, *Autor.*
Eschara, *Ray.*
teres, n. sp.
tridens, n. sp.
saccata, n. sp.
rosacea, n. sp.
Retepora, *Imperato.*
cellulosa, *Lam.*
beaniana, *King.*
Idmonea, *Lamx.*
atlantica, *Forbes.*
Hornera, *Lamx.*
frondiculata, *Lamx.*
Diastopora, *M.-Edw.*
obelia, *Johnst.*
Tubulipora, *Lamarck.*
hispida, *Fleming.*
Defrancia, *Bronn.*
fungiformis, n. sp.
stellata, *Goldfuss.*

Frequently the dredge came up quite full of masses of one or more of the above species. At Keilvig, in Finmark, a dredge from 100 to 160 fathoms water was quite filled with *Retepora.* The *Cellepora cervicornis* frequently formed large patches in 50 fathoms water. The *Idmonea atlantica* was very common, attached to a red weed found in the lower part of the Laminarian zone. We are indebted to Mr. Busk for the above list and notes on the Polyzoa; he has also kindly described and figured the new species, which will be published in an early Number of the 'Annals.'

XXXIV.—*Some Account of an Infant "Orang-Utan."* By Alfred R. Wallace.

This little animal was probably not more than a month old when I obtained it by shooting its mother, with whom it fell to the ground apparently uninjured. I found out afterwards that it had then broken a leg and an arm, which however mended so rapidly, that I only noticed it a week or two afterwards by observing the hard swellings on the limbs where the irregular junction of the bone had taken place. When I first obtained it, it was toothless, but a few days afterwards it cut its two lower front teeth. I fed it with rice-water given out of a bottle with a quill in the cork, which after one or two trials it sucked very well. When however a finger was placed in its mouth it would suck at it with remarkable vigour, drawing in its little cheeks with all its might, thinking no doubt it had got hold of the right thing at last, and wondering that all its exertions could get no milk out of it. It would persevere for a long time till at last it gave up with despair and disgust, indicated generally by a very baby-like scream.

When handled or nursed it was always quiet and contented, but when laid down alone it would invariably cry, and the first night or two was very restless. I fitted up a small box as its cradle with a mat for it to lie upon, which was changed and washed every day. I soon found it necessary to wash the little Mias as well, which appeared to have very good effect. It winced a little and made ridiculously wry faces when the cold water was poured over its head, but enjoyed the rubbing dry amazingly, and was particularly pleased at having the hair of its back, head and legs brushed afterwards, during which operation it would lie perfectly still as long as I liked to continue it. For the first day or two it clung desperately with its four hands to whatever it could lay hold of, and having once unawares caught hold of my whiskers and beard, it clutched them with its little hooked fingers cruelly tight, and I had considerable difficulty in getting free. It doubtless felt quite at home, being accustomed to cling from its birth to the long hair of its mother.

When restless it would struggle about with its hands up to catch hold of something, and might often be seen quite contented when it had some bit of rag or stick grasped in two or three of its hands. At other times it would take hold of its own feet, and latterly its constant practice was to cross its arms like a little Napoleon, and with each hand seize hold of the long hair just below its opposite shoulder. The excessive tenacity of its grasp however soon diminished. The constant and powerful exercise of the limbs in the young Mias, remaining as it does for many hours each day with the whole weight of its body supported by its four extremities from the body of its mother, must induce a development of the limbs which can hardly take place in confinement. We should therefore expect a considerable difference in the proportions of the limbs and body, between animals brought up in a state of captivity and those killed in a state of nature.

I soon found that I could feed my infant Mias with a spoon, and make its food rather more solid. I gave it soaked or chewed biscuit with a little sugar and egg, and sometimes sweet potatoes. These it liked very much, and it was a never-failing source of amusement to observe the curious changes of countenance by which it would express its approval or dislike of what was given it. It would lick its lips, draw in its cheeks, and turn up its eyes with an expression of the most supreme satisfaction when it had a mouthful particularly to its taste. On the other hand, when its food was not sufficiently sweet or palatable, it would turn the mouthful about with its tongue for a moment as if trying to extract what flavour there was, and then push it all out between its lips. If the same food was continued, it would set up a scream and kick about violently, exactly like a baby in a passion.

After about three weeks I obtained a small Hare-lipped Monkey (*Macacus cynomolgus*), which, though young, had its first teeth, was very active, and could feed itself. I placed it in the same box with the Mias and they immediately became excellent friends, not exhibiting the least fear of each other. The little monkey would sit upon the Mias' stomach, or even on its face, with very little regard to its feelings, and after feeding would pick off what was sticking to its lips, and then pull open its mouth and put its little hand in to see if any was left inside, and would afterwards lie down across its body in whatever position was most convenient, without at all consulting the comforts of its companion. The poor little Mias would submit to all these insults with the most exemplary patience, seeming quite glad to have something warm about its body, and occasionally taking its revenge by clutching tight hold of the loose skin on the monkey's back or head, and then, when he tried to escape, holding on by the long tail as long as it could, the vigorous jumps of the monkey generally being too much for it in the end.

It was curious to observe the difference between these two. The Mias like a young baby lying on its back quite helpless, rolling lazily from side to side, stretching out its four hands into the air wishing to grasp something, but unable to guide its fingers to any particular object, and when dissatisfied opening wide its almost toothless mouth and expressing its wants by an infantine scream. The little monkey, on the other hand, in constant motion, running and jumping about wherever it pleased, examining everything with its fingers and seizing hold of the smallest objects with the greatest precision, balancing itself on the edge of the box, or running up a post and helping itself to everything eatable that came in its way. There could not be a greater contrast, and the baby Mias looked more baby-like by the comparison.

In order to give my infant a little exercise and strengthen its limbs, I contrived a kind of ladder upon which I put it to hang for a quarter of an hour at a time; but this was not much to its liking, as it could not get all four of its legs into convenient positions. It would hang for some time by two hands only, and then suddenly leaving go with one would cross it to the opposite shoulder to catch hold of its own hair, and thinking no doubt that that would support it much better than the stick, would leave hold with the other hand and come tumbling down on to the floor, when it would immediately cross its arms and lie quite contented, for it never seemed hurt by any of its numerous tumbles. I then tried to make a kind of artificial mother for the little creature by wrapping up a piece of buffalo-skin into a bundle with the long woolly hair outside, and hung it up about a foot from the ground. This suited it much better, as it could sprawl its legs and arms about wherever it liked, and always find some hair to catch hold of, which its little fingers grasped with the greatest tenacity. But the very success of this plan led to its speedy disuse;—it was too natural; and the poor little creature thinking it had recovered its mother was continually trying to suck. It would pull itself up close by the strength of its arms and try everywhere for a likely place, but only succeeded in getting mouthfuls of wool, when of course it would be greatly disgusted, scream violently, and if not rescued would soon let itself fall. One day it got so much wool into its throat that I thought it would have been choked, but after much gasping it recovered, and this plan of giving it exercise had to be discontinued.

After I had had it about a month, it began to exhibit some little signs of learning to run alone. When laid upon the floor it would push itself along by its legs, or roll over, and thus make an unwieldy progression. When in its box it would lift itself up to the edge into almost an erect position, and once or twice succeeded in tumbling out. When left dirty or hungry, or anyway neglected, it would scream violently till attended to, varied by a kind of pumping noise very similar to that which is made by the adult animal. If its cries were taken no notice of, or no one was in the house, it would lie quiet, but as soon as it heard a footstep near it would recommence with great violence.

In five weeks it cut its two upper front teeth, but in all this time it had not grown the least, remaining both in dimensions and weight the same as when I first procured it. This was no doubt owing to want of milk or other equally nourishing food. Rice-water was a miserable substitute, and cocoa-nut milk, which I sometimes gave it, did not quite agree with its stomach. To this I imputed an attack of diarrhœa which the poor little animal suffered, for which I gave it a small dose of castor-oil which operated very well, and it afterwards soon became better. It was however again taken ill, and this time more seriously. The symptoms were all those of intermittent fever, accompanied with watery swellings of the feet and head. It lost all appetite for its food, and after lingering for a week a most pitiable object, died, after being in my possession nearly three months.

I much regretted the loss of my little pet, which I had at one time looked forward to bringing up to years of maturity, and which had afforded me daily amusement and pleasure by its curious ways and the inimitably ludicrous expressions of its little countenance. Could I have obtained a regular supply of milk, or better still, could I have found some animal to have given it suck, I have little doubt it might have been reared, though it would probably never have reached the dimensions of its parents. It is probable that so young an animal of this species has never been before observed by Europeans. I have therefore given this brief account of its habits, which may not be uninteresting to lovers of nature.

Dimensions of young Orang-Utan.

	ft.	in.
Length : heel to crown	1	2
——— arms extended	1	11
——— legs extended	1	7
——— of feet	0	4
——— of hands	0	3
Girth of body	0	11
—— of thigh	0	$3\frac{3}{4}$
—— of arm	0	$3\frac{7}{8}$
—— of head, chin to crown	1	$1\frac{1}{4}$
Weight 3 lb. 9 oz.		

XXXV.—*On the Theory of the Fecundation of the Ovum.* By E. Claparède.

[Concluded from p. 311.]

We have already seen that J. Müller, on discovering an opening in the envelope of the ova of *Holothuria*, could not avoid mentioning the analogy of this canal with the micropyle of the Phanerogamous plants, so naturally did this comparison occur to the mind. Keber in his turn adopted the name of *micropyle* in treating of the ova of the *Naiades*, and we may now say that both the name and the analogy are sanctioned by science. The analogies between the modes of fecundation in the vegetable and animal kingdoms are indeed of more than one kind. What, in fact, are the phytosperms of the Cryptogamia,—for an exact knowledge of which we are particularly indebted to Nägeli and Leszczyc-Suminski,—unless they are the spermatozoa of these plants? Is it not a very remarkable fact, that in both cases fecundation should be connected with particles endowed with motion, which at first sight might be taken for animated creatures? Prévost and Dumas, Siebold, Müller, Wagner, Kölliker, Quatrefages, Bischoff, Leuckart, &c., have more especially brought forward the importance of these mobile particles in the act of fecundation in animals. Brongniart*, Schleiden†, Nägeli‡, Griffith§, Suminski||, and especially Hofmeister¶ and Henfrey**, have also noticed the importance of the movements of the phytosperms, or vegetable spermatozoa, and the contents of the pollen in the act of fecundation. From what we know of the generation of the Ferns, the Lycopodiaceæ, the Equisetaceæ, the Rhizocarpeæ, the Mosses, and the Characeæ, does it not present so great an analogy with the generation of animals, that the relation must strike everybody? In each case we have oogenous and spermagenous bodies, which are in such similar conditions, that we may ask why we may not say simply *ovary* instead of *archegonium*, and *testicle* instead of *antheridium*? The analogy goes so far, that we find in both groups examples of alternate generations in accordance with the same type. On one hand, for instance, we have a *Hydra* which produces, asexually, buds which become converted into *Medusæ*, whilst the *Medusa* acquires sexual organs and produces polypes in its turn, after fecundation; and, on the other hand, we have Ferns which produce buds (the so-called *spores*) asexually, which are converted into a prothallium, and this developes antheridia and archegonia, that is to say, sexual organs, and in its turn reproduces Ferns, after a fecundation. The sexuality of plants has been long in making its way into science, and, up to the most recent times, the entire group of the so-called Cryptogamia has been excluded from the privilege of possessing sexes. Is it not a singular circumstance, that it should have been reserved for our age to show that these Cryptogamia are of all plants those of which the sexual organs possess the greatest analogy with those of animals? All, or nearly all the Cryptogamia in fact appear to possess, on the one hand, archegonia (or ovaries), and, on the other, antheridia (or testicles); in the latter, spermatozoids are developed. (We prefer the term spermatozoid to that of phytosperm, because it is applicable at once to plants and animals.) We are acquainted with these organs in the Equisetaceæ, the Rhizocarpeæ, the Ferns, the Lycopodi-

* Rech. sur la Génération et le Développement de l'Embryon dans les Végétaux phanérogames. Ann. des Sci. Nat. 1828.

† Grundzüge der wissenschaftlichen Botanik.

‡ Bewegliche Spiralfaden (Samenfaden?) an Farren; in Schleiden und Nägeli's Zeitschr. für wiss. Botanik, 1844.

§ Linn. Trans. xxi.

|| Zur Entwickelung der Farrenkräuter, 1848.

¶ Untersuchungen des Vorganges bei der Befruchtung der Œnotheren. Bot. Zeitung von Mohl und Schlechtendal, 1847.

** Linn. Trans. xxi.; Ann. and Mag. Nat. Hist. ix. 1852.

aceæ, the Mosses and the Characeæ, and we have strong presumptions that we are on the way to discover them in the Florideæ, the Fucoideæ, the Lichenes and the Fungi. Lastly, their existence has lately been ascertained by Pringsheim in the freshwater Algæ*. The analogy of these organs with the generative organs of animals is so great, that it is the sole reason for their being regarded as organs of fructification; for until within the last few years we had no direct proofs of their function. And yet botanists are now almost universally agreed to regard them as organs serving for reproduction. It is an interesting fact, that at the very moment when the discovery of the penetration of the animal spermatozoid into the ovum startled the zoologists, that of the passage of the vegetable spermatozoid into the archegonium appeared on the botanical horizon. It is scarcely a year since Thuret† made known some remarkable experiments made at Cherbourg upon the spores of Fucaceæ. He found that the spores of these plants only germinate when they are in contact with the mobile elements contained in the antheridia, that is to say, with the spermatozoids (antherozoids). When the spores are isolated, which is easily done in the diœcious Fuci, they all perish without exception, and without any development. This proves at least that the antheridia have a part to play in the act of fecundation. But these experiments have not the value of direct observations, and fortunately the want of these is beginning to be supplied. Suminski has already asserted, that he has seen the spermatozoa penetrate into the archegonium of a Fern (*Pteris serrulata*). Hofmeister has observed the same phænomenon in another species (*Aspidium filix*). These observations, however, have given rise to numerous objections, reposing to a great extent upon the difficulties of observation resulting from the tissue which envelopes the archegonium. These objections can scarcely apply to Pringsheim's new discovery of the penetration of the spermatozoid into the archegonium in *Vaucheria*‡, where the sexual organs are so much exposed, that we can scarcely suppose the possibility of error. Besides the reproduction by zoospores, the *Vaucheriæ* present another means of multiplication, which depends on the development of their sexual organs; namely, on the one hand of the recurved horn-like organ, to which even Vaucher§ gave the

* Ueber die Befruchtung der Algen. Monatsberichte der Berl. Akad., March 1855.

† Comptes Rendus, xxxvi. p. 745.

‡ Ann. of Nat. Hist. 2nd Ser. xv. p. 347.

§ Histoire des Conferves d'eau douce. Genève, 1803. See especially his *Ectosperme sessile*, pl. 2. fig. 7 *a*,—sessile seeds furnished with their anther.

name of *filament serving as an anther,* and which actually performs the part of an antheridium; and, in the second place, of the slightly recurved organ placed close beside it, to which Pringsheim thinks we should give the name of *sporangium* rather than that of *spore.* In the course of its development, the sporangium, which is at first only a simple papilla, acquires a kind of beak-like process, turned in the direction of the antheridium. These two organs are then in direct communication by their bases with the tube of the *Vaucheria,* and enclose the same contents as the latter; but they soon separate from it, each forming a septum. The sporangium becomes transparent on its free side, in consequence of the accumulation in that part of the substance called the pellicular layer* (*Hautschicht*) by Pringsheim, whilst the antheridium also becomes transparent, but by the metamorphosis of its chlorophyll and the remainder of its contents. The *pellicular layer* continuing its development causes the sporangium to cleave at the place of the beak-like process, and project externally. The part which has thus issued separates in the form of a mucilaginous mass, and soon decomposes. By a very remarkable coincidence, as soon as the sporangium has split open, the point of the antheridium also opens and pours out its contents. A mass of small moveable corpuscles issues from it, which, lashing the water with their tails, move in crowds about the sporangium, pressing against the pellicular layer. As the beak of the sporangium and the parts in its neighbourhood are completely transparent and destitute of chlorophyll, it is easy to make perfectly sure of the penetration of the corpuscles (*spermatozoids*) into the interior, if this takes place. This is the case, according to the observations of Pringsheim. One or more spermatozoids penetrate into the interior of the pellicular layer, and the latter then, in common with the rest of the contents of the sporangia, becomes surrounded by a membrane which Mohl might this time consider as a true primordial utricle, but for its want of primordiality. It is the mucilaginous pellicular layer itself that becomes converted into membrane; for in proportion as the latter thickens, the former disappears. This cell, which fills all the interior of the sporangium, is therefore the true *spore,* the result of fecundation. In

* This is, in fact, the primordial utricle of Mohl, of which Pringsheim disputes the membranous nature. He has shown that the membranous appearance is due to the reagents employed, which cause the substance to contract. With sufficiently weak reagents, a mucilaginous mass is obtained; but nothing that can be compared to a membrane. See Pringsheim, Grundlinien einer Theorie der Pflanzenzelle, Berlin, 1854; in abstract in Mohl and Schlechtendal's Bot. Zeitung, 25th May 1855, and Annals, 2nd Ser. xv. p. 347.

the course of a few months this spore becomes developed into a *Vaucheria* *.

Pringsheim has also completed the observations of Thuret † and Decaisne on the reproduction of the Fucaceæ, studying particularly the common *Fucus vesiculosus*. In this it is not the spores, properly so called, that are fecundated, but these give origin in their interior to eight secondary spores (*Theilsporen*). During the ebb tide, at the moment when the plants are left dry upon the beach, these secondary spores issue from the mother-spore, and the antheridial sacs also quit the envelopes of the male organs. On the return of the tide, the antheridial sacs burst and give issue to the spermatozoids. These then press in crowds round the secondary spores, which are not yet enveloped by any membrane, and penetrate into their interior. After this fecundation, each secondary spore envelopes itself in a membrane and becomes developed into a Fucus. In this we have a case exactly analogous to that of the animal ovum, in which the spermatozoa penetrate into the vitellus before the formation of the vitelline membrane, or when it no longer exists (as in the Earthworms, according to Meissner).

In the Florideæ, it appears that there are two kinds of spores, of which some reproduce the plant asexually, whilst the others give rise to a product analogous to the prothallium of Ferns, or the pro-embryo of Mosses. It is upon the latter that fecundation takes place. In the Angiospermeæ of Kützing, Pringsheim

* A discovery exactly analogous to that of Pringsheim on the *Vaucheriæ* has lately been made by Cohn in a Conferva (*Sphæroplea annulina*, Ag.). In the cells of this plant stellate spores are produced, which, in their form, present a most deceptive resemblance to the reproductive bodies of the *Volvox stellatus*, Ehr. (hibernating spores of Stein). In the spring, the contents of these spores divide into two, and afterwards into four or eight parts, which become developed into zoospores. These zoospores move about for a certain time in the water, then fix in some place and give rise to young Confervæ. This is a first asexual generation. These young Confervæ, in fact, are only a kind of prothallium, for new spores, or rather new sporangia, are formed in their filaments; these present sexual differences. Some which present themselves in the form of a membrane, *pierced with a certain number of apertures*, have contents which become converted into spores; these are the archegonia. The others, the membrane of which is also *pierced with several apertures*, contain small, mobile, baculiform bodies; these are the antheridia, with their spermatozoids. The spermatozoids escape from their prison by passing through the apertures of the membrane, and, swimming through the water, go in search of the archegonia, into which they penetrate by passing the apertures of their membrane. Cohn has directly observed this interesting phænomenon. (Monatsbericht der Berl. Akad., May 1855.)

† [Thuret had previously seen and described minutely this process of fecundation: see Proc. Soc. Cherbourg, i. p. 161, and Ann. d. Sc. Nat. 4th Ser. ii. p. 197.—Ed. *Ann. Nat. Hist.*]

has also ascertained the existence of two modes of reproduction, one by zoospores and the other by fecundation;—at least the presence of spermatozoids and female organs leads to a supposition of the latter.

It is clear that fecundation must be a pretty general phænomenon in the Cryptogamia, and it is probably effected throughout by the entrance of the spermatozoids into the sporangia or archegonia. A plant allied to *Vaucheria*, the *Achlya prolifera*, in which Unger, Alex. Braun, Thuret and De Bary have studied the reproduction by zoospores, possesses spores of a second description, which are destitute of motion. These rather deserve the name of sporangia, like those of *Vaucheria*. Pringsheim has ascertained the existence of a micropyle in them, and has also pointed out the micropyle in the genera *Bulbochæte* and *Œdogonium*. Besides the zoospores and the stationary spores (sporangia), these two genera possess a third kind of spores, first indicated by A. Braun under the name of *microgonidia* *, and which, according to his observations, germinate, and become converted into a small plant, usually composed of two cells. It is remarkable that these microgonidia, the structure of which is exactly analogous to that of the zoospores, fix themselves in *Œdogonium* sometimes on the membrane of the sporangia, and sometimes on the cell which is closest to them, and in *Bulbochæte* always upon the sporangia themselves. Pringsheim draws attention to the fact, that these microgonidia, when once fixed, open and pour their contents close to the micropyle in *Œdogonium*, and close to the cleft which takes its place in *Bulbochæte*. It is true that the existence of spermatozoids in the microgonidia has not yet been detected; but who can tell what the future has in reserve for us? It would be a great advance in the knowledge of the Cryptogamia, if it should be positively ascertained that the microgonidia are a kind of antheridia, for A. Braun has proved the existence of them in a great many families of freshwater Algæ; and it is probable, from the observations of Thuret upon several families of *Fucoideæ*, that they also occur in the marine Algæ. All that remains to be proved is the existence of antheridia in the *Palmellaceæ*, the *Spirogyræ*, the *Desmidiaceæ*, and the *Oscillarieæ*, in order to give us a complete and uniform picture of the development of the Algæ.

The mother-spores of the *Fuci* and the sporangia of the *Vaucheriæ* are, morphologically speaking, the homologues of the central cell of the archegonium in the Ferns and Mosses, to

* Beobachtungen über die Erscheinungen der Verjüngung in der Natur. Freyburg, 1849–1850. (Ray Society's Publications, 1853.)

which the canal with which this organ is furnished leads; they are also the homologues of the embryonal sac of the Phanerogamia. It appears that the central cell of the archegonium contains no trace of the embryonal cell before fecundation (Pringsheim), and that the latter is only formed subsequently, after the entrance of the spermatozoids, surrounding a portion of the contents of the central cell, and enclosing the spermatozoids.

Pringsheim puts the question, whether something of the same kind does not take place amongst the Phanerogamia, and whether the extremity of the pollen-tube, which penetrates into the embryonal sac, does not contain spermatozoids, which, in common with the contents of the sac, would surround themselves after this fecundation with a fine membrane, and thus give rise to the first cell of the embryo. Such an hypothesis* has no want of probability for those who admit Schleiden's theory, which, it must be confessed, has made some progress during the last few years. For my part, Henri Schacht has shown me some very delicate preparations which appeared to speak strongly in its favour, and which would have completely convinced any person who did not bear in mind the difficulty there is in such remarkably fine preparations in distinguishing what is interior from what is above or below. I have also examined Deecke's famous preparation (a longitudinal section of the ovule of *Pedicularis sylvatica*, with a pollen-tube which has penetrated into the embryonal sac†), which appears to me to be strongly in favour of Schleiden, notwithstanding all the objections which Mohl‡ has brought against it. In any case, the analogy with what takes place in the Cryptogamia and in animals comes in as evidence in favour of the defenders of Schleiden's theory; and although there is no doubt that in the inductive sciences we must be as careful as possible about reasoning from

* It is, moreover, perfectly possible that the presence of spermatozoids may not be absolutely necessary throughout; and it is not improbable that a liquid may play their part.

† See an article by H. Schacht, Flora, 1855, Nos. 10 and 11.

‡ Der vorgebliche entscheidende Sieg der Schleidenschen Befruchtungstheorie. Bot. Zeit. 11th June, 1855. These objections, however, are not of much value with respect to our present subject. Thus, Mohl first objects that the so-called pollen-tube might very probably be the suspensor of the embryo issuing through a rent in the sac, *although it appeared to Mohl himself to be a pollen-tube*. The argument is not one of the strongest. Mohl then passes to the second point; that is to say, he denies that the extremity of the pollen-tube forms the embryo, *without however pretending to dispute that this pollen-tube may penetrate into the embryonal sac*. But we ask nothing more to furnish the analogy with the Cryptogamia and animals, for in the latter also it is not proved that the embryo is directly produced from the spermatozoid or spermatozoids.

analogy, we cannot help regarding this as a reason for paying more attention to an opinion which is held by such distinguished observers as Schleiden, Schacht, Pringsheim, &c.*

We have thought it necessary to dwell briefly upon the fecundation of the vegetable ovule to complete what we had to say of the fecundation of the animal ovum; for it must be confessed, the relations are here so considerable, that they approach what we are accustomed to regard as serial identity in the study of organized beings. The distance which separates the modes of generation in different animals from one another, is often much greater than that which separates the mode of generation of a particular animal from that of a particular plant. Why then separate what Nature has united? Why wish to follow Schleiden when he refuses to recognize any relation between the physiological phænomena presented by plants and those of animals (without saying *why*, however!)? Every day the precise limits which have been arbitrarily drawn between the vegetable and animal kingdoms are disappearing from our view,—the physical and chemical characters have fallen one after the other†, and we have been compelled to fall back upon the presence of vibratile cilia and a contractile vesicle, which animals alone ought properly to possess. The first of these characters is already inadmissible, on account of the zoospores of a great many Algæ; and if we choose to consider the motive organs of these as bristles rather than as vibratile cilia, the *Closteria* will always remain as a stumbling-block. These, although generally regarded as plants, and having nothing animal about them, are, in fact, clothed with vibratile cilia on the whole of their internal surface. These cilia, first discovered by Föcke‡, but afterwards disputed by many, do really exist. If we take the contractility of the cell as the test, we must raise to the rank of animals the Monads, Cryptomonads, Chlamidomonads, and all the Monadina in general, as they have always one or two contractile vesicles. The botanists must also cease to regard the *Euglenæ* as plants,

* [Henfrey (Ann. Nat. Hist. 2nd Ser. xv. p. 349; Microscopic Dictionary, article OVULE; and in a paper recently laid before the Linnæan Society of London) holds that the fluid of the pollen-tube fecundates a protoplasmic corpuscle pre-existing in the embryo-sac, and determines the formation of a membranous coat converting this into the germ- or embryo-cell.—ED. *Ann. Nat. Hist.*]

† The presence of amylaceous substances has entirely lost its importance since they have been found, not only in the Tunicata, but also in Man himself. Virchow (Wurzburger Verhandlungen, 1851; Annals, ser. 2, vol. xiii., p. 158), Prokitanski and Luschka (Virchow's Archiv, 1853), have demonstrated the presence of cellulose in the human brain (*corpora amylacea* of Purkinje), in the Malpighian follicles, in the spleen, in bones attacked by softening, &c.

‡ Physiologische Studien. Bremen, 1847.

as they possess one contractile vesicle (at least *Euglena viridis* does so)*. Many *Volvocinæ* also appear to possess contractile vesicles. It is moreover an idle dispute to attempt to decide whether these low organisms be animal or vegetable; for even if the question be decided, the two beings would still remain so closely related, that it would be a mere splitting of hairs to place one in one kingdom and the other in another. If there exists an actual division in Nature, it is that between the organic and inorganic kingdoms; and even there we must shut our eyes to certain Polycystina, and especially to some of those agglomerations of organized *raphides,* as it were, raised to the state of independent beings, to which the name of *Thalassicollæ* has been given. That my meaning may not be misunderstood—it is with the relation between animals and vegetables as with those of the group of Fishes with the neighbouring groups. In its broad features, the class of Fishes is one of the best existing in zoology; but if we descend into details, we shall find the limits, which at first appeared so well marked, become less and less distinct. If you ask a young student, he will very readily give you a definition of a fish, by means of its biconcave vertebræ, its heart with two cavities, its branchiæ, and some peculiarities of its brain. But if you question an ichthyologist, he will be much more embarrassed; for he knows, on the one hand, that there are fishes with lungs and a heart with three cavities (*Sirenoides*†); and, on the other, that there is a fish without vertebræ, without a brain, and without anything that can be called a heart (*Amphioxus*).

I hope I shall be pardoned for this digression, the only object of which was to show that it is not without reason that the vegetables and animals have been united in treating of the general phænomena of fecundation. We have ascertained the probable universality in the organized kingdom of the penetration of the spermatozoids into the ovules; but what is the part which they play when once arrived there? According to Meissner‡,

* To those who attach importance to chemical and physical characters I would observe, that, according to Angström's observations, whilst the green extract of the Phanerogamia gives three brilliant streaks in the spectrum, that of *Euglena viridis* only gives two, one in the green, the other in the red. It is remarkable that in this respect the *Euglena* behaves exactly like the three Confervæ in which Angström has studied the properties of chlorophyll (*Conferva glomerata*, a *Zygnema*, and a *Vaucheria*). Poggendorff's Annalen, xciii.

† It is to be observed, that the opinions of zoologists as to the true position of these animals (*Lepidosiren* and its allies) are by no means settled, so that M. Claparède is scarcely warranted in treating them as members of the class of Fishes.—Transl.

‡ Beobachtungen über das Eindringen der Samenelemente in den Dotter, No. i. Zeitschr. für wiss. Zoologie, vi., Sept. 1854.

at all events in the animals observed by him, they dissolve and unite to form a drop of oil, which must afterwards mingle with the substance of the vitellus. Nelson had previously seen them dissolve into a transparent fluid. But we may justly ask, whether this be really their destiny, or whether it be not rather the fate undergone by those which are not made use of, and which would consequently be condemned to the fatty metamorphosis, so common in animals, when Nature desires to facilitate the absorption of useless materials. The spermatists may perhaps some day raise their heads again, and again seek for their young embryo in the spermatozoid; the only object of which in seeking to lodge itself in the ovum would then be, to find a suitable medium for its development. In the Earthworms, in which, as we have seen, the eggs, on arriving in the common receptacle, float in a very considerable mass of semen, a large quantity of the latter passes with the eggs into the capsule at the moment of deposition. Those spermatozoids which have penetrated into the vitellus become converted there into an oily fat, which mingles with the elements of the vitellus; the others, according to Meissner, undergo the same metamorphosis, and remain in the form of fat around the vitellus. Subsequently, by means of their vibratile cilia, the embryos pass the whole of this fat into their alimentary canal, in the same way that the embryos of the Leeches consume their vitellus of nutrition.

It remains now to be seen whether the new discoveries have caused the theory of fecundation to take a step forward. The theory of the dynamists has not made any progress; for to say that the touching of an ovum by a spermatozoid awakens a new life in it, may be the expression of the fact, but is not an explanation. Bischoff, who not long since supposed that the essential part of the semen is the liquid itself, and that the spermatozoa only prevented its decomposition by their movements, has abandoned this opinion, and has the merit of having introduced into science a new theory, which appears capable of accounting for the facts, provisionally at any rate, in a more satisfactory manner*. It is well known that Liebig admits the existence in nature of a force analogous to the catalytic force of Berzelius, his *force of contact,* by means of which he explains various phænomena which, without it, would be difficult to understand. It consists in the fact that a body in a state of chemical decomposition, or, to speak more correctly, a body the molecules of which are in a state of chemical movement, is capable of disturbing the chemical equilibrium of certain other bodies, without adding anything to, or taking anything from

* Ueber die Befruchtungstheorie. Müller's Archiv, 1847.

them,—calling up in them, by virtue of its own state, a chemical movement which is in relation either to the composition of the bodies themselves, or to the quality of the chemical movement existing in the acting body. Thus, to take the commonest example, the ferment of beer, being in a state of chemical movement, induces the formation of alcohol in a saccharine solution, without, however, the occurrence of any chemical combination between the elements of the ferment and those of the sugar. This is an attractive hypothesis, and the more so as there is not perhaps a more general law in nature than that by which a body in motion communicates a part of its motion to another body with which it comes in contact; and this is more considerable in proportion to the amount of resistance offered by the second body. According to Bischoff, the seminal fluid may be compared to the yeast of beer, and the ovum to the saccharine solution. The former being in a state of chemical movement, would induce in the second a series of modifications, commencing with the segmentation of the vitellus up to the formation of the embryo. After all, this would only be to place the phænomenon of generation upon the same footing as that of digestion. In fact, whether we call the substances actively in operation in digestion, *ptyaline*, *pepsine*, *pancreatine*, or *diastase* of the saliva, of the stomach, pancreas, &c., we are not the less obliged to recur to the force of contact in order to account for their action. Bischoff's explanation was not very satisfactory, as long as it was believed that the semen only came in contact with the membranes of the ovum. But now that we know that the spermatozoa penetrate into the interior of the ovum, either through the micropyle or otherwise, and that when there they are in a state of chemical movement (the fatty metamorphosis of Meissner), this theory is far from losing probability. Nevertheless it is still nothing but a theory, convenient it is true, but impossible to demonstrate. That organized beings may be the products of a simple fermentation is possible, but we shall only attach positive credence to it when we obtain palpable proofs of its truth. The *force of contact*, again, is itself really nothing but the expression of the facts, and not an explanation; so that by Bischoff's theory the difficulty is only removed a step backwards. We must leave the question in doubt, impressed as we are with the feeling that great precaution is required in applying purely chemical explanations in such cases as the present, not merely to *organic*, but to *organized* bodies. The existence of the micropyle and the penetration of the spermatozoids into the ovules of organized beings are important discoveries; but by these only a corner of the veil has been raised, and the veiled image of Isis still leaves us many mysteries to be revealed. Thus we believe we must for once sympathise with Keber, by repeating with him in conclusion the words of the great embryologist Von Baer:—

"The future still reserves rewards for more than one observer; but the palm will only belong to him who shall be fortunate enough in regard to the forces which preside in the formation of the animal body to determine their place amongst the general forces which govern the system of the world. The tree from which the cradle of this man will be made, has not yet germinated in the forest."

XXXVI.—*Another Note on* Scissurella. By S. P. Woodward, F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen,

When a naturalist thinks he has discovered an error in your pages, he is bound in courtesy to communicate his suspicions to the *author*—rather than the *editor*—that he may have an opportunity of putting himself right. I am compelled for once to depart from this practice, because I have protested in vain against the publication of the mistake.

The distribution of Mr. Jeffreys' Mediterranean shells was entrusted to Mr. R. Damon of Weymouth, who kindly sent me examples of *Scissurella elegans*. In these specimens I observed, and pointed out to Mr. Jeffreys, the conversion of the *fissure* into a *foramen* when the shell became adult; a circumstance which, like the operculum, had escaped his observation. I proposed, in accordance with modern practice, to give a *subgeneric* name to the species exhibiting this character; but on referring to Philippi, and Sowerby (Zool. Journ. 1824), I found it was already known, and existed in the species which Sowerby regarded as typical.

I was, therefore, rather astonished when Mr. Jeffreys told me, some time after, that he had written an article for the 'Annals,' adopting the notion I had discarded, and seeking to justify it by the testimony of persons unacquainted with the facts of the case. I urged him to refer to D'Orbigny's original paper in the Memoirs of the Natural History Society of Paris for 1823, but he declined taking the trouble, adding that I could do it.

In this Memoir the genus *Scissurella* was first described, and illustrated by large figures. The first and second species, *S. lævigata* and *costata*, were found living on sea-weed; the others, *S. decussata* and *elegans*, were obtained from the newest tertiary sands of Castel Arquato, in the Plaisantin. In the year 1844, M. Philippi figured two other *recent* species, *S. plicata* and *striatula*, which are considered identical with D'Orbigny's *S. costata* and *elegans*. I believe the whole six are varieties of *one species*; and at all events the type of Mr. Jeffreys' new genus is a typical *Scissurella*. There is some difficulty about the species called *elatior* and *concinna* in Sowerby's 'Genera of Shells,' but they are probably synonymous with some of the varieties before described: there is no species of *Scissurella* in the "Calcaire grossier," nor any *extinct* species known, as I told Mr. Jeffreys before he published his article.

If the genus *Scissurella* was incompletely described by M. D'Orbigny in 1823, it was certainly made good by Mr. G. Sowerby in 1824; and my friend Mr. Henry Adams, to whom I have submitted the question, quite agrees with me, that we have no alternative but to regard Mr. Jeffreys' new genus as *an exact synonym of* Scissurella.

Should it prove that in the British *Scissurella crispata*, and some others, the slit is never closed, Mr. Jeffreys may reimburse himself by proposing a new name for this section. It is true that Philippi, Adams, and M'Coy have adopted Montfort's name *Anatomus*, but without sufficient reason; for the "*Anatomus Indicus*" is represented like a *Skenea*, or *Valvata spirorbis*, and the slit is in the *lower margin* of the lip: it may be the fry of a Nucleobranch, or altogether apocryphal.

The name *Pleurotomaria* (Defrance, 1821) has better claims, and a species is really found in the Paris basin; but it is a large *pearly* shell, and I think Prof. Forbes was right in hesitating to associate with it the little translucent *Scissurella*.

S. P. Woodward.

Barnsbury, April 1856.

XXXVII.—*On the Occurrence of the Fossil Genus* Conoteuthis, *D'Orb., in England.* By S. P. Woodward, F.G.S.

The rich collection of Mr. Bowerbank contains a specimen of *Conoteuthis*, obtained by himself from the Gault of East-ware Bay, Folkestone. It is an oblique, chambered cone, curved rather suddenly near the apex, and measures 6 lines in diameter by the same in height. The dorsal side is 8 lines in length, and has a slight ridge towards which the lines of growth are curved, and become longitudinal, showing that when perfect there was a projecting process on this side. The *septa* have simple margins, and the last eight occupy a space of four lines; the apex is not solid.

The type of this genus, *C. Dupinianus*, D'Orb., occurs in the Lower Greensand (*Aptien*) of France; it is of the same size, but slenderer, and less curved than the English specimen. It has a ventral *siphuncle* like the Belemnite, and is supposed to have been attached to a style more than 6 inches in length, like the appendix to the pen of many Calamaries.

The plate illustrating *Conoteuthis* is wanting in most copies of the 'Paléontologie Française,' but occurs in the 'Mollusques Vivans et Fossiles' of the same author, and one of the figures is copied in my Manual, pl. 2. f. 9.

XXXVIII.—*On the Development of the Freshwater Sponges.* By N. Lieberkühn*.

The structures hitherto recognized as belonging to the fresh-water Sponges are the following:—The skeleton, consisting of siliceous needles of various forms; the gelatinous substance; the so-called gemmules, which are furnished with a pore, and are either surrounded by a smooth shell, or by a ring of amphidisks†; moveable bodies occurring at certain periods of the year, and effecting the propagation of the sponges: according to Hogg, these move by an endosmotic process; according to Laurent, by cilia. Grant has described similar bodies in the marine sponges, ciliated in front, but not behind; Quekett was unable to confirm this observation, and gives a totally different account of the propagation. Huxley has described spermatozoa in *Tethya*, and Carter in *Spongilla*.

The following observations have been made almost exclusively upon specimens of *Spongilla fluviatilis*, which I examined almost daily in the fresh state during two summers and a winter. They are very common in the river Spree at Berlin, especially upon old wooden posts, and at the bottom of the water.

Skeleton and Gelatinous Substance.—The siliceous spicula have been frequently described, both in their common and unusual forms (see Dujardin's work upon the Infusoria, and Ehrenberg's 'Mikrogeologie'). Meyen states that their ends are connected together by a delicate colourless siliceous mass. I have found this formation, especially in dead sponges, upon which however gemmules and young sponges are often situated; but the connecting material is not silica, for it is destroyed by a red heat, the needles and amphidisks being left. The needles are usually so arranged that several form a rod, the apex of which is applied to the apex of similar rods at an obtuse angle.

* From Müller's Archiv, 1856, i.

† The term *Amphidiscus* was applied by Ehrenberg to a supposed genus of Infusoria, consisting of bacillar spicules of sponges with discoidal ends. —Ed.

These rows of rods project slightly outwards beyond the surface of the sponge, and are further connected with each other by groups of needles. The distance they are apart from each other is easily recognized in a branched sponge which has been kept out of the water for a short time; the apices of the rods project strikingly, and render the surface of the sponge spinous. Each projecting point is seen under the microscope to consist of a bundle of several needles.

The gelatinous substance has been examined most accurately by Dujardin. Small portions exhibit under the microscope Amœba-like movements; but whether these are vital phænomena, as supposed by Dujardin, or are connected with decay, is unknown. Other portions were furnished upon part of their surface with long cilia, by means of which they rapidly changed their position, at the same time emitting processes from the portion free from cilia, and again retracting them, just like Amœbæ. The ciliated portions were not found in winter, but appeared in the spring; in the winter, only those exhibiting the Amœba-like movements were present. These portions, which are always obtained by spreading living Spongillæ upon an object-glass, are not, however, amorphous masses, as represented by Dujardin, but frequently exhibit distinct structures having the form of a cell: this is especially observed in winter, when the granular matter is not so abundant. When the Amœba-like movements cease in one of these masses, a nucleus and a nucleolus become visible; and at this time, not merely a part of the gelatinous mass consists of them, but the entire sponge.

I have never succeeded in displaying the cell-membrane itself; hence the use of the term 'cell' is not at present justifiable, being used for the sake of brevity. Sometimes the nucleus with its nucleolus is found isolated between other uninjured cells, especially when the sponge is not perfectly fresh. The cells are $\frac{1}{1200}$ inch in diameter, the nucleus $\frac{1}{2500}$, the nucleolus $\frac{1}{9000}$. Frequently the nucleolus only is visible in the cells, and sometimes not even this, the interior of the globule being then filled with green or colourless granules. Frequently also the cells do not attain the above magnitude. In some cases I found structures containing within them foreign bodies, such as Diatomaceæ; in other respects these exactly resembled the sponge-cells, containing also a similar nucleolus; a contractile vesicle was absent; they emitted and retracted processes, and were possibly true Amœbæ, in which often no trace of a contractile vesicle can be detected. True Amœbæ with contractile vesicles are not rare in sponges.

The Spongillæ generally abound with infusorial life, especially in winter. I found, in the course of last winter, large numbers of *Paramecium Aurelia*, *Paramecium Colpoda*, *Chilodon cucullulus*; several species of *Trachelius*, especially *Trachelius ovum*; less frequently the various forms of *Amphileptus*, especially *Amphileptus Anser* $\frac{1}{24}$th of an inch in diameter, with a bacillar coat to the œsophagus, resembling *Prorodon*, which was also present; moreover, *Loxodes bursaria*, several species of *Bursaria* and *Ophryoglena*. Of the *Oxytrichina* were found principally *Stylonichia*, *Urostyla*, and *Euplotes*.

The Gemmules.—The living sponges are often situated not directly upon wood, stones, or other objects, but separated from them by a peculiar dark brown earthy mass, often several inches thick. This consists principally of the remains of the dead sponge, empty shells of gemmules with their amphidisks, various siliceous needles and decayed gelatinous substance; sometimes it contains brown gemmules, the contents of which are susceptible of development. In many the developing power of the contents is extinct, and they consist merely of extremely slender acicular crystals and a detritus-like mass; the crystals are too minute to allow of the determination of their shape, yet the angles are perfectly distinct in some of them. In a few instances the dead and broad sponge retained exactly the form and colour of the living, but the microscope showed that the cells were absent: between these acicular skeletons gemmules were also present. The dead branched sponges, which exist mostly at the bottom of the water, are frequently so densely covered with gemmules as to appear grey or greenish; the points of the needles then project beyond the gemmules; these again are often entirely covered by new sponge-formations, and are not visible until the sponge is broken. In the lowest layers of the living broad sponge, which bound the dead layers, large numbers of shining white gemmules are sometimes found; they resemble in general the ordinary brown gemmules; their shell is very firm, and when pressed offers considerable resistance; but the amphidisks are remarkably distinct. Their contents consist of the well-known globular masses, composed of smaller or larger fat-like granules and albuminous matter,—are of about the size of the largest sponge-cells, and when pressed are easily broken up. Other gemmules found here are distinguished by a very soft transparent shell, which is immediately burst, even when the glass-cover is carefully laid upon the object; their amphidisks are also very distinct, but the globular masses contained within them do not break up very easily. When a piece of one of these sponges containing the above-described formations is dissected under water with fine needles, isolated whitish ill-defined globular pieces, of about the size of the gemmules, are usually detected, with the following properties. Even under a low magnifying power, two different layers of the substance are distinguishable,—the uppermost possessing a low refractive power, about equal to that of the ordinary sponge-cells, the inner globular mass being highly refractive, almost like aggregations of fat. When these are compressed by a glass-cover, they become resolved into two kinds of cell-formations, both of which are of about the size of the sponge-cells. The innermost, which belongs to that portion which refracts the light most strongly, adhere firmly together, and consist of a sarcoid mass, in which tolerably large fat-like granules are densely interspersed. When isolated, they exhibit motions resembling those of the sponge-cells; they emit processes into which the granules enter, and again retract them. When forming a larger aggregation, this resembles a lump of fat which begins to fuse, and emits the liquid in separate striæ in all directions. When suitable pressure is made upon the mass, the original separate pieces are distinguishable, but of the most variable forms. I was unable to find in them the delicate transparent coat which surrounds the white gemmules above described. In its place was found only a layer of firmly cohering cell-like globules, some of which resembled the sponge-cells in the arrangement of the granules and the nucleolus, whilst the others enclosed amphidisks. Some of the enclosed amphidisks had exactly the same form as those usually surrounding the gemmules; each bounding by the periphery of its disk a circular portion of the interior of the shell of the globule, which it encloses. In others the two disks were not present, but a slender rod with slightly capitate ends existed in the interior of the cell-like formation; in others again, a row of extremely slender setæ radiated at right angles from the knob of the rod. If these setæ were broader and the stalk thicker, the form would be that of the ordinary amphidisk. The outlines of the cellular body furnished with an amphidisk are as sharp and distinct as in the sponge-cells, but I could not find a nucleus in them; sometimes they contained some fat-granules. Among the white gemmules were some with amphidisks enclosed in vesicles situated upon their transparent envelope together with free amphidisks. There can be no doubt that the previously described bodies are imperfectly developed gemmules. Sometimes firmly connected whitish aggregations of sponge-cells are found with them, of the same size and of a spheroidal form. They are also obtained on dissecting a suitable portion of sponge; but usually the cells separate in this operation.

I am not acquainted with similar facts in the case of the sponges with smooth gemmules; neither have I hitherto met with the smooth gemmules and those surrounded with amphidisks simultaneously in the same sponge. Both forms occur at all times of the year. The branched sponges living at the bottom of the river Spree have hitherto only contained smooth gemmules. In the broad sponge which grows upon boards and posts, both forms were met with, but not in the same piece. The ordinary contents of the gemmules have already been accurately described by Meyen (Müller's Archiv, 1839, p. 83), where it is shown that the amphidisks are constituents of the gemmules. In several specimens, the globular arrangement was not present; the finer granules exhibiting molecular motion being present in great numbers.

In regard to the destiny of the gemmules, Meyen supposed that a polyp-like animal was developed in them, and escaped from the pore. Grant had previously stated, that in the marine sponges, at certain times of the year, infusorial beings, ciliated at the anterior end of the body, are produced; these subsequently becoming fixed, and forming sponges.

In the freshwater sponges, Grant did not find the gemmules exhibiting motion, nor were cilia present. Dujardin mentions two forms of reproductive bodies in the freshwater sponges,—the gemmules and the ciliated bodies found by Laurent. Johnston states, that at certain times of the year the gemmules separate from the general mass of the sponges; that they are then furnished with locomotive organs, like Infusoria, with which they might easily be confounded. The results of the observations of Hogg and Carter have already been published in the 'Annals.' Carter found no trace of swarm-spores. The course of development described by him by no means, however, excludes the possibility of his having overlooked them. But the observation that insular groups of germs occur, the contents of which are gradually converted into the variously shaped cells, is correct.

During the month of June of the present and last year, I have frequently observed ciliated swarm-spores of the freshwater sponges; and a number of circumstances prove that they are integral components of the sponges.

That the entire gemmule is converted into the swarm-spore, as supposed by some observers, is incompatible with the facts to be presently described. The shell of the gemmule and the cortical substance of the swarm-spores are totally different in their properties. Very frequently empty shells of the gemmules are met with; and nothing is opposed to Meyen's supposition, that their inhabitants escape from the pore.

The Swarm-spores.—I first detected these after leaving recent sponges for some hours in a glass full of river-water. They are visible even to the naked eye, being about $\frac{1}{33}$ inch in length, and about $\frac{1}{50}$ in their broadest diameter. They are oval, and usually somewhat more pointed at one end, like a hen's egg. The smaller forms are not half so large, just as similar variations exist in the size of the gemmules. In most specimens, without the microscope, a transparent hemispherical space may be distinguished in the anterior, and a shining white one at the posterior part of the body; the distinction of anterior and posterior being based upon their position when swimming, which takes place at about the same rate as in *Trachelius ovum*. They swim in all directions: sometimes at the surface of the water, next towards the bottom, gliding along this, and then rising towards the surface again; sometimes in straight lines, at others forming a circle. When two of them meet, they often swim for some minutes around each other, subsequently going apart; frequently they remain motionless for a time, and then start off again. If touched when at rest, they swim away. They remained in this state for one or two days, when they went to the bottom of the vessel, where they adhered and began to decay. In but few instances, notwithstanding numerous experiments, have I succeeded in inducing their development. After the above time, the substance of the bodies becomes expanded into a delicate layer, in which a structureless mass with the fine siliceous needles is soon all that can be distinguished: the experiments succeeded when spring-water was applied. On the 20th day I remarked that the spots formed by the spores had become larger. Examination showed the presence of the constituents of young sponges, viz. moveable cells, smaller and larger needles, and some germ-granules. The movements are effected by cilia regularly spread over the entire body. They are of about the same length as those of the Turbellaria, but more slender. But what distinguishes them at once from the ciliary apparatus of all known Infusoria, and from that of the Turbellaria, so accurately examined by Schultze, is a kind of epithelial layer upon which they are situated. This consists of a single layer of spherical cells, about $\frac{1}{7500}$ inch in diameter. The cells are not so crowded as to flatten each other, but they are mostly in contact. I have not as yet detected a nucleus or nucleolus in them, but they usually contain some highly refractive granules.

On watching a swarm-spore under the microscope, part of the epithelial layer is not unfrequently seen to separate from some part of the body,—eight or ten connected cells often becoming detached and set in motion in the liquid by their cilia. Each cell has a single cilium, and never more than one. In a few not perfectly fresh swarm-spores, the surface was divided into several circular and irregular spaces, which under a low magnifying power appeared like large cells, but under a high power became resolved into groups of the above-described small cells.

On dissecting larger portions of sponges, within which swarm-spores exist, the latter are easily lacerated, and fragments only of them become separated for examination, in which the ciliary motion continues active. Dujardin was not aware of the origin of these portions when he described the movements of the sponges. It sometimes happens also, that the spermatozoa-like bodies, hereafter described, adhere to a smooth piece of sponge, which exhibits the Amœba-like movements, and that they carry it about with them in the liquid. These bodies were also unknown to Dujardin. I am unacquainted with the other moveable forms of the sponges which Dujardin calls Monad-like.

Beneath the epithelial layer the cortical substance is situated, the thickness of which is considerable in comparison with the cellular layer—it is visible even to the naked eye. Even under a high magnifying power, no definite structure could be detected in it. It forms a gelatinous mass, in which here and there some granules of fat are scattered, without regular arrangement. When isolated portions of sponge are separated by dissection, so that they are unconnected with the cilia, they exhibit the same locomotive phænomena as the sponge-cells themselves.

Next to the cortical substance comes the medullary portion, which fills the interior of the spore as a spheroidal mass. Even under a low magnifying power, this is seen to form a body distinct from the cortical layer. The diameter of this spheroid at its broadest part is about $\frac{1}{50}$ inch; but it varies in about the same degree as the swarm-spore itself. Its surface consists of a thinner mucoid layer, and the interior is the same portion of the swarm-spore, which exhibits great varieties in different specimens, whilst the remainder is nearly constant. The larger and most anterior portion of the spheroid in the swarm-spores examined early in June formed a pulpy mass, with fine scattered granules; the posterior part of the spheroid exhibited larger and smaller fat-like granules, forming with sarcoid matter larger and smaller globules, which, when kept for some time in water, became confluent. Many of them contained a very highly refractive body, which sometimes almost entirely filled the gelatinous globule; sometimes these bodies were found without any gelatinous envelope, and were of about half the size of an ordinary sponge-cell. The above-described contents give rise to the white appearance, visible with the naked eye, in the posterior part of the swarm-spore. The entire spheroid, both the transparent and the white portions, contains extremely small siliceous needles, often of exactly the same shape as the adult spicula. The smallest are of a barely measurable breadth, but about $\frac{1}{1800}$ inch in length; the larger being about $\frac{1}{12,000}$ inch broad, and $\frac{1}{750}$ and more long. The larger are either smooth or furnished with minute spine-like processes. The latter form is also not uncommon among the fully developed siliceous needles; and some Spongillæ contain these exclusively. The spicules in the swarm-spores are arranged without definite order. The constant presence of the siliceous needles in the swarm-spores formed the first indication of their origin from the Spongillæ. I found the swarm-spores both in the broad and in the branched sponge, in that with smooth gemmules as also in those with amphidisks.

Differences in the contents of the Swarm-spores.—These consist principally in the greater or less number of the germ-granules. The mature germ-granules are usually spherical, rarely lenticular. Sometimes two of them are relatively so placed, that one extends like a shell over the greater part of the other; such watch-glass-shaped bodies also occur separately, and may also be empty shells. The germ-granules attain the diameter of $\frac{1}{1800}$ inch, but some of them are much smaller. A very highly refractive shell and contents are distinguishable in them. In those occurring in the swarm-spores, the latter are not so distinct as in many of those which are free, and which will be noticed presently. Sometimes they contrast strongly with the shell, and form an ill-defined gelatinous globule; in many germ-granules they cannot be directly perceived. Notwithstanding their simple form, the germ-granules are so characteristic, that they cannot be mistaken for any other objects. At first sight they might be considered as large fat-globules; but the difference is soon made manifest when they are strongly compressed and burst. The number of these germ-granules is so great in many swarm-spores, that, with the minute siliceous needles and the albuminous matter, they almost exclusively make up the medullary mass of the swarm-spores; some being free within it, others aggregated in twos and threes with fatty granules and albuminous matter. These swarm-spores are distinguishable with the naked eye, the highly refractive portion occupying the greater part of their interior, and sometimes forming a perfect spheroid. The above-described form of swarm-spore also appears to contain a white globule, when the anterior part of the spore is directed downwards and the posterior part upwards; but the real state of things is discovered when it swims in the usual manner. It sometimes happened that one of these aggregations of germ-granules with its siliceous needles escaped completely from the swarm-spore when its envelope was burst by pressure; it was of a spherical form, and surrounded by a mucoid, structureless, and readily crushed coat.

The aggregations of germ-granules, of a spherical form, exist free, in vast numbers, in all parts of Spongillæ, but especially at the base. In the same parts I have also found ciliated swarm-spores; they lie completely in the mass of the living sponge, but can seldom be separated from it uninjured. Empty shells of gemmules are not found in these parts. The swarm-spores, however, attach themselves firmly to the empty siliceous skeletons; when detached, they swim about as usual. The aggregated germ-granules seldom contain the small, smooth, and spinous spicula in their interior; but these are often found in their immediate neighbourhood. The mucous envelope is sometimes separable, by evacuating the contents with gentle pressure; but it is structureless. The size of the aggregations of germ-granules varies from $\frac{1}{75}$ to $\frac{1}{50}$ inch. The germ-granules are either uniformly diffused through the entire substance, or are arranged in spherical heaps, and mixed with fatty globules and mucous matter. Many of them exhibit a distinct gelatinous globule, which sometimes contains small fatty granules, at others also a nucleus-like body.

We may here recur to Carter's investigations. As far as I can conclude from his descriptions, the insular groups of germs, which, according to Carter, pass into the variously shaped cells, are my aggregations of germ-granules. But the statement of this observer, that these escape directly from the gemmules, is essentially different from my view. Were we to suppose that Carter had directly observed this occurrence, and that it was not simply based upon supposition, and that the swarm-spores were absent in the sponges examined by him, the difference between the developments of such nearly allied formations would be so great, that it could scarcely occur. In some instances I saw pieces of sponge, the aggregations of germ-granules of which had no longer the definite form, but appeared to be undergoing decomposition. The mucous envelope was also absent, the separate granules being scattered around them.

Moreover, at the period at which all the above-described bodies are present, large masses of sponge are always met with which contain no trace of them. Even in one and the same locality, we find near together Spongillæ containing large numbers of gemmules, swarm-spores, and aggregations of germ-granules, and others in which none of these are present.

Immature forms of the gelatinous substance and of the spicula.—As early as June, white spots about the size of one or several of the aggregations of germ-granules are perceptible on various parts of the sponge, some of which are well defined, whilst others are confluent with the surrounding parts. They are sometimes also found upon other bodies at the bottom of the water, as upon shells of the Mollusca, the exuviæ of the larvæ of the *Phryganidæ*, upon straws, stones, and other similar objects upon which sponges grow. Their microscopic constituents are,—germ-granules of the above-described form and size, which contain either a finely granular globule distinctly contrasted with the enclosing shell, or a cell-like body containing a low refracting body resembling the nucleolus of the sponge-cells; germ-granules, which protrude a sarcoid substance from some part of their surface, and this is continued within the germ-granule, the outline of the portion situated outside being continuous with that lying within; large and small ordinary sponge-cells, some containing a distinct nucleolus, whilst others merely form an aggregation of fine granules and sarcoid substance, exhibiting the Amœba-like movement; variously formed small and large siliceous needles, some resembling the smooth and tuberculated forms met with within the swarm-spores and the aggregations of germ-granules, others being larger, but not so large as the fully developed ones. It is uncertain whether these spicula are developed from the germ-granules; some of them agree in size with these; they are either spherical, drawn out into fine points at the ends, or spindle-shaped, and usually tubercular; they are easily recognized by the refractive power peculiar to siliceous spicula, but in the smallest specimens even this character becomes uncertain. Whether the above-described reproductive bodies of sponges are the only ones which occur, or whether sponge-cells also propagate by spontaneous division, is unknown.

A comparison of Sponges with allied bodies may be met with in J. Müller's memoir upon *Thalassicolla, Collosphæra,* and *Acanthometra**.

The Spermatozoa-like bodies.—In June of the last and the present years, large numbers of moving corpuscles were not unfrequently seen on dissecting sponges, which were readily distinguishable from those giving rise to the movements of the swarm-spores; for in the former the filament is much longer and thicker, and the head much smaller. When swarming, their heads are usually directed towards each other, and their movements greatly resemble those of ordinary spermatozoa. They are seldom met with in the locality where they are developed. They are formed in globules enveloped by a transparent structureless membrane, and surrounded by sponge-cells. The globules are about $\frac{1}{300}$ inch in diameter. They are seen to move to and fro within the globules until these burst, when they swim away in large or small groups, the filament constantly vibrating to and fro. To determine their import as spermatozoa, I endeavoured to observe their entrance into the pore of the gemmule, as perhaps forming the micropyle, but in vain.

* Monatsbericht der Berliner Akademie, April 1855.

As already mentioned, Carter has observed peculiar bodies in sponges, which he regards as spermatozoa. These agree in no respect with the above; they are much larger, and are furnished with a contractile head, whilst the far smaller head of the above-described spermatozoa never exhibits contractions. I have found bodies during the winter in the sponges exactly resembling Carter's figures; these I can only regard as large and small specimens of *Trachelius trichophorus*, the occurrence of which in sponges Carter does not mention; more rarely I found a kind of Monad, probably identical with Dujardin's *Cercomonas acuminata*; this differs, however, importantly from all the components of sponges, in the presence of a contractile vesicle. On the other hand, the spermatozoa which Huxley has figured as those of *Tethya* closely resemble those of the Spongillæ; but Huxley has said nothing about either their origin or their power of motion.

XXXIX.—*On the Development of the* Chitons. By Prof. S. Lovén*.

When on a visit to our Western Skerries three years ago, I had an opportunity of observing the development of *Chiton marginatus*, Pennant (*C. cinereus*, Linn., according to Forbes and Hanley).

Some individuals of this species, which were kept in confinement, laid their eggs, loosely united in clusters of from seven to sixteen, upon small stones. Each egg was furnished with an envelope, which being folded, and as it were vesicular, was of considerable thickness, amounting to about half the total radius. All the stages of segmentation were already passed, and the envelope contained a well-formed moving embryo (fig. 1).

The embryo, 0·18 mill. in length, exactly of an oval form, and without any trace of shell, is divided by a circular indentation into two nearly equal parts; and close to this indentation are attached the cirri, by means of which the movements of the embryo are effected. In the middie of the upper part there is a tuft of very fine filaments, which scarcely exhibit any movements. The lower half exhibits two dark points, one on each side close to the indentation; these are the eyes, of which however only one is usually very distinct. The general form of the animal is somewhat variable, the lower part sometimes giving rise to a tapering process. The young ones, when freed, swim

* Translated from Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1855, p. 169.

round the clusters of eggs; their form is more elongated than when enclosed within the egg; the fore-part exhibits not hing but fine cilia, which probably existed previously, and the tuft of filaments is extended at full length and occasionally vibrated, although but slowly. There is nothing as yet to indicate the *Chiton*; but the posterior part of the animal now begins to grow more rapidly than the anterior (figs. 2, 3), which becomes more conical; and the lower part is specially characterized by the separation of the back of the mantle by means of two furrows and its division into joints, of which seven are distinguishable, and through which some close granulations make their appearance as

Development of (*Chiton*) *Leptochiton cinereus.*

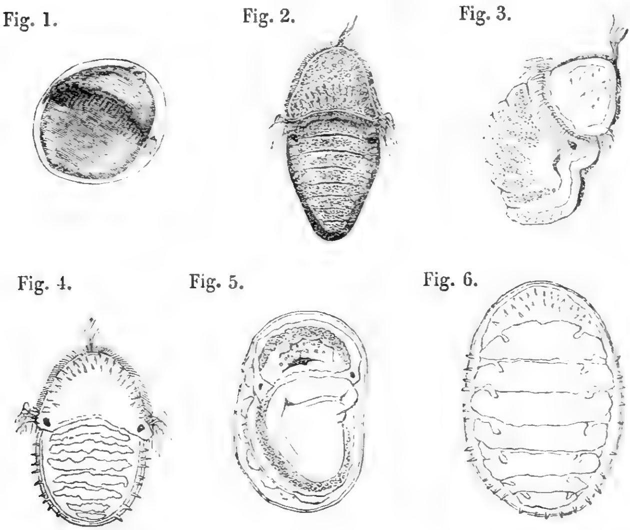


Fig. 1. Embryo in the egg.
Fig. 2. Dorsal view of young Chiton, showing the commencement of the divisions.
Fig. 3. Lateral view of the same.
Fig. 4. Dorsal view of young Chiton further advanced, with the seven irregular plates deposited in the segments.
Fig. 5. The same from beneath, showing the foot, with the eyes on the sides of the head.
Fig. 6. Dorsal view of a still older Chiton.

the first rudiments of the shell. The anterior part is sprinkled with pointed tubercles, which are also seen on the margins of the mantle. The animal bends itself frequently; it is still quite soft, and can only swim; but soon after this it begins to crawl (fig. 2). By the circular indentation of the mantle on the under side, its margin separates from the foot, each lamina remaining free. The eyes are seen more distinctly than before to be situated on the ventral side, but they are also indistinctly visible from above (fig. 2). The joints of the mantle become more distinctly separated, and its margin more closely set with points. The anterior, more conical part is still rather large and covered with small pointed tubercles, which however are principally on the upper surface. As yet I could observe no traces of the oral aperture, and the animal was still seen sometimes swimming and sometimes crawling. In the meantime, the first layer of the shell-valves was formed on the back (fig. 4), in the shape of narrow bands with irregular margins, of which, as yet, I only observed seven; the three or four anterior ones being nearly equal in length, whilst the posterior diminished rapidly. At this period the cirri disappear. Thus they are wanting in the form shown in fig. 5.

But now a considerable change takes place. We observe that the conical anterior part of the animal is no longer to be seen, nor the tuft of filaments which it has hitherto borne. In place of this the head, with its oral opening, is perfectly developed, and above it the curved folds which are also found in the mature animal. The eyes are situated on the sides upon distinct protuberances, and consist of pigment-spots and lenses. The foot has somewhat increased, but has not yet attained its full size in proportion to the head. No trace of the branchiæ is yet visible, but many approximated cells may be observed in the place which they are to occupy. The mantle has advanced over the head, and one of the shells may already be seen in front of the eyes. This advancement of the mantle is distinctly shown in fig. 6. In this there are still only seven distinct shells, and in front of the most anterior of these is a plane surface studded with pointed tubercles; this is all that remains of the conical anterior part of the embryo. This plane surface is gradually much diminished, at the same time that the eighth shell is produced behind the seventh.

If the formation of the shells be examined more closely, it appears in the first place, that, with the exception of the eighth, they are formed almost simultaneously at the commencement; that is to say, the anterior shells are at first of a proportionate size when compared with the posterior ones, which they do not afterwards retain. Thus, in fig. 4, the first is a transverse arch of equal length with the second and third. But this proportion has already changed in fig. 6, and it alters still more subsequently. The first does not occupy the same breadth on the animal as the three following ones, and thus the oval becomes more distinct, as now the posterior shells increase in breadth.

The anterior shells are earlier in acquiring their form than the posterior; thus the foremost will have assumed its crescent shape before the posterior is scarcely formed.

In the second place, we find that the shells first make their appearance in the form of narrow plates with irregular waved edges, and increase both in breadth and thickness by the deposition of new and somewhat larger plates beneath those first formed. But fig. 6 shows that each shell soon acquires two deep notches (*incisuræ laterales*, Midd.), one on each side of the anterior margin. When the new laminæ are deposited by the mantle, these notches are gradually closed when viewed from above, and only a mark on its inner part is left; but it is more than probable that by this mode of growth the lower surface of the shell, which is applied against the accustomed surface of the mantle, ought to present a pitted furrow directed forwards and outwards (*sutura lateralis porosa*, Midd.). It also appears that the *articulamentum* of Middendorff is first formed. I saw no distinct indications of a *tegmentum*. It would seem moreover that, at least in *Chiton marginatus*, the shells are not united by four *articuli*, and still less is there any support for the opinion that the posterior valve is the true shell, analogous to that of *Patella*, and that the anterior ones are laid over this.

As regards the edges of the mantle, I have only to observe that its pointed tubercles appeared quite irregularly, as they were seldom present over the whole surface, but only in patches.

Nothing could be ascertained with regard to the internal anatomy, from the want of transparency of the external parts.

If we compare this development with that of other Mollusca, it is evident that the circle of cirri, by means of which the animal moves in its first or swimming stage, corresponds with the cirri of the velum in the young of other Gasteropoda and of the Acephala. But in *Chiton* the velum is not developed into a broad, extensible sail. Instead of this, another part has acquired a considerable thickness, namely, the anterior conical portion having the tuft of filaments. This is exactly what I call the "pyriform body" which bears the "flagellum" in the marine Acephala.

The velum disappears in many Mollusks, so as to appear only as buccal tentacula or labial palpi. Perhaps a vestige of it is to be found in the fold of skin which surrounds the head in *Chiton*.

XL.—*On Cell-development in Plants.* By Prof. Arthur Henfrey, F.R.S.

To the Editors of the Annals of Natural History.

Gentlemen, April 18, 1856.

In a recent Part of the 'Transactions of the Microscopical Society of London' appeared a paper entitled "On the Formation and Development of the Vegetable Cell," by Mr. Wenham (Quarterly Journal of Microscopic Science, January 1856), a well-known microscopist. This essay, containing internal evidence of the author's want of familiarity with the subject treated, tended to revive the long-exploded hypothesis that vegetable cells originate as bubbles or vacuoles in a formless 'plasma,' into which cavities the true cell-contents penetrate after the formation of the cell. The paper would not have required any notice at the hands of physiological botanists, had it not been endorsed in some degree by the late President of the Microscopic Society in his Anniversary Address (Quarterly Journal, April 1856). The deservedly high authority of Dr. Carpenter as a physiologist renders it necessary that a protest should be entered by some one having practical experience in these matters. I have no hesitation in saying that Mr. Wenham's observations are faulty, consequently his conclusions useless. The objects selected for observation were *unfavourable,* and not favourable as he imagined; for young leaves of most flowering plants, in the stages figured by him, are not flat plates, but cones, or at all events solids having more than one thickness of cells in all three dimensions; therefore the view is confused by one layer lying behind another. The young leaves of most Mosses or Liverworts, the prothallia of Ferns, and similar structures composed of a single flat layer of cells, exhibit the phænomena much more clearly; but even in the young leaves of *Anacharis,* the application of dilute sulphuric acid and solution of iodine suffices to render the structures clearly distinguishable as quite different from what is represented in Mr. Wenham's drawings. The appearances presented by the protoplasmic structures in such nascent tissue are familiar to most of those who have practically studied these questions, so that it is merely necessary for me to state, from my own experience, that the objects observed by Mr. Wenham really offer no exception to the general rule, that the primary cell-wall is formed on the *outside* of the mass of protoplasm (*primordial utricle, protoplast, primordial cell, portion of cell-contents,* or whatever we may choose to call it), which is to form the active nitrogenous contents of the future cell.

I am, &c., yours truly,

Arthur Henfrey.

BIBLIOGRAPHICAL NOTICES.

A Monograph of the British Hieracia. By JAMES BACKHOUSE, Jun. 8vo, York, 1856.

WE have much pleasure in announcing the publication of this book, which cannot fail to attract considerable attention. The author has spent several years in obtaining the requisite information, in collecting multitudes of specimens, and in cultivating most of the supposed species. He has been in active correspondence with those botanists in this country and on the European continent who are known to have carefully studied this difficult genus.

It is with great satisfaction that we perceive the modest manner in which Mr. Backhouse introduces his book to its readers. He does not pretend to have produced a perfect monograph, but hopes that what he has done may "form a nucleus round which further knowledge may be collected." He thinks it not unlikely that some of his species may ultimately be proved to be only varieties, and that some of his varieties may be considered as species by future botanists, and very reasonably hopes to obtain that indulgence and excuse for errors of the kind which every real searcher after truth has a right to expect. Let his views be examined in the spirit in which they are published, and the author is manifestly ready to submit cheerfully to the result.

We have some slight personal knowledge of the care with which Mr. Backhouse has examined all the points treated upon in this book, and have considerable confidence in the soundness of the opinions formed by him. We know that he has not spared time nor labour in the acquisition and arrangement of his materials.

It will probably astonish some of our older readers to find that there seem to be 33 distinct species of *Hieracium* inhabiting the United Kingdom, and still more, that 11 of these are supposed to be new. The wonder will be lessened by remembering that the only really elaborate work upon the genus is the 'Symbolæ Hieraciarum' of Fries; also, that until after the publication of that work, very little addition had been made to the knowledge of our native species since the appearance of Smith's 'English Flora;' most collectors, and even some botanists, being satisfied if they could force any plant discovered, to conform itself to some one or other of Smith's species. This habit was not confined to such difficult genera as *Hieracium*, but applied to the whole native flora. It is probable that such a compliment has seldom or never been paid to any other book treating upon natural history. That it was well deserved originally we do not deny; but we do assert, that after a few years this habit became most detrimental to the advancement of science. Its bad effects have hardly disappeared, and even now the knowledge of the native botany of Britain can scarcely take a position of equality with that attained in several other European countries.

But we must return to the consideration of Mr. Backhouse's book. Probably the most elaborate and novel part of it is that which treats upon the species allied to *H. alpinum*, *H. nigrescens* and *H. pallidum*. He has shown, we think satisfactorily, that the *H. alpinum* of all our Floras includes several well-marked species. Similarly he states, that several new species occur in each of the other groups represented by the above-named plants; and also, that some of the names hitherto used in our books (and even in the above-mentioned great work of Fries) are erroneous.

From his position at York, and various engagements, the author has not been enabled to elucidate the synonymy as much as we could have desired; neither has he studied some of the Herbaria that we should have recommended to his notice. He has however been supplied with large accurately named collections by Professors Fries, Blytt and Grenier, and has thus had sufficient materials for the determination of the plants described in the 'Symbolæ' and the 'Flore de France,' where the French species are described with great skill. He also appears to have had the free use of the large collections of Professors Arnott and Balfour and that of our colleague Mr. Babington.

We think that he has made a good use of these opportunities and therefore cordially recommend his book to our readers.

A Rearrangement of the Nomenclature and Synonymy of those species of British Coleoptera which are comprised under the sections Geodephaga, Hydradephaga, *and part of* Philhydrida, *being the first portion of a general British Catalogue.* By J. F. Dawson, LL.B., and Hamlet Clark, M.A. London, 8vo. 1856. Post free for 12 stamps, on application to the Rev. H. Clark, All Saints, Northampton.

In the shape of a small pamphlet of ten printed pages, and under the above promising though somewhat indefinite title, we have received the first instalment of what will certainly be a welcome boon to the collector of British Coleoptera. For years the want of some list of these insects, which, with the Lepidoptera, engross nearly the whole attention of our native entomologists, has been severely felt; the imperfections of the 'Manual of British Beetles,' by the late James Francis Stephens, and of the lists of British insects published by that author and by Mr. Curtis, becoming every year more manifest. Under these circumstances the value of the present undertaking, by authors so well known as careful Coleopterists, must be evident to every entomologist, and we trust that the sale of the present part, of which more than half consists of the nomenclature of the *Geodephaga* so recently and admirably worked out by Mr. Dawson, may be such as to induce them to continue their enterprise. A certain number of these lists are printed on one side, so as to serve as labels for the cabinet, and the synonyms given appear to be confined to such names as have been quoted by British authors.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

February 7, 1856.—Colonel Sabine, R.A., V.P. and Treasurer, in the Chair.

"On the Vitality of the Ova of the Salmonidæ of different Ages; in a Letter addressed to Charles Darwin, Esq., M.A., V.P.R.S. &c." By John Davy, M.D., F.R.S. Lond. and Edinb. &c.

My dear Sir,—In a letter which I had the honour to address to you last year "On the Ova of the Salmon in relation to the distribution of Species," I have expressed the hope that some of the results of observations therein described may aid in solving the question as to the period, the age, at which the impregnated ova of fish are most retentive of life, and consequently are in the state best fitted for transport without loss of life.

Joining with you in considering the subject in need of and deserving further inquiry, I have taken the earliest opportunity that has offered of resuming it. The experiments which I have made, and which I shall now describe, have been more limited than I could have wished, having been confined to the ova of the Charr, as I was not able to obtain the ova of the Salmon or any of its congeners in a fit state for the trials required.

The ova of the Charr which have been the subject of my experiments, were from living fish brought to me from the river Brathay, a tributary of Windermere, on the 9th of November. They were obtained by the pressure of the hand on the abdomen of the females under water, and immediately after their expulsion a portion of liquid milt, procured in the same way from a male, was mixed with them for the purpose of impregnation.

The ova thus treated, 654 in number, procured from two fish, were transferred, after little more than an hour, to a shallow glazed earthenware pan, of a circular form, about a foot in diameter, without gravel, the water in which, afterwards, was changed daily once, and once only. The vessel was kept in a room of a temperature fluctuating from about 55° Fahr. when highest, to about 40° when lowest. The water used was well-water of considerable purity, and before used it was allowed to acquire the temperature of the room.

Two modes occurred to me as likely to afford the means of testing the vital power of the ova, or their power of endurance without loss of vitality; viz. one by subjecting them for a limited time to a temperature raised above the ordinary temperature; the other, by having them conveyed to a considerable distance.

For the trials first proposed, the ova were put into a thin glass vessel half-full of water, which was placed in a water-bath and heated to the temperature desired.

The first experiment was made on ova taken from the general stock one day after their expulsion. Six, for two hours, were exposed to a temperature varying from 79° to 80° of Fahr. The result was, that they became opaque in the course of twenty-four hours, all but one, and that, some days after, underwent the same change, denoting loss of vitality.

The second experiment was made on the 10th of November. Six ova were similarly exposed for two hours to a temperature rising gradually from 70° to 78°; the result was similar: on the following day they were all found opaque.

The third experiment was made on the 11th of November. The same number of eggs were exposed for an hour to a temperature falling from 70° to 69°. Two shortly became opaque; four retained their transparency during a month, though in reality dead, which was denoted by their bearing no marks of development when seen under the microscope, those ova which retained their vitality being at that time well advanced.

The fourth experiment was made on the 1st of December; the ova, the same number, were exposed to a temperature rising from 75° to 78° for an hour and twenty-two minutes. Three became opaque, other three retained their transparency and vitality, and in due time were hatched, the first on the 31st of December, the last on the 7th of January.

The fifth experiment was made on the 13th of December. Six ova were exposed for an hour and twenty-five minutes to a temperature falling from 82°, which it was at the beginning, to 78°, which it was at the end. Two became opaque; in these no marks of progress could be seen of development, thus indicating that they were dead at the time of trial. Four remained transparent; in these, under the microscope, embryo-fish were seen with an active circulation of the blood-corpuscles. One of them was hatched on the 31st of December; one, the last, on the 6th of January.

The sixth experiment was made on the 20th of December, on six ova, containing living embryos. They were exposed for an hour and twenty-eight minutes to a temperature of about 98°, and this during the whole time. When taken out, they had not lost their transparency, but in each the heart's action was arrested, and death was the result: they all sooner or later became opaque, from the common cause, the imbibition of water.

The seventh experiment was made on the 21st of December, on six ova, in which the circulation was distinct in the fœtal fish. After an exposure for an hour and five minutes to a temperature of 70° rising to 82°, in five, on cooling, the circulation was found active; in one, stopped, which was dead; two were hatched on the 5th of January; three, the remainder, on the 7th of the same month.

The eighth experiment was made on the 23rd of December, on six ova, each containing a living fœtus. They were exposed to a temperature falling from 84° to 82° during an hour and twenty minutes. Examined after the water had cooled, in one, the circulation was seen pretty distinct; in two, very feeble; in three, the blood-corpuscles appeared to be stagnant. Examined on the following day, the circulation was seen active in all. One was hatched on the 5th of January, the other five in the two following days.

The ninth experiment was made on the 24th of December. Six ova were exposed for two hours and four minutes to a temperature falling from 72° to 70°. Examined a quarter of an hour after, and before the water was cold, the circulation was found vigorous in all. One was hatched on the 2nd of January, the remainder between the 5th and 8th.

The tenth experiment, and the last of its kind that I have to describe, was made on the 2nd of January. Six ova, in each of which the circulation was distinct, were exposed for four hours to a temperature varying from 70° to 72°—the greater part of the time 72°. Examined immediately on being taken out, the circulation was seen uninterrupted in three, arrested in the other three. In three-quarters of an hour, when the water had cooled nearly to the temperature of the room, 55°, the circulation was found to be renewed in the latter. In the interval, one of the former was hatched, and a vigorous fish produced; on the following morning four more had come forth, and in the one remaining egg the fœtal circulation was vigorous; it was hatched on the 4th of January.

I beg now to pass to the other series of experiments referred to, those in which trial of the vitality of the ova was made by sending them to a distance. The method was briefly the following. The ova were lightly packed in wet wool contained in a tin-plate box perforated in its bottom to admit air, and covered with a wooden cover that had been soaked in water, with the intent of preserving moisture. The box was wrapped in tow, loosely covered with oiled paper, and the whole, in an envelope of common writing-paper, was well secured by a binding of thread. Thus prepared, the ova were sent by post to Penzance, in Cornwall, a distance exceeding 500 miles, with the request that they should be sent back by return of post unopened.

The first experiment was made on the 9th of November. The number of ova sent was thirty, taken from the common stock without selection. They were received on their return on the 14th of the same month. On taking them out, all were found transparent; but, with the exception of one, all became opaque on being put into water, and that one, after a few days, also underwent the same change.

The second experiment was made on the 14th of November. Twenty ova then sent were returned on the 18th. All became opaque on being put into water.

The third experiment was made on the 1st of December. Twenty ova then sent were returned on the 5th. Put into water, eleven became opaque within a minute; most of these were slightly shrivelled. After three hours, two more became opaque. After forty-eight hours, four only remained transparent; in these, under the microscope, the circulation was found active in two; in the other two it could not be detected. One was hatched on the 31st of December, the other died before hatching.

The fourth experiment was made on the 13th of December. Twenty-two ova then sent came back on the 17th. During the interval there was a severe frost; the thermometer here in the open air was constantly below the freezing-point, and it would appear to have been much the same throughout England. When examined, eleven of the ova immediately became opaque on immersion in water. In the other eleven there was no loss of transparency, and in these, under the microscope, the circulation was found active. Those which had become opaque were placed in a pretty strong solution of common salt, by which their transparency was restored, the saline solution dissolving the coagulum. Now examined, no traces of development could be detected under the microscope in any one of them,—showing that they had been dead before they were sent away.

On the following day, the 18th of December, the eleven transparent ova were repacked, and again sent the same distance. They came back on the 22nd; they retained then their transparency; placed in water, a feeble circulation was to be seen in two under the microscope; in nine the blood-corpuscles had ceased to flow; these became opaque. Of the two in which the circulation was perceptible, one was hatched on the 28th of December; the young fish in the other died, it would appear, in the act of breaking the membrane, its head, on the 29th, having been found protruding, but the heart's action stopped.

The fifth experiment was made on the 26th of December. Ten ova, in which the circulation was active, and the fœtus in each well advanced, were sent off on the day mentioned, and returned on the 31st. The weather, during the whole time, was mild, the frost having ceased. When opened, the ova were all found hatched, and the young fish dead, as might have been expected. When put into water, not one of them showed any signs of remaining vitality; they were all examined under the microscope.

The sixth and last experiment was made on the 6th of January. Six ova, in each of which the circulation was vigorous, were put into a glass tube of one cubic inch and a half capacity, with water to the height of about 1·4 cubic inch, the remaining space, after closure by a cork, being filled with air. The intention was to try the effects of conveyance to a distance on these ova in water with a small quantity of air. Owing to a mistake, they were not forwarded. Examined on the following day, five ova were found hatched, the young fish dead; in the one ovum remaining unhatched, the fœtus was alive, the circulation active; on the 9th it burst its shell; the young fish was vigorous.

As I could not with any certainty determine, at the time the experiments were commenced, what eggs were impregnated and alive, and what were not, I had at the beginning thirty ova taken indiscriminately from the common stock, and put apart in a glass vessel, the water in which was also changed daily. Of this number, seven were found in progress of development on the 14th of December, or 23 per cent.; the rest had become opaque. One of the seven was hatched on the 31st of December, the others in succession, the last on the 8th of January.

Further to arrive at a proximate average of the proportion of impregnated and unimpregnated ova, or living and dead, on the 14th of December, when in the living ova the circulation was distinct under the microscope, and the embryos were visible even to the unaided eye, I examined the whole number then remaining, viz. 405, thus reduced, owing to 67 having been removed, one after another having become opaque, and 152 having been taken out for the purpose of experiments. Of these 405 remaining, 138 were found alive, each containing a well-formed embryo, and 267, though still transparent, without life, no marks of organization being to be seen in them, either with the naked eye or under the microscope. Hence, irrespective of the 152 experimented on, the proportion of living to dead on the 14th of December would appear to be as 138 to 364, or about 25 per cent. And, with the exception of two which died after the 14th, all those then alive were hatched, the first on the 31st of the same month, the last on the 9th of January.

What are the conclusions to be drawn from these results? From those of the first series of experiments, may it not be considered as proved that the power of resisting an undue increase of temperature is possessed in a higher degree by the ova in an advanced than in an early stage of development,—the degree probably being in the ratio of the age? From those of the second series, is it not as manifest that the power of bearing distant transport, and of retaining life in moist air, is in like degree increasing with age? And from both, may not the general conclusion be drawn, that the strength of vitality of the impregnated ovum, or its power of resisting agencies unfavourable to its life, gradually increases with age and the progress of fœtal development? And as the Charr is one of the most delicate of the family of fishes to which it belongs, may it not further be inferred, with tolerable confidence, that the ova of the other and more hardy species of the Salmonidæ, were they similarly experimented upon, would afford like results, confirmatory of those obtained last year in some trials on the ova of the Salmon, and mentioned in my former letter to you?

The practical application of these results, and of the conclusions deducible from them, is obvious, and need not at present be dwelt upon.

I am, my dear Sir, yours very truly,

John Davy.

Lesketh How, Ambleside,
January 10, 1856.

ZOOLOGICAL SOCIETY.

January 9, 1855.—Dr. Gray, Vice-President, in the Chair.

Notice of the Horns of an unrecorded Species of Prong Horn (Antilocapra), in the Collection of the Derby Museum, Liverpool. By Dr. John Edward Gray, F.R.S., V.P.Z.S. etc.

Some years ago the late Earl of Derby showed me a pair of horns attached together by the skin of the forehead, which he had then recently received; and more lately, Mr. Moore, the Keeper of the Derby Museum, submitted these horns to my examination, requesting my opinion on them. At his request I bring a short notice of them before the Society, in hopes to obtain further information respecting them, and a specimen of the animal itself, should it prove to be a distinct species of the anomalous American Antelope. The horns are most probably from America; but this is not certain, as the special locality has not been recorded, nor the person from whom they were obtained.

The colour, substance, and texture of the hair on the skin of the forehead attached to the horns, exactly resembles that of the Cabrit or Prong-horn (*Antilocapra Americana*, Gray, Cat. Mam. B.M. p. 117), and if it were not for the very peculiar form of these horns, I should have been inclined to have considered them as only the deformed horns of that animal; but both the horns are alike and have the same peculiarities, which is not usual in malformations; under these circumstances it appears better to regard them provisionally as belonging to a distinct species, to be established or erased from the list as further knowledge may decide.

There can be no doubt of the position of the horns, as a part of the upper surface of the orbit is to be observed, with the remains of the eyelids and eyebrows at the base of the left horn.

Fig. 1. *Antilocapra Americana.*

Fig. 2. *Antilocapra anteflexa.*

ANTILOCAPRA ANTEFLEXA.

The horns compressed, dark brown, rugose, rounded and curved and arched behind, compressed in front, becoming more so as they reach the supra-medial frontal process. The apex subtrigonal, evidently compressed and angularly bent forwards rather above the compressed frontal process, with a deep furrow rather on the inner side of the middle of the hinder upper part of the bend; the inner edge of the recurved tip is rounded, the outer compressed, rather produced and sharp-edged; the extreme tip is roundish, tapering, with a white end. They are considerably larger than the horns of the usual species.

In the *Cabrit* or *Antilocapra Americana*, the horns are thick, rounded on each edge and produced into a compressed submedial frontal process, which is gradually bent towards the inner side. The tips of the horns are rounded, becoming nearly cylindrical, and are gradually and regularly arched backwards and inwards with a bluntish extreme end.

The horns of the genus are peculiar for being lined internally with a close velvety coat of short hair, directed towards the tip of the cavity; and the whole outer surface of the horn appears to be formed of agglutinated hair, some separate hairs being seen on the surface.

The peculiarity in the internal structure of the substance of the horns of this genus shows, like the branched external form, a similarity to the horns of the Deer; the hairy horn being the analogue of the deciduous velvet of the Deer, and the permanent hairy coat of the Giraffe. The ring of hair round the base of the outer surface is to be observed equally developed in the horn from Lord Derby's Collection and in that of the common *Prongbuck*.

March 27, 1855.—Dr. Gray, F.R.S., Vice-President, in the Chair.

Note on the Sixteen Species of Texan Birds* named by Mr. Giraud of New York, in 1841. By Philip Lutley Sclater, M.A.

1. Icterus Audubonii, Giraud (no plate), is *Psarocolius melanocephalus*, Wagl. Isis, 1829, p. 750. A good figure and interesting account of this fine species is given by Mr. Cassin in his new work on the birds of California, Texas, Oregon, &c. pt. 5. p. 137. pl. xxi.

2. Muscicapa texensis, Giraud, pl. 1. This seems very like *Elænia cayennensis* (Linn.), (which is included by Mr. Swainson in his Synopsis of the Birds of Mexico,) though rather larger in size.

3. Muscicapa Lawrenceii, Giraud, pl. 2. fig. 1.

4. Muscicapa fulvifrons, Giraud, pl. 2. fig. 2.

5. Sylvia Halseii, Giraud, pl. 3. fig. 1. This and the two preceding species I do not recognise.

6. Muscicapa Derhamii, Giraud, pl. 3. fig. 2, is *Muscicapa vulnerata*, Wagl. Isis, 1831, p. 520; *Setophaga vulnerata*, Bp. Consp. p. 313.

7. Muscicapa Belli, Giraud, pl. 4. fig. 1. This bird I believe to be *Sylvia chrysophrys*, Licht. in Mus. Berol.; *Myiodioctes chrysophrys*, Licht. Nomencl. p. 32; *Basileuterus chrysophrys*, Bp. Consp.

* Descriptions of sixteen new species of North American birds, collected in Texas, 1838, described in the 'Annals of the New York Lyceum of Nat. Hist.' by Jacob P. Giraud, Jun.—New York, 1841, 1 vol. fol.

p. 314. But Mr. Giraud's name has many years' precedence, and it will therefore stand as *Basileuterus Belli* (Giraud).

8. Parus leucotis, Giraud, pl. 4. fig. 2, is without doubt *Setophaga rubra,* Sw. Phil. Mag. 1827, p. 368, and has other prior synonyms.

9. Fringilla texensis, Giraud, pl. 5. fig. 1, is *Chrysomitris mexicana* (Sw.); *Carduelis mexicana,* Sw. Phil. Mag. 1827, p. 435.

10. Pipra galericulata, Giraud, pl. 5. fig. 2=*Euphonia elegantissima* (Bp.); *Pipra elegantissima,* Bp. Pr. Z. S. 1837, p. 112, and has other synonyms.

11. Muscicapa leucomus, Giraud, pl. 6. fig. 1, is *Setophaga picta,* Sw. Zool. Ill. n. s. pl. 3.

12. Muscicapa Brasieri, Giraud, pl. 6. fig. 2, seems to be the same as *Basileuterus culicivorus,* Bp. Consp. p. 313; *Sylvia culicivora,* Licht. in Mus. Berol., which in that case must be called *Basileuterus Brasieri* (Giraud).

13. Muscicapa rubrifrons, Giraud, pl. 7. fig. 1. This very pretty bird is named in Bonaparte's Consp. p. 312, *Cardellina amicta,* Dubus; and a reference is given to that author's 'Esquisses Ornithologiques,' 1850, t. 25, which, unless I am much mistaken, is still unpublished. Be that as it may, Mr. Giraud's name has many years' priority, and the bird will stand as *Cardellina rubrifrons* (Giraud).

14. Sylvia olivacea, Giraud, pl. 7. fig. 2, is *Sylvia tæniata,* Dubus, Bull. Ac. Brux. xiv. part 2. p. 104; Rev. Zool. 1848, p. 245. Mr. Giraud's name has the priority.

15. Certhia albifrons, Giraud, pl. 8, is *Salpinctes mexicanus,* Bp. Consp. p. 224; *Thryothorus mexicanus,* Sw. Zool. Ill. n. s. pl. 11.

16. Alauda minor, Giraud (no plate), is an *Otocorys,* probably the same as Wagler's *Alauda chrysolæma,* Isis, 1831, p. 530; *Otocorys chrysolæma,* Bp. Consp. p. 246. But there is much confusion at present among the American, as among the Old-World species of this genus.

I have thought it worth while to give the previous list of the Texan birds described by Mr. Giraud, and some remarks on their synonymy, as his book appears to be very little known on this side of the Atlantic. The only copy I have seen is that in the Society's Library, to which it was presented by the author. It will be observed that by far the greater portion of the species have been also noticed by European naturalists, though in some cases subsequently to Mr. Giraud's publication of them.

On a New Species of the Genus Todirostrum of Lesson. By Philip Lutley Sclater, M.A.

Todirostrum nigriceps.

T. supra flavo-olivaceum: alis caudaque nigris; rectricibus et remigibus primariis stricte, secondariis autem et alarum tectricibus latius flavescente limbatis: pileo cum nucha et capitis lateribus nigris: subtus flavum; gutture et crisso albis: rostro pedibusque nigris.

Long. tota 3·4, alæ 1·5, caudæ 1·1.

Hab. Santa Martha in Nov. Grenada.

De Lafresnaye has given an account of the species of this peculiar South American genus of Tyrants in the 'Revue Zoologique' for 1846, p. 360. Bonaparte in his 'Conspectus' has rather extended the list; but his 4th and 5th species from Desmarest seem rather doubtful, and the *Muscicapa diops* of Temminck is, I believe, quite incorrectly stated to be identical with Hartlaub's *Todirostrum granadense*, and does not belong to this genus. There is also little doubt that *Todus melanocephalus*, Spix, is the same as *Todus cinereus*, Linn., and the first and third species of the Conspectus are therefore coequal. The latest additions to this genus are:—

1. *T. ruficeps*, Kp. in these Proceedings, 1851, p. 52=*T. multicolor*, Strickl. Cont. Orn. 1852, pl. 85. fig. 2.—(*Todirostrum pectorale*, Kp. of the same page does not differ from Hartlaub's *granadense*.)
2. *T. chrysocrotaphum*, Strickl. Cont. Orn. 1850, p. 48. pl. 49.
3. *T. striaticolle*, Lafr. Rev. et Mag. de Zool. 1853, p. 58.
4. *T. fumifrons*, Hartl. Journ. f. Orn. 1853, p. 35; and
5. *T. rufilatum*, Hartl. *l. c.* 1855, p. 98.

The present elegant species I cannot identify with any of those previously described. It is a typical *Todirostrum*, and may be placed near *T. cinereum*, the type of the genus, from which it is easily distinguished by its pure black head, yellowish-olive back, and white throat. I obtained the only example of it I have yet seen from the MM. Verreaux, by whom it was received along with many other rare and valuable species from Santa Martha, on the north coast of New Grenada.

Mr. Gould has specimens of the *Todirostrum spiciferum*, Lafr., from Chamicurros in North-east Peru. This species, with its largely-developed crest, quite reminds one of the *Muscivora regia* (Gm.).

April 10, 1855.—Dr. Gray, F.R.S., Vice-President, in the Chair.

Descriptions of Eight New Species of Birds from South America. By John Gould, Esq., F.R.S. etc.

Before describing the following birds, all of which are in my own collection, I would remark, that I have submitted them to the inspection of Mr. P. L. Sclater, who has paid much attention to South

American birds, and who pronounces them new to science; I therefore embrace the earliest opportunity of placing them upon record.

1. Campylorhynchus hypostictus, Gould.

General hue of the upper surface brown, the feathers edged with greyish-brown, producing a somewhat spotted appearance; from above each eye, down the side of the neck, an obscure streak of buffy-white; upper tail-coverts dark brown, fringed with reddish-brown; along the margins of the primaries a series of dark brown dots on a light brown ground; tail brown, with lighter edges dotted with dark brown like the primaries; under surface greyish-white, with a streak of light brown down the centre of each feather, small on the throat, gradually increasing on the abdomen, and assuming the form of bars on the flanks; under tail-coverts buff, barred with dark brown; irides red; bill light horn-colour; feet olive-brown.

Total length, $8\frac{1}{4}$ inches; bill, 1; wing, $3\frac{1}{2}$; tail, $3\frac{7}{8}$; tarsi, 1.

Hab. River Ucayali in Peru.

Remark.—This species is very closely allied to *C. scolopaceus*, Spix, but differs in being of a rather larger size, in having a somewhat more curved bill, a more uniformly coloured back, and in the greater number and larger size of the brown markings of the under surface, which, moreover, extend on to the upper part of the neck and throat.

2. Chamæza nobilis, Gould.

Head very dark brown suffused with rufous; upper surface, wings and tail-coverts rich reddish or saffron-brown; tail reddish-brown, crossed by a broad black band near the end, and slightly tipped with buffy-white on the centre feathers, and much more conspicuously on the lateral ones; lores fawn-colour; under surface white, the feathers of the breast broadly, and those of the centre of the abdomen narrowly bordered on the sides with brownish-black; on the flanks the latter hue increases to such an extent as to leave only a lanceolate stripe of the white down the centre of each feather; under tail-coverts buff, speckled with brown; above each eye a narrow streak of buff commencing a little in advance of the centre of the eye, and extending downwards as low as the nape; irides brown; bill black; feet reddish-brown.

Total length, $9\frac{1}{2}$ inches; bill, $1\frac{1}{8}$; wing, $4\frac{1}{2}$; tail, $2\frac{7}{8}$; tarsi, $1\frac{3}{4}$.

Hab. Chamicurros, on the eastern side of Peru.

Remark.—This is the largest and perhaps the finest species of the genus: its legs and feet are very powerful, its bill thick and strong, its tail very short and rounded, its wings concave, and its plumage offers that silkiness to the touch which is so characteristic of the members of the genus *Chamæza*, of which it forms in every sense a typical example.

3. Formicarius nigrifrons, Gould.

Band across the forehead black; crown, occiput and nape deep chestnut; upper surface and wings rich brown; central primaries edged at the base with yellowish-brown; base of the inner web of the primaries and secondaries golden, showing conspicuously on the under surface, but not perceptible on the upper; the outer covert at the shoulder with a streak of ochreous-yellow along the margin of its outer web; tail brown at the base, gradually deepening into black at the tip; throat, neck and breast sooty-black; abdomen and under tail-coverts fuliginous-brown, assuming an olive tint on the flanks; irides brown; bill black; feet dark brown.

Total length, 7 inches; bill, $\frac{7}{8}$; wing, $3\frac{3}{8}$; tail, $2\frac{1}{4}$; tarsi, $1\frac{1}{8}$.

Hab. Chamicurros, on the eastern side of Peru.

Remark.—About the same size and nearly allied to ***F. Cayennensis***, but may be at once distinguished from that species by the bar of black on the forehead.

4. Formicarius erythropterus, Gould.

Head, upper and under surface and the tail black; feathers of the shoulders and mantle fringed with grey, giving it a scale-like appearance; those of the back fringed in a similar manner, but so narrowly as to be scarcely apparent; tail-coverts black, edged with rusty-red; extreme edge of the shoulder white; wing-coverts black, tipped with dark rust-red, forming first a narrow bar of red, and then a broad one of black; primaries rusty-red, largely tipped with black; secondaries rusty-red at the base, then black and tipped with rusty-red, the extent of the red increasing as the feathers approach the body; orbits naked and apparently red; bill black; feet fleshy-brown.

Total length, $6\frac{3}{4}$ inches; bill, $\frac{7}{8}$; wing, $3\frac{1}{2}$; tail, $2\frac{1}{2}$; tarsi, $\frac{3}{4}$.

Hab. Interior of Demerara.

Remark.—This is a very fine species. The specimen above described, which is the only one I have seen, is in my own collection.

5. Schistochlamys speculigera, Gould.

Head, neck, breast, back, wings and tail black; base of the third, fourth and succeeding primaries white, forming a small conspicuous patch in the centre of the wing; lower part of the back, rump and upper tail-coverts grey; under surface of the wing, abdomen and under tail-coverts white; flanks grey, with a few black feathers interspersed on the sides of the chest; irides red; bill, legs and feet greenish.

Total length, $6\frac{3}{4}$ inches; bill, $\frac{3}{4}$; wing, 3; tail, 3; tarsi, $\frac{7}{8}$.

Hab. River Ucayali in Peru.

6. Thamnophilus Corvinus, Gould.

The entire plumage deep black with the exception of the shoulders, on which is a broad mark of white; bill black; feet dark olive.

Total length, 7 inches; bill, $1\frac{1}{8}$; wing, $3\frac{3}{8}$; tail, $2\frac{5}{8}$; tarsi, $1\frac{1}{4}$.

Hab. River Ucayali in Peru.

7. Thamnophilus melanurus, Gould.

Male.—Crown and sides of the head, crest, back, lesser wing-coverts and tail, black; the wing-coverts tipped with white; remainder of the wing blackish-brown; throat and all the under surface white; bill black, becoming lighter at the base; feet olive-brown.

Total length, $8\frac{1}{3}$ inches; bill, $1\frac{1}{4}$; wing, $3\frac{1}{2}$; tail, $3\frac{1}{2}$; tarsi, $1\frac{1}{4}$.

Female.—Crown of the head, crest, upper surface of the body, wings and tail, chestnut; throat and chest white, passing into the mingled grey and sandy-red of the flanks; feathers clothing the thighs rusty-red tipped with white; bill blackish-brown; feet olive-brown.

Hab. River Ucayali in Peru; I have also received examples from Bogota. I must remark, however, that the specimens from the latter locality are somewhat smaller than those from Peru.

8. Thamnophilus hyperythrus, Gould.

Crown and sides of the head, all the upper surface and tail, slaty-black; wings brownish-black, with a spot of white at the tip of each of the coverts, forming three semicircular rows across the wing; chin, breast and abdomen rich dark chestnut-red, gradually blending on the flanks and vent into the dark hue of the upper surface; bill black; feet olive-brown.

Total length, 7 inches; bill, 1; wing, $3\frac{1}{8}$; tail, $2\frac{1}{2}$; tarsi, 1.

Hab. Chamicurros in Peru.

Remark.—I believe the above to be the description of a female.

Notes on the Habits of some Indian Birds. By Lieut. Burgess. Part IX.

Genus Ardea.

Subgenus Egretta (Swainson).

Ardea Caboga. Cattle Heron.

This active little Heron is abundant in the Deccan, and, as its name implies, is a constant attendant on cattle, running about amongst them, and picking off the flies that settle on them. I give the following from my note-book on their habits:—"Towards the end of November I observed a number of the common small White Heron feeding near some cattle, and the same day twenty or thirty others, and there were probably more feeding in fields of the toor plant; they appeared to be picking up food from the ground, and were in constant motion, frequently taking short flights from one part of the field to the other. I observed the same birds next morning sitting on a banian tree within the walls of a village; they quite whitened the top of the tree with their numbers.

"1st May, 1848.—Observed that the small White Heron has at this season of the year the fawn-coloured neck, and also that the long feathers falling over the breast are fawn-coloured.

"12th May.—Saw numbers of the small White Heron feeding amongst the sheep and along the grass plain at Khoonthephi.

"18th May.—Observed a flock of fifty-nine small White Herons in a ploughed field picking up the worms and insects brought out by last night's heavy rain; several of them were without the fawn-colour on the neck, head and breast."

"8th May, 1849.—Saw five or six of the small White Heron feeding amongst cattle. They keep close to the animals whilst feeding, and I saw one evidently picking the flies off a bullock; all these had more or less of the buff-colour on the neck. It is extremely amusing to observe these birds chasing flies, their long neck stretched out as they follow every turn and twist of the fly, which is seized immediately it has settled."

The Cattle Heron breeds during the month of April, building in tall trees. The nest is composed of sticks, and contains four eggs of a pale greenish-blue colour, $1\frac{8}{10}$ in. in length by $1\frac{3}{10}$ in. in width. I obtained eleven eggs from one tree on which there were twenty nests. I do not know if it has been satisfactorily determined whether both sexes assume the buff head and neck during the breeding season.

Subgenus Nycticorax.

Ardea Nycticorax. Night Heron.

Is a tolerably common bird in the Upper Deccan, but from its habit of roosting during the day in thick lofty trees, which it leaves for the streams after dusk, is not often observed. Its harsh grating cry is heard in the early dawn as it returns to its hiding-places. I made several attempts to obtain its nest and eggs, but without success, neither could I learn its time of breeding; however, I shot a young bird on 3rd December, with some down remaining on its head, which circumstance leads me to believe that they do not breed at the same time as others of the Heron tribe. Dr. Jerdon says, "it breeds on palm and other trees, many nests together." The Night Heron of England, identical I believe with that of India, "builds in trees," says Mr. Yarrell, "and lays four pale greenish-blue eggs, rather more than 2 in. in length by $1\frac{1}{2}$ in. in breadth."

Genus Platalea.

Platalea leucorodia. White Spoonbill.

I have seen flocks of these birds on the river Godavery, and occasionally on the smaller streams. They breed during the month of April, building in tall trees on the border of a stream. I append a note on the subject:—"18th April, 1848. Found the White Spoonbill breeding in a peepul tree beside a stream. The nest was not, like those of the species of *Tantalus* and *Ibis*, built on the top of the tree, but on the outside branches, about two-thirds from the ground; it was composed of sticks, and appeared small for so large a bird. It contained four eggs of a white colour, spotted with pale red, of much the same size as those of the *Tantalus leucocephalus*." The egg is $2\frac{6}{10}$ in. in length, by rather more than $1\frac{7}{10}$ in. in breadth. The gizzard of the male bird, which I shot rising from the nest whence the eggs were taken, was of a strong and rough texture, much like that of a fowl; it contained some bright yellow substance, a few small stones, a seed, and a few small particles of grass. Although the Spoonbill does not build its nest in the same situation as the *Tantalus* or *Ibis*, I quite agree with Dr. Jerdon that the Spoonbill shows more affinity to the Ibis than to the Herons, from the size and colouring of its eggs; and I believe that the more the study of oology is taken up, the more clearly will it be shown that birds may be nearly as well classed by the number and colour of their eggs and their mode of nidification, as by their external form and internal organization. The egg is white, with a belt of light red spots at the larger end.

Genus Ciconia (Briss.).

Ciconia leucocephala (Jerdon). White-necked Stork.

I have but seldom met with this handsomely-marked bird, but I was fortunate enough to find it in its breeding haunts, and to secure its eggs. On the 7th March 1850, I found a pair of these Storks breeding in rather a low peepul tree; the nest was composed of sticks, and contained four white eggs, nearly $2\frac{5}{10}$ in. in length, by nearly $1\frac{9}{10}$ in. in breadth. On the same tree a Black Vulture (*Vultur ponticerianus*) had also built its nest, containing one egg. In February I found young birds; when hatched, the beak and bare skin of the face are of a dull greenish-black, irides brown; the body is covered with light brownish fawn-coloured down, legs and feet dull brownish-orange. On one tree were two nests, each containing two young. The nests were composed of sticks, and built near the top of the tree, a tall Indian fig, the stem of which was partly within the walls of a village. These birds, I was informed, breed in the same tree every year.

Genus Tantalus (L.).

Tantalus leucocephalus. Pelican Ibis.

The Pelican Ibis, as it is called by Dr. Jerdon, is a common bird in the Deccan, frequenting rivers and tanks, and feeding, I believe, chiefly on fish. Its large size renders it remarkable, particularly during the breeding season, when the back and scapulars attain their particularly rich rosy tint. These birds are social, feeding in flocks. I was told by the natives of a village close to a tank frequented by them, and close to one of their breeding places, that when they fish in the tank they walk in the shallow water in line, driving the fish before them. In another village, about ten miles from the Godavery River, where there are a great number of large banian trees both outside and inside the walls, I found a community of these birds, which had built their nests on them, probably to the number of fifty. The trees inside the walls were as thickly covered with nests as those outside, and the birds, which appeared docile and tame, did not mind the noise of the people passing beneath them. At the time that I visited the village, the young birds were all well fledged, and most of them able to fly. The village people informed me that the old birds move off to the river in the very early dawn, and having caught a sufficient supply for their young, return about eight or nine o'clock. A second expedition is made during the afternoon. Some idea of the quantity of fish caught by these birds may be gathered from what the people told me, that quantities of fine fish were dropped by the old birds when feeding their young, and were eaten by them. A young bird of this species which I shot in Scinde, disgorged a large quantity of small eels. This Ibis breeds during the month of February. The nest is composed of small sticks, and is placed at the top of the trees. If there are many on the same tree, they are placed pretty close together. They lay three or four eggs, of a dull opake white, nearly $2\frac{6}{10}$ in. in length, by rather more than $1\frac{8}{10}$ in. in width. The young birds are able to fly by the month of May. I kept a young bird which had dropped from the nest and broken its wing in my garden for three or four months. It was most gentle and quiet, occasionally only snapping its strong beak at any person it did not like. In a short time it recognized the person who fed it, and whenever he made his appearance it would walk towards him, uttering a piteous cry, flapping its long wings and bowing its head towards him. It was a most ludicrous sight, which many came to see. It was fed on fresh fish, and would not touch any that were at all tainted. Another young bird which I also kept, would devour the bodies of birds brought in for stuffing, and did not appear at all particular as to the quality of its food. The stomach of an old bird contained a grassy substance, the remains of fish, and what appeared to be the claw of a small crab. I give a description of a young bird taken on 20th April. The beak dark lead-brown, darkest at the base, which is very thick ; the skin on the face and forehead the same blackish lead-colour ; the feathers on the head brownish-grey ; the feathers on the neck of an ashy-brown, mixed with down. Shoulders ashy, with light brown edges ; scapulars much the same, with much lighter ash edges ; the centres of the feathers darkest in colour ; lesser wing-coverts brownish-black, with an ashy tinge and light ashy edges ; larger coverts dark greyish-black ; outer webs tipped with whitish ash-colour, and inner webs tinged with the same colour on the edges. Tertials much the same colour as the greater coverts, but tinged with rose-colour. Primaries and secondaries black, with green reflections ; back beautiful pale rose-colour ; upper tail-coverts dusky grey ; tail-feathers twelve, black, with bright green reflections. The breast, belly and sides covered with beautiful white down, interspersed on the breast with some dark ash-grey feathers, and on the sides with white, tinged with delicate rose-colour ; the whole of the back is also covered with beautiful down. This bird was evidently a nestling, the first feathers having scarcely grown enough to cover the body.

Genus Ibis.

Ibis papillosa (Temm.). Warty-headed Ibis.

This Ibis is more common than the Black-headed, and is fond of open places, as well as the sandy shores of the larger streams and rivers. They are seen in flocks in the open country, picking up insects; the stomach of one which I shot contained nothing but the heads, legs, and wing-cases of locusts; that of a second was full of large grasshoppers, and a lizard; that of a third was filled with the *chrysalides*? of butterflies. At the approach of evening the Warty Ibis retires to thick trees to roost, uttering its loud and discordant cry. It breeds during the months of February, March, April, May and June, laying as many as three, and probably four eggs, of a pale bluish-white, slightly streaked and spotted with pale brown, $2\frac{4}{10}$ in. in length, by nearly $1\frac{7}{10}$ in. in width. I found the nest of this Ibis built on the top of a peepul tree (a species of Banian), and containing three young birds, in the month of March.

April 24, 1855.—John Gould, Esq., F.R.S., in the Chair.

On some new or little known Species of Birds in the Derby Museum at Liverpool. By Philip Lutley Sclater, M.A.

The zoological collection of the late Earl of Derby, now at Liverpool, contains one of the largest and finest series of birds at present in existence, many of the examples being valuable not only for their rarity, but also as types of species described long ago by Latham in his 'General History' and other works, and which are hardly to be recognized without examination of the original specimens.

Mr. Thomas Moore, the present Curator, is busily engaged in arranging this mass of materials, and affords every facility to those who are anxious to inspect any of the objects committed to his care. Among the birds I have had an opportunity of examining there during a recent short visit are the following, which I venture to characterize as new.

1. Conirostrum ferrugineiventre, Sclater.

C. cærulescenti-schistaceum, pileo et alis caudaque intus nigricantibus: superciliis latis et elongatis albis: subtus intense ferrugineum aut ferrugineo-rufum.

Long. tota 4·9, alæ 2·75, caudæ 2·0.

Hab. in Bolivia.

This is a typical *Conirostrum*, and quite distinct, I think, from any species hitherto described. The members of this genus with which I am at present acquainted are—

1. Conirostrum cinereum (Lafr. and d'Orb.); D'Orb. Voy. Ois. pl. 59. fig. 1. From Tacna in Peru and Sicasica in Bolivia.

2. Conirostrum rufum, Lafr. Mag. de Zool. 1843. *Dacnis rufo-cinerea*, Bp. Atti 6ta Riun. Sc. It. 1845, p. 404, et Consp. p. 401. From Bogota.

3. Conirostrum sitticolor, Lafr. Rev. Zool. 1840, p. 102. *C. bicolor*, Less.; Gray's Gen. pl. 34. From Bogota.

4. Conirostrum albifrons, Lafr. R. Z. 1842, p. 301; Mag. de Zool. 1843, Ois. t. 35 (from which, I believe, *C. atrocyaneum*,

Lafr. R. Z. 1848, p. 9, and *C. cæruleifrons*, Lafr. R. Z. 1842, p. 302, only differ in age or sex). From Bogota.

Conirostrum superciliosum of Hartlaub, R. Z. 1844, p. 215, and Bp. Consp. p. 402. sp. 5, is a true *Sylvicola* of Swainson, the same as *Parula mexicana*, Bp. Consp. p. 310, and has of course nothing to do with these birds.

The only other species that have been referred to this genus, as far as I am aware, are *Conirostrum ornatum*, Townshend, Ann. Lyc. New York, 1851, p. 112, pl. 5. fig. 1, from Texas (the same as *Ægithalus flaviceps* of Sundeval, according to Dr. Hartlaub), and the *C. fuscum* and *colombianum* of Lesson, Descr. d. Mamm. et Ois. pp. 273 and 274, none of which I have as yet recognized.

2. Synallaxis erythrothorax, Sclater.

S. fuscus, olivaceo-tinctus, capite obscuriore: gutture nigro-cinereo: alis extus, nisi parte apicali, tectricibus subalaribus et vitta lata pectorali rufo-castaneis: ventre medio cinerascente, lateribus brunnescenti-olivaceis: cauda brunnea: rostro nigro: pedibus brunneis.

Long. tota 5·3, alæ 2·3, caudæ 2·5.

Hab. in America Centrali; Coban et Honduras.

Of this *Synallaxis*, which seems different from all other members of the genus that I am acquainted with, there is a specimen in the Derby Museum procured at Coban by Delattre in 1843. The British Museum contains an example from Honduras, and I have a single skin in my own collection purchased in Paris, which I believe to be from the same locality. The occurrence of species of this group north of the Isthmus of Panama seems hitherto unnoticed, except by the Prince Charles Bonaparte, in a list of a Guatimala collection of birds in the Proc. Zool. Soc. for 1837, p. 118, in which he includes the *Synallaxis cinerascens* of Temminck (Pl. Col. 227. fig. 3). But the characters there given do not at all agree with Temminck's bird, and would seem *more* applicable to the present species. Besides, the true *Synallaxis cinerascens* is said to be from Brazil, and is not likely to occur also in Guatimala.

In my specimen of the present species the throat is slightly speckled with whitish.

3. Ramphocænus cinereiventris, Sclater.

R. olivaceo-brunneus; capitis lateribus rufis, spatio postoculari nigro: alis extus brunnescentibus: gutture albo, nigro-cinerascente striato: abdomine cinerascente, medialiter albescentiore, lateraliter autem olivascentiore: cauda nigricanti-fusca: rostri mandibula superiore nigrescente, hujus autem apice et mandibula inferiore albidis.

Long. tota 4·0, alæ 2·0, caudæ 1·3.

Hab. in rep. Novæ Grenadæ, Pasto.

A third species of this peculiar genus, beautifully intermediate in colouring as in locality between the *Ramphocænus melanurus* of Brazil and the *rufiventris* of Central America. When I say a *third* species, I am perhaps doing an injustice to M. Lesson, who has already described a third and a fourth. But I have never seen the *Ramphocæni trinitatis** and *viridis*†, and indeed they are hardly likely to be recognized again from such meagre descriptions.

The *Ramphocænus cinereiventris,* of which there is only one example in the Derby Museum, was procured at Pasto, in the mountains of New Grenada, by the indefatigable Delattre. It is a rather shorter-billed bird than the other two to which I have compared it. Like *R. rufiventris,* it has the sides of the head rufous, but differs in showing a well-marked postocular spot. It is also striated on the throat like that species, but has no tinge of rufous on the abdomen, which is darkish cinereous. The tail of the specimen, I regret to say, is not quite perfect, but there is no appearance of the white markings which are the distinguishing characteristic of the Guatimalan bird.

The Derby Museum contains examples of *R. rufiventris* from Coban and Panama, and also specimens of *R. melanurus.* The latter species appears to extend from the Amazon, where Mr. Wallace collected specimens in the neighbourhood of Para, to South Brazil, where Prince Maximilian of Neuwied notices its occurrence under the name of *Troglodytes gladiator,* Beit. iii. p. 751.

4. Cyphorinus albigularis, Sclater.

C. intense rufo-brunneus: alis extus obsolete nigro-fasciolatis; cauda nigra, brunneo fasciata: capitis lateribus nigris; superciliis posticis et gutture toto pure albis: abdomine crissoque nigris, fasciis minutis albidis transvittatis: rostro nigro, tomiis pallidis: pedibus nigris.

Long. tota 5·75, alæ 2·7, caudæ 2·1.

Hab. in Isthmo Panama.

This fine large typical *Cyphorinus,* distinguishable by its pure white throat and dark closely-banded under plumage, is also due to the researches of M. Delattre, by whom it was brought from the Isthmus of Panama. The only species I can find which resembles it in some degree is *Cyphorinus leucostictus,* Cab. Orn. Notiz. in Wiegm. Archive 1844, p. 206; Schomb. Reise, iii. p. 673. sp. 37, from Mexico and Guiana; but that would appear to be a much smaller bird, and has the under parts from the chin to the belly white, with the sides and crissum reddish-brown.

Among the rare types in the Derby Museum is Mr. Eyton's *Dendrexetastes capitoides* (Cont. Orn. 1851, p. 76). This does not seem to me different from M. de Lafresnaye's *Dendrocolaptes temmincki* (Rev. et Mag. de Zool. 1851, p. 154. pl. 4), named about the same time, but I think the latter term has a slight precedence in point of date, and the bird will therefore stand as *Dendrexetastes temmincki,* if thought worthy of continuing to rank as a separate genus. The Derby Museum specimen is, to judge by its make, decidedly a Cayenne skin. The *Dendrocolaptes temmincki* in the Leyden Museum is said to be from Bogota.

* Lesson, Rev. Zool. 1839, p. 42. *R. pileo rufo: dorso et alis brunneo-rufis: corpore infra niveo, lateribus griseis*

† Lesson, Traité d'Orn. p. 377. *Vert-olivâtre en dessus, jaune en dessous!*

Upon examining Dr. Kaup's *Psaris fraseri*, of the Proc. Zool. Soc. 1851, p. 47, I found it the same as *Tityra albitorques*, Du Bus, Bull. Ac. Brux. 1847, xiv. pt. 2. p. 104; and his *Psaris parinus*, ib. p. 48, seems to me very closely allied to, if not identical with, *Pachyramphus atricapillus* (Gm.), Pl. Enl. 687. fig. 1.

I can also confirm what Dr. Hartlaub has said in Wiegmann's Archiv, 1854, that *Todirostrum pectorale*, Kp., of the same paper is *T. granadense*, Hartl., *T. ruficeps*, Kp. = *T. multicolor*, Strickl., and *Setophaga flammea*, Kp. = *S. intermedia*, Hartl. R. Z. 1853, p. 5. But in the two latter cases Dr. Kaup's names were first given, though from the long delay in publishing the Proceedings the others were first published.

When criticising other writers, it is proper also to mention my own mistakes; and I take this opportunity therefore of stating, that my *Tænioptera striaticollis* of the Proc. Zool. Soc. 1851, p. 193 (of which the Derby Museum contains examples), has been long ago named and figured in D'Orbigny's Voyage as *Tyrannus rufiventris*, p. 312. pl. 32. fig. 2.

LINNÆAN SOCIETY.

March 4, 1856.—The President in the Chair.

The following papers were read :—

1. "Note on some Larvæ voided by Children," by Mr. E. Newman.

2. "Notice on the occurrence of *Sepia biserialis* in Cornwall," by J. Couch, Esq.

3. "A Memoir on the Development of the Ovule of *Santalum album*, with some Remarks on the Phænomena of Impregnation in Plants generally," by Prof. Henfrey.

The observations detailed in this memoir were undertaken with the object of confirming Mr. Henfrey's views on this subject, as detailed in the 21st volume of the Society's Transactions, which views coincide generally with those of Amici, Von Mohl, Müller, Hofmeister, and Tulasne, and are in opposition to those of Schleiden and Schacht. Even among the disciples of Amici, however, a certain degree of discrepancy exists in regard to the origin of the germinal vesicle, as to whether it exists before, or is formed after fecundation. Hofmeister says before. Tulasne states that he never could find it anterior to the fertilization; though, he adds, "this delicate question no longer (1849) possesses all the interest which was accorded to it by MM. Mirbel and Brongniart, and more recently by Mr. Henfrey. It is true the existence of the embryonary vesicle at a period anterior to the arrival of the pollen-tube would, if placed beyond doubt, prove invincibly that this vesicle could not owe its origin to the latter organ: even now that the error of the pollinists is no longer uncertain, the question seems worthy of attention, especially on account of the theoretical consequences involved." Confidently as Tulasne expressed himself as to the origin of the germinal vesicle independently of the apex of the pollen-tube, this very point is most warmly contested by Schacht.

Notwithstanding a tolerably positive opinion, derived from a number of cases in which the end of the pollen-tube and the germinal vesicle were seen together, but distinct, in one preparation, the objects are so delicate, and the causes producing obscurity so difficult to guard against, that Mr. Henfrey cannot but think the demonstration of the pre-existence of the germinal vesicle in the embryo-sac must be considered the most important fact that can be brought forward in opposition to the views of Schleiden. As remarked by Tulasne, it has great philosophical importance in reference to the speculations as to the source of the vitality of the new being; and it is no less important for the establishment of the relations of the processes of embryogeny in the various classes of plants, and of the analogy which these present to phænomena attending the reproduction of animals. The details of Mr. Henfrey's researches were given with great exactness, and were illustrated by many excellent sketches. The memoir was chiefly occupied in describing the course of development of the ovule of one plant, in which the complete series of observations have been repeated many times. Other fragmentary corroborative researches being set aside, the facts detailed, though not now brought forward for the first time, were offered as supplementary, partly confirmatory, partly emendatory, of the memoirs on the same subject by the late Mr. Griffith. "The investigation itself," Mr. Henfrey remarked, "had derived a melancholy interest from the materials having been furnished by the late lamented Dr. Stocks."

After describing many of his microscopic examinations, Mr. Henfrey continues, "I have directed my utmost efforts to the accurate observation of the ends of the embryo-sacs with the pollen-tubes adherent. They are tolerably easily extracted with needles under a low doublet. I have examined at least five-and-twenty, and have applied every means to make the structures clear. . . . . The end of the pollen-tube adheres so firmly to the end of the embryo-sac, that it cannot be torn away in a really fertilized ovule. My decided opinion is that Griffith was in error in stating that the pollen penetrates into the embryo-sac; I believe that it only applies itself firmly against it, over the point where the line of division exists between the two coagula lying in the apex of the embryo-sac. But I incline to believe that a phænomenon analogous to *conjugation* takes place. Moreover, very soon after the pollen-tube becomes adherent, the pre-existing protoplasmic globule acquires a proper coat of cell-membrane, becomes a real cell, the germinal vesicle from which the suspensor is developed. I think the contents of the pollen-tube, after it becomes adherent to the summit of the embryo-sac, pass into the latter, reach the germ-globule, and determine its conversion into a cell. . . . . The facts relating to the germination of the Fucaceæ and Confervæ described by Thuret and Cohn, together with those brought forward in this paper, tend to prove that the process of impregnation in plants consists in the absolute admixture of the protoplasmic substance of two cells ('male' and 'female'), of which the female (or germinal) substance or body always pre-exists in the form of a nucleus, or 'protoplast,' while the male (or spermatic) substance exists in the form of a granulose fluid. In the flowering plants the spermatic fluid is conveyed directly into the embryo-sac by the channel of the pollen-tube; a similar process appears to exist in the conjugation of some of the lower Algæ; in other cases the spermatic fluid is conveyed from organs situated at a distance from the parent-cell of the germinal vesicle by the agency of the locomotive structures (spermatozoids) developed in the spermatic cells, bathed in and discharged with their contents, and themselves composed of the nitrogenous protoplasmic matter of cell-contents." A series of thirty-six clever microscopic figures was given in illustration of the memoir.

GEOLOGICAL SOCIETY.

February 20, 1856.—D. Sharpe, Esq., President, in the Chair.

"On the Affinities of the great extinct Bird (*Gastornis parisiensis*, Hébert) from the lower Eocene near Paris." By Prof. Owen, F.R.S., F.G.S.

Prof. Owen communicated the results of his comparisons of the fossil tibia of the *Gastornis parisiensis*, Hébert,—a large bird from the lower Eocene deposits at Meudon near Paris—with the tibiæ of known recent and fossil birds.

The tibia of the *Gastornis* presents the same median position of the supra-tendinal bridge as in the Albatross and the lamellirostral web-footed birds; but, as the same position of the bridge occurs in the *Notornis*, the Gallinule, the Raven, and some accipitrine birds, that character is not conclusive of the affinities of the *Gastornis* to the Palmipeds; and it is further invalidated by a difference in the aspect of the plane of the lower outlet of the bridge. In the Albatross (*Diomedæa*) and the Lamellirostres, the foramen or outlet looks directly forwards; its plane is vertical. In the oblique aspect of that outlet, the *Gastornis* more resembles the large Waders (*Grallæ*) and the *Dinornis* tribe. Amongst the *Gallinaceæ*, the Turkey (*Meleagris*) nearly resembles the *Gastornis* in the position of the bridge; and more nearly resembles it than does the Albatross or the Swan in the low tuberosity external to the bridge above the base of the outer condyle, as well as in the shallow groove dividing that tuberosity from the bridge. The depression on the fore-part of the tibia above the distal condyles, if natural to the *Gastornis*, is a structure not precisely repeated in any of the *Grallæ*. In the *Ciconia Argala* the anterior interspace of the condyles forms a cavity, bounded above by the tubercle and ridge developed from the bridge, and by the oblique converging upper borders of the condyles below. The canal of the bridge opens below into the concavity. In the *Grus Antigone* the lower border of the outlet of the bridge defines, with a tubercle external to it, the shallow supracondyloid cavity; but there is no definite fossa, like that in the *Gastornis*.

In the *Notornis*, the breadth of the lower end of the tibia a little exceeds the depth or fore-and-aft diameter of the condyles. The supra-tendinal bridge is of moderate breadth, is transverse, and median in position; its lower outlet looks forward just above the wide and shallow intercondyloid space. The extinct *Aptornis* chiefly differs from the *Notornis* in the less median position of the bridge, and in the more shallow canal leading to it. In the *Dinornis*, the breadth and depth of the condyles are equal; the outer condyle is the broadest, the inner one is the most prominent; their articular surfaces are so continuous as to leave no space answering to the intercondyloid space in the *Aptornis*, *Notornis*, &c. The bridge is situated nearer the inner side of the bone, is subtransverse, rather narrow, with a widely elliptical lower outlet opening above the inner condyle.

The *Gastornis* was a bird of the size of the Ostrich, but with more bulky proportions, and in that respect more resembling the *Dinornis*: it appears to have had nearer affinities with the wading order, and therein, perhaps, to the *Rallidæ*; but the modifications of its tibia indicate a genus of birds distinct from all previously known genera.

"Description of some Mammalian Fossils from the Red Crag of Suffolk." By Prof. Owen, F.R.S., F.G.S.

The fossils described in this paper were referred by the author to the following genera and species:—*Rhinoceros*, a species nearly allied to, if not identical with, *Rh. Schleiermacheri*, Kaup; from crag-pits at Wolverston, Sutton, and Felixstow, Suffolk. *Tapirus priscus*, Kaup; from Sutton. *Sus palæochœrus*, Kaup; from Sutton. *Sus antiquus*, Kaup; from Ramsholt, Suffolk. *Equus*: two species, one apparently *Eq. plicidens*, Owen; from Bawdsey, Suffolk. *Cervus dicranocerus*, Kaup; from Ipswich and Sutton. *Cervus megaceros*, from Felixstow. *Ursus*, sp. indet., less than *Ur. spelæus*. *Canis*, apparently *C. Lupus*. *Felix pardoïdes*, Owen; from Newbourn, Suffolk. *Mastodon longirostris*, Kaup; from Sutton, Felixstow, and Ipswich. *Ziphius longirostris*, Cuv. (*Dioplodon Becanii*, Gervais); *Hoplocetus crassidens*, Gervais; *Balænodon affinis*, *Bal. definita*, *Bal. gibbosa*, *Bal. emarginata*, Owen; and remains of species of *Delphinus*, of the size of the Grampus.

The conclusion which the author deduced from the large proportion of miocene forms of mammalia, and the very great numerical superiority of individual fossil specimens from the Red Crag referable to miocene species, and from the admixture of these fossils with a few eocene and pleistocene species, was that the Red Crag was the *débris* of former tertiary strata of different periods, and, in a great proportion, of the miocene period.

MISCELLANEOUS.

The British Museum—its Catalogues and accessions in Zoology.

"It is with great pleasure," said the Prince Charles Bonaparte, in presenting the Academy of Sciences of Paris with a copy of Dr. Gray's recent 'Catalogue of the Tortoises,' "it is with great pleasure that I lay before you this new work on the Chelonian Reptiles, because it is a true model of what the catalogues of great museums ought to be, taking the science at its standing point, and furnishing figures of new or doubtful species and of such as have been ill represented. In one word, it is a work worthy of its author, of the national establishment in which he presides over the Zoological Department, and, above all, of the Administrators or 'Trustees' under whose charge it is. These enlightened statesmen, raised above low intrigues and personal considerations, although imbued with a spirit of order and strict economy, know how to avoid parsimony when the advancement of science is in question. Of this, the publication of this fine book by order of these 'Trustees' is a fresh proof, and the thanks of the scientific world are due to them for it."

If there be any class of men to whom the old proverb, that "a prophet is without honour in his own country," may be more especially applied, it is undoubtedly to our British zoologists; for while plain Brown, Jones, and Robinson may bawl themselves hoarse without finding a hearer, the moment Professor Schafskopf or Herr von Windbeutel makes his appearance he is greeted with unanimous applause; every opinion he puts forward is treasured up as so much gospel; and although here and there a thorough John Bull may be found to stand up for the merits of his countrymen, most of us are as little inclined to abate one jot of our exclusive faith in foreign scientific literature, as was mine 'host of the Garter' to suspect the honesty of his German customers. Under these circumstances it is very gratifying to find that the continental *savans* themselves by no means treat the labours of our British zoologists with contempt, and we have thought it worth while to quote the above passage from Prince Charles Bonaparte's oration, as it serves to show the estimation in which one of a long series of works, but little known to many of our readers, is held by one who is certainly no mean authority in such matters.

The books here referred to are the Catalogues of the Zoological Collections in the British Museum, which have now been appearing in constantly increasing numbers for a period of twelve or thirteen years. The value of their contents has also partaken of this progress; for instead of the "Lists," containing merely the names of the species existing in the national collection, with a few of the most important synonyms, which constituted the earlier volumes, those recently published generally include all the described species of the group on which they treat, accompanied by a full synonymy and descriptions of the new species; whilst in many cases the characters of all the species, and those of the genera and other groups are given. This applies especially to the Catalogues prepared by Dr. Gray himself, which embrace a portion of the Mammalia (the *Cetacea*, *Pinnipedia*, and *Ruminantia*), the whole of the Reptiles with the exception of the Colubrine Snakes, and the Cartilaginous Fishes; but some of Mr. Walker's and Mr. Smith's recent Entomological Catalogues present the same feature. Many of them also are accompanied by plates illustrative of the characters of the new genera, or, as in Dr. Gray's Catalogues of Mammalia, of all the genera; and it is with a view to the more effective illustration of the subjects that these books have lately cast off the form of unpretending duodecimos, in which they originally appeared, and come out boldly as quartos. Such is the 'Catalogue of Chelonian Reptiles' referred to by Prince Bonaparte in the above extract, which is illustrated by some admirable plates of Tortoises by Mr. G. H. Ford; and such is also the excellent Catalogue of the *Papilionidæ* not long since brought out by Mr. G. R. Gray, which contains coloured figures of the new species described. We must therefore echo His Imperial Highness's expression of thankfulness to the Trustees for placing within our reach, at a moderate price, such a mass of valuable zoological literature.

In connexion with this subject we may also call attention to the vast additions which have been made to the zoological collections in the Museum in the course of the last twenty years, but especially since 1840, as shown in the following table, derived from the Parliamentary returns, as this more than anything will serve to show, not only the energy displayed in the conduct of the Department, but also the abundance of materials at the disposal of the authors of the different catalogues to enable them to render their works as perfect as possible :—

Additions made to the Zoological Collections in the British Museum during the years 1836 *to* 1855 *inclusive.*

	Vertebrata.	Insects and Crustacea.	Other Invertebrata.	Total.
1836.	302	1,755	248	2,305
1837.	1923	233	4,779	6,935
1838.	1088	1,807	803	3,698
1839.	1019	7,049	1,558	9,626
1840.	654	12,371	8,164	21,976
1841.	1936	3,744	11,345	16,238
1842.	2740	5,125	10,877	18,742
1843.	4503	10,221	6,150	20,874
1844.	3517	19,191	10,200	32,908
1845.	5842	8,868	2,688	17,398
1846.	4535	10,181	3,960	18,678
1847.	2396	6,337	5,524	14,266
1848.	2717	11,566	3,661	17,944
1849.	1608	5,011	3,559	10,178
1850.	2251	7,260	3,827	13,338
1851.	2889	9,438	8,415	20,742
1852.	2303	8,237	5,724	16,264
1853.	1979	105,406	5,015	112,400
1854.	903	9,663	13,847	24,413
1855.	4865	15,173	4,340	24,378
				422,301

Note on the Development of the Lampreys. By M. Schultze.

The author has examined the development of the ova of *Petromyzon Planeri*, which occurs commonly in a small brook near Berlin. The ova were artificially impregnated. The mature ova are white and opake; they possess a viscous, temporary outer envelope, and a finer delicate chorion (*membrane coquillière* of Vogt). The latter is finely punctured, and appears to be pierced by minute tubes, as in other fishes. The vitellus is furnished with an extremely delicate vitelline membrane. No micropyle could be discovered.

The segmentation of the vitellus commences six hours after impregnation. It implicates the whole of the yelk, and differs in this respect from that which occurs in other fishes, in which only a small portion of the vitellus (formative vitellus) undergoes this transformation. The segmentation of the vitellus in the Lampreys is exactly the same as in the Frogs, and the vitelline membrane furnishes very delicate envelopes for the segments, which are true cells.

The two first furrows are perpendicular, whilst the third is transverse, separating the egg into upper and lower portions. The segmentation goes on much more rapidly in the upper half, so that when the segmentation is complete (two days after fecundation), the cells contained in it are much smaller than those in the lower portion. During this period a large cavity is formed in the interior of the egg, but situated almost entirely in the upper part, which it dilates into a thin vesicle, whilst its bottom is formed by the large cells of the lower part of the egg. As in the eggs of the Frogs, this cavity disappears during the further development, and its purpose is not known.

The first changes which take place after segmentation consist in the increase of the upper part, which grows over the lower and covers it,—not equally on all parts of the circumference, but only on one side, by a margin in the form of a high ridge. At the side of the latter and beneath it, a hollow is formed in the lower part of the egg, corresponding to the anus in the eggs of the Frog. This is the entrance to a second cavity, the *primitive alimentary cavity*, which is developed during the diminution of the cavity of segmentation; it subsequently becomes the anus of the Lamprey, and is therefore the first portion of the fish to make its appearance. No trace of vibratile cilia is distinguishable on the surface of the egg, which does not exhibit any rotatory movement like that which distinguishes the eggs of the Frog. On the fifth day, dorsal ridges, like those of the Batrachia, make their appearance, and the dorsal furrow which is situated between them soon closes above; the extremity of the head now rises distinctly, whilst the anus constantly becomes smaller, but never disappears entirely. In the meantime the primitive alimentary cavity extends up to the extremity of the head of the embryo, whilst it disappears gradually in the neighbourhood of the anus, from the approximation of the large cells of the lower portion of the yelk, by which it was enclosed. In this way the primitive alimentary cavity, which never exhibits vibratile cilia in its interior, becomes the pharyngeal, and subsequently the branchial cavity. At this time also the *chorda dorsalis* and the heart make their appearance; the latter only makes sixteen pulsations in a minute. On the sides of the *chorda dorsalis* appear parts which become the lateral muscles (*vertebral divisions* of Vogt); above it are the commencements of the spinal cord and the cerebellum, the latter only forming a clavate inflation of the former, as in *Amphioxus*.

On the fourteenth day the young Lampreys, $1\frac{1}{2}$ line in length, languid, white and opaque, quit the egg; they are incapable of rising from the bottom of the vessel. In the inflated extremity of the hinder part of the body are the large cells formed by the segmentation of the lower half of the vitellus; they are filled with the elements of the yelk, and do not entirely disappear for three or four weeks after exclusion. During this period the young fishes take no nourishment.

After leaving the egg, the branchial apertures are formed successively by wrinklings of the skin, which attain the number of seven on each side, and become constantly deeper until they reach the pharyngeal cavity. At the same time another wrinkle of the skin produces the mouth; and above the anterior extremity of the *chorda dorsalis*, between the skin and the cerebellum, there appears a spot of black pigment, which constitutes the eye. This is formed in the manner of the eye in the Invertebrata. Behind the eye, and near the brain, a large clear cell becomes filled with calcareous granules; this is the auditory vesicle, with the otolithes. The heart divides distinctly into ventricle and auricle, and the peripheric portion of the vascular system is developed. Behind the heart some large yellowish cells form the liver.

At the bottom of the branchial apertures the branchial filaments spring from the partitions; they are never furnished with vibratile cilia. The cartilaginous branchial arches commence their development from the *chorda dorsalis*, and passing beneath the skin of the partitions soon meet beneath, forming a branchial skeleton exactly like that of the mature Lamprey. Beneath the branchial cavity the branchial artery is produced, and between this and the skin a long oval gland, composed of small granulated cells, is formed. It is situated in a cavity with soft walls, which it fits exactly, and its surface is covered with vibratile cilia. The author regards it as a thymus gland, but it does not exist in the mature fish.

Round the mouth are formed the upper and lower lips, and two lateral flaps united with the upper lip. The young animal becomes more and more transparent; but in several parts of its body, especially over the artery and vein beneath the *chorda dorsalis*, cells of black pigment are deposited in a stellate form. Here also numerous adipose cells are developed, from which some small papillæ arise above the heart and liver; these are directed towards the abdominal side, and oscillate freely; they also bear on their surface a longitudinal range of cilia. The author doubts whether they are the first rudiments of the kidneys or of the Wolffian body, as he subsequently saw the formation of a tortuous canal further back, but still above the liver, which presented no oscillations, and which perhaps would become the Wolffian body, discovered in other fishes not long since by M. Reichert. When the membranes of the intestine are developed, and the residue of the vitelline mass is consumed, a vibratile epithelium is seen in the posterior portion of the digestive tube.

This is at four weeks after exclusion, and it is only then that the young Lampreys take some nourishment from the mud in which they delight to bury themselves. Some cartilages also now make their appearance at the anterior extremity of the *chorda dorsalis*; these are the foundations of the basilar cartilage of the cranium. The eyes are still deeply immersed in the skin, but the auditory vesicles are enlarged and the number of otolithes increased. A single olfactory organ, a small cavity covered with a vibratile epithelium, is situated in front of the brain, and receives a short, thick, olfactory nerve. It is remarkable, that four weeks after exclusion there was no trace of peripheric nerves, either in the head or body, although the spinal cord is very thick.—*Comptes Rendus*, Feb. 18, 1856, p. 336.

CLAUSILIA MORTILLETI.

To the Editors of the Annals of Natural History.

Cheltenham, March 30, 1856.

GENTLEMEN,—My attention was only very lately directed to a note from Herr Adolf Schmidt, of Aschersleben, in your 'Annals' for January last, mentioning the occurrence of *Clausilia Mortilleti*, Dumt., near Cheltenham.

In the autumn of last year I found a *Clausilia* in this neighbourhood, which I at first suspected might be *Clausilia Rolphii*, a species I have always hoped to find in this county. I sent three specimens to the British Museum, with the statement, that if not *C. Rolphii*, with which I was not acquainted, and the figure and description of which differ widely from each other and from the species itself in Turton's 'Manual,' it was probably *Cl. Mortilleti*, Dumt. I subsequently sent two examples of the same to Herr A. Schmidt, from whom I had previously received continental shells, with the note, that if it was not a very ventricose variety of *Clausilia rugosa*, it was probably *Clausilia Mortilleti*.

In this neighbourhood the species is extremely local. I found it in company with *Azeca tridens*, among nettles and long grass, in a damp and shaded locality, and did not procure more than a dozen examples altogether. It is not a very well marked species; but, in addition to structural points of difference, its "habit" is unlike that of *C. rugosa*.

I am, Gentlemen, yours obediently,

CHARLES PRENTICE.

On a supposed New Species of the Genus Equus. By M. I. GEOFFROY SAINT-HILAIRE.

The Empress of the French has recently received as a present from the Viceroy of Egypt, and presented to the Menagerie of the Jardin des Plantes, two specimens of an Equine animal, which M. Geoffroy Saint-Hilaire considers to be a new species. It belongs to the section of the great genus *Equus* of which Dr. Gray has formed his genus *Asinus*. It is most nearly allied to the Djiggetai (*Equus* (*Asinus*) *Hemionus*), but differs from that species in the smaller size and better shape of the head, its shorter ears, and its tail partially covered with long hairs. It thus appears to be intermediate between the Djiggetai and the Horse, for which reason M. Saint-Hilaire proposes to name it *Equus hemippus*. Its colour is the same as that of the Djiggetai, and, like that species, it has a blackish mane and dorsal line. It is supposed to be a native of the deserts of Syria between Palmyra and Bagdad.—*Comptes Rendus*, Dec. 31, 1855, p. 1214.

METEOROLOGICAL OBSERVATIONS FOR MARCH 1856.

Chiswick.—March 1. Cloudy: fine. 2. Cloudy: slight rain. 3, 4. Cloudy and cold. 5. Overcast. 6. Cloudy and cold: fine. 7. Cloudy: fine. 8. Fine: slight rain. 9. Cloudy. 10. Foggy: fine. 11. Foggy: hazy: frosty at night. 12. Clear and frosty: cloudy and windy. 13. Cold and dry. 14. Excessively cold wind: clear, cold and dry. 15. Cloudy. 16. Slight haze: heavy rain at night. 17. Hazy. 18. Hazy: fine rain. 19, 20. Hazy: overcast. 21. Hazy: cloudy. 22. Overcast: fine. 23. Hazy: fine: clear. 24, 25. Hazy and cold. 26. Cloudy and cold. 27. Clear: fine: frosty. 28. Cloudy and cold. 29. Dry cold haze: frosty at night. 30. Slight haze: fine: sharp frost. 31. Slight haze: very fine: frosty.

Mean temperature of the month	38°·95
Mean temperature of March 1855	37 ·61
Mean temperature of March for the last thirty years	42 ·09
Average amount of rain in March	1·344 inch.

Boston.—March 1, 2. Cloudy. 3. Cloudy: rain P.M. 4, 5. Cloudy. 6. Cloudy: rain A.M. 7—9. Fine. 10. Cloudy. 11. Cloudy: snow A.M. 12, 13. Cloudy. 14. Fine. 15. Cloudy. 16. Fine. 17. Cloudy: rain A.M. and P.M. 18. Cloudy: rain P.M. 19. Cloudy: rain A.M. 20. Cloudy. 21. Cloudy: rain A.M. and P.M. 22—26. Cloudy. 27. Fine. 28. Cloudy. 29—31. Fine.

Sandwick Manse, Orkney.—March 1. Cloudy A.M.: fine, drizzle P.M. 2. Drizzle A.M.: fine, cloudy P.M. 3. Damp A.M.: fine, clear P.M. 4. Showers, fine A.M.: fine, cloudy P.M. 5. Damp A.M.: fine, aurora P.M. 6. Drops A.M.: fine P.M. 7. Fog A.M. and P.M. 8. Showers A.M.: fine, aurora P.M. 9. Showers A.M.: cloudy P.M. 10. Frost A.M.: clear, frost P.M. 11, 12. Snow-showers A.M. and P.M. 13. Snow, frost A.M.: clear, frost P.M. 14. Clear, frost A.M.: very clear P.M. 15. Bright A.M.: very clear, aurora P.M. 16. Clear A.M.: very clear P.M. 17. Bright A.M.: cloudy P.M. 18. Cloudy A.M. and P.M. 19. Bright A.M.: cloudy P.M. 20, 21. Cloudy, fine A.M. and P.M. 22. Bright, fine A.M.: clear, fine P.M. 23, 24. Cloudy A.M.: cloudy, fine P.M. 25. Cloudy A.M.: clear, fine P.M. 26. Bright A.M.: cloudy, fine P.M. 27. Bright A.M.: clear, aurora P.M. 28. Cloudy A.M.: very clear, fine P.M. 29. Clear A.M.: very clear, fine P.M. 30. Cloudy A.M.: very clear, fine, aurora P.M. 31. Bright A.M.: cloudy, fine P.M.

Mean temperature of March for previous twenty-nine years...	40°·40
Mean temperature of this month	40 ·39
Mean temperature of March 1855	36 ·61
Average quantity of rain in March for fifteen previous years .	2·60 inches.

This month has been unprecedentedly dry, the rain being only about one-eighth of the average for March, and less than that of any month during my observations, except April 1852, when it was only ·11 of an inch. Rain fell only on eight days.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. March.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·606	30·584	30·24	30·50	30·54	44	40	41	46	45½	ne.	n.	w.	....	....	....
2.	30·569	30·556	30·20	30·59	30·64	46	37	45	47½	43	ne.	ne.	w.	·01	....	·04
3.	30·577	30·530	30·22	30·61	30·55	44	35	41·5	43½	42	ne.	n.	wsw.	....	....	....
4.	30·539	30·475	30·18	30·43	30·37	44	33	38·5	44	44½	ne.	n.	w.	....	·02	·04
5.	30·286	30·177	29·95	30·20	30·26	46	33	35	47	41	ne.	n.	nnw.	....	....	....
● 6.	30·197	30·139	29·84	30·27	30·32	44	27	40	40	40½	ne.	n.	w.	·01	·02	·01
7.	30·350	30·230	29·98	30·28	30·25	44	21	36·5	46	44	ne.	n.	wnw.	....	....	....
8.	30·341	30·297	29·98	30·20	30·20	52	26	34·5	46	44½	se.	nw.	w.	....	....	·07
9.	30·232	30·131	29·80	29·92	30·02	51	25	38	46	37½	w.	w.	nw.	....	....	·02
10.	30·126	30·079	29·73	30·09	30·18	51	35	43·5	34½	30	n.	ne.	......	....	....	·01
11.	30·080	29·983	29·77	29·87	30·05	44	19	40	35	29	c.	s.	nnw.	....	....	·05
12.	30·006	29·944	29·70	30·09	30·08	43	31	38	32	32	ne.	ne.	s.	....	·02	·07
☽ 13.	30·070	29·988	29·80	30·10	30·27	42	31	36	36	34	e.	e.	s.	....	....	·03
14.	30·140	30·103	29·95	30·39	30·46	43	28	36	38	36	e.	e.	se.	....	....	....
15.	30·144	30·090	29·94	30·42	30·36	46	32	36	38½	36½	e.	e.	ese.	....	....	....
16.	30·023	29·949	29·75	30·23	30·15	50	39	39	42	40	e.	e.	se.	·68	....	....
17.	29·951	29·924	29·67	30·06	30·01	44	39	42	43	41	e.	ese.	se.	·02	....	....
18.	29·930	29·764	29·61	30·05	30·03	50	41	44·5	43	39	e.	e.	se.	·24	·12	....
19.	29·909	29·734	29·40	29·91	29·93	51	41	46·5	42½	39	ne.	ese.	e.	....	·02	....
20.	29·953	29·932	29·62	29·98	30·01	52	40	41·5	44	41	n.	n.	ne.	·01	....	....
○ 21.	29·985	29·896	29·56	30·00	30·04	54	30	43	44	40	n.	n.	e.	....	....	....
22.	30·063	30·051	29·74	30·12	30·19	51	25	46	44	39	n,	nw.	......	....	·05	....
23.	30·148	30·074	29·86	30·25	30·27	50	35	42	42½	40	ne.	n.	nne.	....	....	....
24.	30·144	30·007	29·85	30·22	30·17	45	36	41	42	40	e.	ne.	......	....	....	....
25.	29·909	29·828	29·62	30·11	30·11	43	35	40	41½	38½	ne.	ne.	e.	....	....	....
26.	29·879	29·852	29·66	30·14	30·12	42	29	39·5	44	37	e.	e.	sse.	....	....	....
27.	29·884	29·873	29·68	30·04	30·06	51	21	36·5	38	37	ne.	ne.	nne.	....	....	....
28.	29·979	29·913	29·68	30·09	30·19	47	29	40	42	33	ne.	n.	e.	....	....	....
☾ 29.	30·232	30·144	29·92	30·19	30·17	44	17	36	41	40	e.	e.	wsw.	....	....	....
30.	30·243	30·212	29·96	30·08	30·02	52	15	32	41	36	e.	s.	ese.	....	....	....
31.	30·152	30·018	29·86	29·86	29·77	60	20	32	44	45½	s.	se.	s.	....	....	....
Mean.	30·111	30·079	29·83	30·170	30·186	47·42	30·48	39·4	41·88	38·90				0·97	0·25	0·34

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 102. JUNE 1856.

XLI.—*On the British* Diastylidæ. By C. Spence Bate, F.L.S.

[With three Plates.]

The first recorded specimen of the anomalous group of Crustacea which forms the subject of the present memoir, was that figured by Col. Montagu in the 'Transactions of the Linnæan Society,' vol. ix., as *Cancer scorpioides*. He there describes it as a mutilated specimen, and the only one which he had observed. The head or forepart he believed to have been wanting, and thus accounted for his inability to detect the eyes or antennæ. But still, from the general appearance of the creature, he thought it entitled to a place amongst the *Cancri*,—which term appears to be with him synonymous with *Crustacea*, exclusive of the Isopoda and the Entomostraca,—and that it bore a near relation to *Cancer esca* of Gmelin.

Say, in the 1st volume of the 'Transactions of the Philadelphia Philosophical Society,' describes a Crustacean under the name of *Diastylis*, which he affirms to be of the same genus as the *Cancer scorpioides* of Montagu and the *Cancer esca* of Gmelin.

In the 13th volume of the 'Annales des Sciences Naturelles,' Dr. Milne-Edwards has described another specimen, under the name of *Cuma Audouinii*; but this he afterwards, in his 'Histoire des Crustacés,' qualified with a doubt as to whether it might not be the immature form of some known Decapod.

This last opinion has been recently supported by the assertion of Professor Agassiz to Mr. Dana, that the *Cumæ* were the larvæ of certain Macroura. Consequently the most recent and one of the most important works on the subject, Mr. Dana's great work on Crustacea, contains the following passage:—"But according to recent observations by Prof. Agassiz, communicated by him to the author, the *Cumæ* are in part, if not always, the young or immature forms of certain Macroura, as *Alphæus, Palæmon,* and *Hippolyte.* This distinguished observer has actually obtained *Cumæ* from the eggs of *Crangon septemspinosus, Palæmon vulgaris,* and *Hippolyte aculeata.*"

A communication made by so eminent a man is like the sound of a trumpet, the voice of which extends to the farthest limits of the earth, and long is the time ere its echo shall cease to be repeated.

Agassiz says that he has "*actually obtained Cumæ* from the eggs of *Macroura.*" This strong assertion by so great a man will require the clearest evidence that careful investigation can produce in order to demonstrate its error and to elucidate the truth, that the *Cumæ* are adult animals perfect in themselves, and that they belong to the suborder Stomapoda among Crustacea, in which they form a family of themselves, the *Diastylidæ.*

I have chosen this name from the earliest given to a genus of the family, which appears moreover to be the type of the group; also as considering the term *Diastylis* to be more significant in relation to the form of the animal than either of the other generic names in the family.

Kroyer, in his illustrations to the 'Voyages en Scandinavie,' &c., has figured several species most carefully and most correctly, in accordance with the usual practice of that eminent carcinologist. More recently Mr. Goodsir, in the Edinburgh New Philosophical Journal for 1843 (in a paper which has been reprinted in full in Bell's 'British Crustacea'), has described all the known British forms, and with the exception of Kroyer, whose work Mr. Goodsir appears not to have been aware of, has entered more fully into the subject than any previous author. He has recognized their true character as animals in their adult condition, and considers that they should be ranged with the lower forms of Macroura, and between them and the Stomapoda. With this, Prof. Bell in his 'British Crustacea' entirely agrees, and has included these anomalous forms of Sessile-eyed Crustacea amongst the Podophthalma.

Sir James Dalyell, in his fine work on the 'Rare Animals of Scotland,' has figured one or more species, without adding much, *we believe,* to the knowledge of either the structure or habits of the animals.

The first step will therefore be to describe the separate parts of the dismembered animal; and although this to a certain extent has been done by Kroyer, yet his great work is in the hands of so few, that it will scarcely be deemed a work of supererogation even to repeat some that he has well displayed, and by this means we shall be enabled homologically to consider the relation which their several parts hold to the same respectively in the larvæ of the Decapoda, and demonstrate not only that the *Cumæ* are not the young of certain Macroura, but that they are animals complete in their development and capable of the production of others of their own form.

That the *Diastylidæ* are a depauperized family, there can, I think, be no doubt; yet it is one of those forms in creation which assist to destroy the popular theory of authors, of a gradual rise in the gradation of animal existence; for though in classification we place them among the higher types, yet there can be little doubt that in organized perfection they are less complete than those of animals below them in the natural scale of arrangement.

Genus Diastylis.

Diastylis, Say, Trans. Phil. Soc. Philad. vol. i.
Alauna, Goodsir, Edin. New Phil. Journ. (1843).
Cuma, Kroyer (Voyages en Scand. &c.).

Carapace with the lateral angles developed anteriorly, and meeting without uniting in front of the eye and antennal segments, and produced anteriorly in the form of a rostrum. Eyes confluent, and situated as a single organ on the top. Five segments of the thorax exposed behind the carapace. Upper antenna short, scarcely reaching to the anterior margin of the carapace. Lower antenna longer than the upper. First five abdominal segments without appendages, except the two anterior in the male only. The sixth furnished with a pair of members terminating with double stylets. The *telson** produced into a long styliform process.

Diastylis Rathkii. Pl. XIII.

Cuma Rathkii, Kroyer.
Alauna rostrata, Goodsir.

The genus *Bodotria* is perhaps the highest form in the family; but since my opportunity of dissection has been more complete on the *Alauna* of Goodsir, which I believe to be of the same genus as *Diastylis* of Say, I shall take this latter as the type of the whole family, and under their respective heads trace the generic or specific differences in the group.

The first character in the general appearance of one of these animals that strikes the observer is that of its being a mutilated creature,—an idea present to the mind of Montagu when

* From *τέλσον, extremity*. The centre tail-piece in Crustacea generally; the twenty-first segment in the homologies.

he described and figured in the 'Linnæan Transactions' the animal in the collection at the British Museum. From the reduced form of the members generally, many appear, on a careless examination, to be wanting; hence it is that both Say and Montagu mistook the character of their respective species.

Taking each of the segments in succession, we observe that that which supports the first pair of appendages in Crustacea is strongly marked as an independent segment, both in *Squilla* among the Stomapoda, and *Palinurus* among the Decapoda; and that in the Decapoda when the segment itself is absent, the eyes are still borne on projecting peduncles; but in the whole of this group not only is the segment absent, but the peduncles themselves are wanting; and the eyes not only lose their *podophthalmic* character, but the two are so closely associated as to appear, as they probably are, but a single organ, and to general observation fixed in the centre of the carapace, in which anomalous position they have been described by those who have discovered the organ, except Kroyer.

The second segment, or that which supports the first or internal pair of antennæ, is closely associated with the third, or that which bears the second or external pair of antennæ; the two segments united together are attached to the next succeeding by the posterior margin only, which is somewhat broader than the anterior, the centre of which is slightly advanced, as if to cover the organ of vision. The fourth segment, or that which supports the mandibles, is developed posteriorly to the preceding, to which it is united by the entire width of the anterior segment, but only at its posterior margin, for the lateral edges, unlike what is found in the perfect Macroura, are free. The lateral processes or wings of the mandibular segment extend considerably forward on each side of the segments which bear the antennæ, and meet without uniting in front of the same. This segment forms nearly the whole of the carapace, and surrounds the anterior segments, which appear as a central patch on the dorsal surface.

The carapace is developed from the same segments as in the perfect Macroura, but in this tribe covers only the first two or three instead of all the segments of the thorax;—obedient to a law which I think has been made out in a previous paper (see Ann. Nat. Hist. July 1855), that the anterior portion of the carapace lessens in importance in relation to the posterior, and that the whole decreases as the animal descends in the scale of nervous centralization. Consequently the great buckler, which in the Brachyura and Macroura protects the whole of the thoracic portion of the animal, extends its defence only over the two anterior segments; the last five are seen posterior to the carapace, and, unlike the same segments in the higher forms, have the dorsal portion complete, and each is developed into a perfect ring to which the respective thoracic legs are attached.

The seven succeeding segments belong to the abdomen, and are unfurnished with appendages, except the penultimate, which is supplied with a pair of double-branched stylets, from which peculiarity of form Say derived his generic name for the American species. In the male however the first two segments are each supplied with a pair of short, stout, styliform appendages, which are probably intromittent organs, since they homologize with those which are known as such in the higher forms. The last segment is developed into a caudal style, the edges of which are furnished with short spinules: near the centre of this articulation debouches the alimentary canal.

The upper or interior antenna is short and pyriform, apparently consisting of a peduncle, which is formed of a single segment and a short filamentary appendage of four articulations, each being furnished with a long ciliated hair (Pl. XIII. fig. 4 *a*). The whole organ does not extend beyond the rostrum-like projection of the carapace.

The lower or exterior antenna is considerably longer than the upper, and consists of a peduncle formed of a single joint and a filamentary appendage, the first two articulations of which probably homologize with the second and third joints of the peduncle in the antenna of the true Macroura, since that which we call the peduncle in this, evidently homologizes with the first, or first and second, for the olfactory organ is distinctly discernible in the middle of the segment (Pl. XIII. fig. 5 *a*), which is considerably broader than the next succeeding; we therefore think it convenient to describe it as the peduncle, and the slighter continuation as the terminal filament, rather than according to what may or may not be homologically true. The first joint of the filament is nearly as long as the peduncle, and the second considerably longer, whereas the four terminal are extremely short, each successively shorter than the preceding; the last is tipped with a slight brush of cilia, and reaches considerably in advance of the most anterior extremity of the animal.

The mandibles are the next succeeding pairs of appendages, and are very powerful organs, not developed upon the type of the Decapoda, but furnished with a molar tubercle and a comblike row of teeth or hairs as found among the Amphipoda, possessing however a long osseous tendon as in the Macroura, and therefore forming a type intermediate between the two extremes, and probably belonging to the Stomapoda (Pl. XIII. fig. 6).

The maxillæ are thin foliaceous plates intermediate in their form between the higher and the lower types (Pl. XIII. figs. 7, 8). The maxilliped (fig. 10) partakes more essentially of the higher type than that of the lower forms; it is pediform, and consists of a stout basal joint supporting five terminal smaller ones, the last of which ends in an extremely fine point; three large plumose hairs are given off from the penultimate and antepenultimate articulations. To this pair of limbs are attached the branchial appendages, which consist on each side of eight or nine secondary saccular cæca, connected with a common membranous chamber in which the blood circulates for its perfect aëration.

The two gnathopoda (or second and third maxillipeds) are developed upon the true type of the Macroura; the anterior (fig. 11) does not possess the secondary palpi, whereas the posterior (fig. 12) does, and moreover is developed so as to become the closing operculum to the mouth. The basal joint is long and broad, and its internal margin is fringed with a row of hairs, which answers to a corresponding row of teeth-like prominences in the true Macroura, where they perform the part of an efficient biting apparatus; the upper extremity of the joint extends on the outer side, slantingly forwards, and is crowned with hairs. The five terminal articulations are short and unimportant, the whole not equalling the first joint in length. This pair of limbs, together with the preceding, is attached each to one of the first two rings of the thorax, the sternal portion and lateral walls of which are alone developed.

The next succeeding pair of feet are those which homologize with the great cheliform limbs of the Decapoda (fig. 13); they are the most powerfully formed organs which the animal possesses, are considerably longer than any of the others, and reach anteriorly beyond the extreme limits of the antennæ. Each is formed of an anteriorly curved basal joint, three succeeding posteriorly curved articulations, the three together equalling in length the preceding, and two others which appear to be more freely jointed than any of the preceding, and which together equal in length the basal articulation. The basal segment is ciliated upon the convex or posterior margin, the three succeeding are furnished with long plumose cilia upon the anterior margin, and the terminal one has long simple hairs upon the posterior margin only. Arising from the coxa, which in the whole family is closely associated and probably anchylosed with the segment of the body, is the *palpe* (of M.-Edwards's earlier writings, the *exognathe* of his later),—a secondary appendage to the legs peculiar to the Stomapoda; it consists of a single articulation, and a terminal ciliated stalk or filament (*tige*) equalling in length about half that of the true leg.

The next succeeding pair of limbs (fig. 14) homologize with the (so-called) second pair of thoracic legs in the Macroura. Each agrees closely in character with the preceding, but differs in details by the increased size of the coxæ, the shortness of the joints succeeding the basal, and the very great length of the penultimate articulation of the legs: like the two preceding sets of limbs, it is furnished with a *palpe* or secondary appendage. Moreover, in the female a scale-like appendage, the *fouet* of Milne-Edwards, is attached to this, the one preceding and the next succeeding pairs of legs, forming by their mutual overlapping the incubatory pouch, in which the egg is nourished, and the embryo cherished, and the larva carried until it assumes the form of the adult animal, when it leaves the parent to seek its existence as a self-providing animal.

The three next succeeding homologize with the three posterior pairs of legs in the Decapoda, and are developed in one form (fig. 15). The first joint or *coxa* appears not to be so closely associated with the segment of the body as those belonging to the anterior legs. The second joint is long, the third short, the fourth long, and the two next intermediate; the last joint appears to be represented by a stout jointed hair.

Appendages are attached to the two next succeeding segments of the body, in the male only, these being the first two segments of the abdomen; they must therefore homologize with the styliform processes in the males of the Decapoda which are known to be intromittent organs, and probably answer the same purpose in these creatures.

The three succeeding segments are unfurnished with appendages in both sexes; but the next, the penultimate, supports a pair of a form peculiar to the family. They consist each of a long basal joint, armed with a single row of spinules upon the inner margin, and a pair of unequal terminal styliform processes slightly fringed with cilia. This pair of appendages, with the pointed terminal segment or *telson*, form the caudal appendage or tail of the animal.

The general structure of the integumentary tissues is slight: the cell-character of the original formation is readily apparent beneath the microscope, with a few granules of lime deposited in each. The colour of the animal is stated by Mr. Harry Goodsir, who took them in the Frith of Forth, as of a beautiful bright straw colour inclining to yellow. I have never seen any alive, but have received specimens from the Moray Frith from a highly esteemed correspondent, the Rev. Geo. Gordon; also from St. Ives, where it has been dredged by my friend Geo. Barlee, Esq., who also dredged a single specimen with mature larvæ off the Isle of Arran. From Falmouth I have received it from my friend W. Webster, Esq., and have taken it myself from the refuse of the trawlers in the neighbourhood of Plymouth.

Genus Cuma.

Cancer, Montagu.
Cuma, Edwards, Ann. Sc. Nat.; Goodsir, Edin. New Phil. Journ. 1843; Kroyer, Voyages en Scand.

Carapace with the lateral angles meeting in front of the confluent eye and the antennal segments, but not produced anteriorly into a rostrum-like projection. The lower anterior margin not generally receding. *Four segments* of the thorax complete, and exposed behind the carapace. The *upper antennæ* "single-jointed and scalelike" (*Goodsir*); the *lower* short and unimportant, reaching not far in advance of the carapace. *Abdomen* without appendages to the *five anterior* segments, sixth with double branched stylets, seventh or *telson* absent.

Cuma scorpioides. Pl. XIV. fig. II.

Cancer scorpioides, Montagu, Linn. Trans. vol. ix.
Cuma Audouinii, Edwards, Ann. Sc. Nat.; Goodsir, Edin. New Phil. Journ. 1843.
—— *Edwardsii*, Goodsir, Edin. New Phil. Journ. 1843.

This animal has been described by Edwards and Goodsir. I have received but a single specimen, and that taken in the Moray Frith by the Rev. Geo. Gordon, from which the present drawing was made *. Mr. Goodsir was more fortunate, having captured many, some carrying spawn. He has imagined that there were two species among them, but I am inclined to think that neither his figures nor his descriptions support this conclusion, and I believe them to have been mere varieties of the species described in the 'Annales des Sciences Naturelles,' vol. xiii., by Dr. Milne-Edwards, and that the whole, as also the one from which my own figure has been taken, are identical with the species found by Montagu and figured by him in the Linnæan Society's 'Transactions,' and still preserved in his collection in the British Museum.

Upper antennæ "rhomboidal" (*Goodsir*); lower very short, terminating but a little in advance of the carapace. The lateral angles of the carapace meeting in front of the antennal segments, but not culminating to a rostrum-like projection. A lateral ridge extends on either side from the posterior margin nearly to a level with the eye. Eyes confluent, and apparently a single organ. Thoracic feet furnished with a palpe. Telson rudimentary.

* Not wishing to destroy the only specimen that I have seen, I am not enabled to examine the animal by dissection; therefore my description is taken from the perfect creature.

The whole animal (says Goodsir) is of a fine straw colour with a delicate tinge of pink, which is brighter in certain lights.

Cuma Edwardsii. Pl. XIV. fig. IV.

Cuma Edwardsii, Kroyer, Voyages en Scand.

Carapace covering only two segments of the thorax, leaving the five posterior ones exposed as complete rings in themselves. The carapace is marked on the lateral margins as if it were divided into segments; its anterior portion extends in front of the antennal segments, the anterior inferior angle receding. The lower antenna exposed considerably in advance of the carapace. The two anterior thoracic legs succeeding the gnathopoda are extremely long, the three posterior extremely short, and all except the posterior furnished with a palpe or secondary appendage. The segments of the thorax lie very compact, and resemble a continuation of the carapace; those of the abdomen are naked, except the penultimate, which is furnished with a pair of limbs common in form to the tribe. *Telson* rudimentary.

Having seen but a single specimen, for which I am indebted to Professor Williamson, who obtained it from Weymouth and kindly sent it to me, I am not enabled to speak so positively as one could wish, but I am much inclined to believe that it should represent a separate genus. All the *Cumæ* exhibit but four segments posterior to the *carapace,* whereas this species exposes five; it is less compressed at the sides, the anterior form of the carapace is more pointed, and the antenna appears longer, but the importance of these relative parts can only be distinctly appreciated by dissection and a proper examination of the details.

It is evidently the same species as the one figured in Kroyer's great work, and until further opportunity occurs of examining its structure, it must still be retained in the genus assigned to it by its discoverer.

Eudora, n. g.

Differs from *Cuma* in having the upper antenna obsolete*.

Eudora truncatula, mihi. Pl. XIV. fig. III.

The lateral angles of the carapace meet in front of the antennal segments and are somewhat raised above them. The inferior

* My own inclination is to unite this genus with *Cuma,* and *Venilia* with *Bodotria,* to which in general form they respectively agree. But Mr. Goodsir, who has dissected many of the genus *Cuma,* distinctly affirms the upper antenna to be present, whereas in *Bodotria* he is as positive that the lower is "quite obsolete;"—facts so distinctly at variance with my own experience of the closely allied forms of *Eudora* and *Venilia,* that I am compelled, in deference to so careful an investigator, to place the new species in separate genera.

anterior edge is considerably produced, and gives a truncated character to the appearance of the animal. The margin is serrated, anteriorly more prominently so.

The upper antenna is wanting; the lower (fig. 5) is very short, and consists of a peduncle of three joints and a filamentary terminal appendage, the first segment of which is long and the rest extremely small and fine.

Mandible furnished with a prominent molar tubercle, but not supplied with hair-like spinules between it and the incisive margin. The first gnathopod (fig. 11) is pediform; the second (fig. 12) also, but the basal articulation is broadly developed anteriorly, so as to fulfil the office of an operculum; the internal margin is convex and furnished with strong hairs; the external margin is concave posteriorly, and extends at the anterior corner into a long, firm, ciliated spine; a second spine of the same character is situated on the anterior margin between the former and the terminal joints of the appendage, which consists of four small segments supplied with a few plumose cilia. This pair of limbs is furnished with a *palpe*, or secondary appendage, consisting of a single-jointed peduncle and a terminal filamentary appendage supplied with a brush of cilia. The next succeeding pair of legs (fig. 13), the homologues of the large claw-feet of the Decapoda, are extremely long, reaching considerably in advance of the anterior margin of the animal; each of them consists of a long basal joint, denticulated with four or five strong spines upon the convex or inferior margin, followed by a short joint and three terminal long ones: this as well as the three succeeding legs are furnished with a *palpe* similar in formation to that of the preceding pair.

The four next succeeding pairs of legs (figs. 14, 15, 16, 17) are similarly formed, except that they gradually diminish in size posteriorly, the last being considerably the smallest, and moreover unfurnished with a *palpe*. In the female the two anterior pairs of these last four are furnished with *fouets*, or scale-like appendages which overlap each other and carry the ova and the larvæ.

I have received four or five specimens of this species, which were dredged by W. Webster, Esq., in Plymouth Sound, somewhat within the Breakwater; some of them having eggs in the incubatory pouch.

Genus Halia, n. g.

Cuma, Goodsir.

Carapace elongate, compressed, covering the thorax, except the three posterior segments. The four posterior legs of the thorax without a *palpe*. Telson rudimentary. Upper antenna prominent, lower membranaceous.

Halia trispinosa. Pl. XIV. fig. v.

Cuma trispinosa, Goodsir.

The carapace is long and much compressed, the lateral angles meeting in front of the antennal segments, and projecting forwards into a rostrum-like point. Half-way between the eye and the posterior margin of the carapace are two (three, *Goodsir*) small teeth or spines, from which the specific name is derived. The superior antenna consists of a single-jointed peduncle and a terminal filament, the first two segments of which are half the length of the whole organ; the remainder are minute and furnished with cilia. The lower antenna consists of a peduncle formed of two minute articulations, calcareous in structure and furnished with plumose cilia, and a terminal filament of a membranous structure, soft and flexible in its character, the anterior portion of which exhibits an appearance of rudimentary articulations, and the organ generally bears a strong resemblance to that of the embryo Crustacean.

The mandible (fig. 6) is furnished with a very prominent molar tubercle and a secondary incisive denticle, as well as a row of intermediate spinous hairs more or less furnished with cilia. The maxillæ (figs. 7, 8) are foliaceous, and resemble those described in *Diastylis*.

The maxilliped (fig. 10) consists of a long and stout basal joint, followed by a second, rather shorter and less robust, furnished on the inner margin with minute denticles, and terminated by two minute articulations well supplied with cilia. This pair of members carries the branchiæ.

The first gnathopod (fig. 11) is pediform, consisting of a long basal joint and four or five terminal smaller ones.

The second gnathopod (fig. 12) is also pediform, but developed so as to fulfil the office of an operculum. The basal joint is long, and the external anterior margin is prominent and furnished with a number of hairs; the second joint is similarly formed, but short; the three terminal ones are unimportant. The member is furnished with a *palpe* consisting of a basal joint and a terminal filament.

The next succeeding leg (Pl. XV. v. fig. 13), which is homologous with the large cheliform organ in the Decapoda, consists of a long basal joint (the rest except the *palpe* in our specimens were broken off).

The four succeeding pairs closely resemble each other, and are each respectively formed of a long basal joint and four or five terminal shorter ones. None of these are furnished with a *palpe*, or secondary appendage. They are moderately covered with cilia, most of which are of a peculiar form, very long and slight (15 *a*), with a smaller, short stout hair at the base. The longer one is very straight, and through two-thirds of its length possesses what appears to be an internal spiral.

The penultimate segment of the abdomen is furnished on each side with a member consisting of a long basal joint and a pair of terminal styliform appendages, each of which is double-jointed; the outer one being fringed on the inner side only with plumose cilia, the inner one with corresponding serrated spinules. The termination of the alimentary canal is seen to debouche in the rudimentary *telson* (or terminal joint of the animal).

We have received this species through the kindness of the Rev. Geo. Gordon, who took it in the Moray Frith. Mr. Goodsir took a single species in the Frith of Forth.

Genus Bodotria, Goodsir, Edin. New Phil. Journ. 1843.

Bodotria arenosa, Goodsir *. Pl. XV. fig. vi.

First, second, third, fourth and fifth segments of the abdomen each armed with a pair of bifurcate finlets. The two terminal scales of the caudal styles are single-jointed. The superior antennæ are quite obsolete; the inferior pair are of considerable length, and are terminated by means of two long spines.

Genus Venilia, n. g.

Carapace with the lateral angles meeting in front of the antennal segments. Both pairs of antennæ well developed. Five of the posterior segments of the thorax exposed. Each of the five anterior abdominal segments carries a pair of swimming feet; the penultimate is furnished with a pair of appendages of the form common to the family. Telson rudimentary.

Venilia gracilis, mihi. Pl. XV. fig. vii.

Carapace long and narrow, the lateral angles meeting in front of the antennal segments, and projecting anteriorly into a rostrum-like point. The superior antenna well developed, and reaching much beyond the anterior margin of the carapace. The inferior antenna consisting of a peduncle formed of three (or more) articulations, the last of which is longest, and an extremely long and delicate terminal filamentary appendage,

* For this description, together with the figure, I am indebted to Mr. Goodsir's paper, to which I must refer the reader for a more complete account.

equalling about half the length of the entire animal. The third thoracic leg, the homologue of the claw in the Decapods, is very long, reaching to the anterior margin of the carapace; the four succeeding are much shorter, being scarcely longer than the basal joint of the preceding. None of them appear to be furnished with a *palpe*.

The abdomen is well developed, and partakes of the character of the higher types in the way in which the lateral edges overlap the sides and seem to protect the delicate appendages beneath, which consist, to each segment, of a pair of organs formed each of a basal joint and a pair of flexible scale-like appendages.

The appendages of the sixth or penultimate segment resemble those of the preceding species. The telson is rudimentary.

This very elegant species was taken in the Moray Frith by the Rev. Geo. Gordon, among several specimens of *Halia trispinosa*.

Having examined all the forms of the family that I have met with, or believe to have been discovered as British, and the structure of those of which I could obtain more than a single specimen, it will be necessary that I should compare them with the larvæ of the Decapoda Macroura, since Agassiz' assertion that he has taken *Cumæ* from *Hippolyte*, &c., is so very positive. All the species mentioned by Agassiz are American—it will therefore be difficult for persons on this side of the Atlantic to procure their evidence from the same; but I think an examination of one of the same genus will be quite sufficient, particularly as all the *Diastylidæ* that have been examined in this paper are British; consequently, if they are the young of any of the Decapoda Macroura, as asserted by Agassiz, they must be those of British forms. The larva which I have chosen as being the nearest to those mentioned in Dana's work, is that of *Hippolyte varians*, of which I have given a careful figure in Pl. XV. fig. VIII. It was obtained direct from the parent,—therefore in the same manner that Agassiz obtained his *Cumæ*.

The carapace, furnished with a distinct rostrum, is broad, and not laterally compressed; it reaches back to the commencement of the abdomen, which consists of but three segments, the terminal one being dilated at the extremity into a fish-tail form, having seven unequal spines on each division.

The eyes are large, situated laterally at the anterior portion of the carapace, and extend on each side beyond the margin; they can scarcely be ranked among the sessile forms of the organ, as typified among the Edriophthalma.

The anterior antenna (Pl. XV. fig. 2) has at least two segments to the peduncle, and two terminal short filaments (the number belonging to the genus in the adult form). The posterior antenna (Pl. XV. fig. 3) consists of a peduncle with two segments, to the first of which is attached a scale-like appendage, the extremity of which is fringed with cilia, and to the second a terminal filament scarcely so long as those belonging to the anterior organ.

The mandibles and maxillæ are distinctly visible; and Mr. Darwin, who dissected the specimen from which the figure accompanying this paper is taken, found the mandibles and two pairs of maxillæ*, after which follow six pairs of appendages, all of which are united at the base in pairs, so that they represent three sets of limbs. The basal articulation of the anterior organ is furnished with three strong spines, which are directed anteriorly. That of each of the two posterior members has but a single spine. Each separate appendage consists of from two to three articulations, furnished with four or five strong hairs.

The abdomen is unfurnished with appendages, but at the posterior limit of the first segment are two cells with a coloured nucleus.

In this immature state of a known decapod Crustacean, we perceive the organs that are present possess the character of the adult animal in an embryonic form. The eyes are placed at the lateral margins of the carapace, ready to be elevated on foot-stalks. The superior antenna has a peduncle, with two out of three of the normal articulations, and differs in no other feature but size from the perfected organ of the adult Crustacea. The inferior antenna bears also a near resemblance to the adult form, except in the incomplete number of the articulations in the peduncle. The moveable scale peculiar to the Macroura is distinctly seen, and the terminal filament differs from that of the adult only in being very short, and the three double pairs of leg-like appendages are the immature forms of the maxillipeds in the adult Crustacea. The rest of the appendages are yet in embryo. The length of the entire animal is the sixteenth of an inch; and as it increases in size, other limbs are developed upon the type of those which they ultimately assume in the adult form, becoming more and more complete as the creature progresses in age and growth.

But in the *Diastylidæ* we find that there is a material difference. The carapace, instead of being broad and flat as in the larva of the Macroura, is laterally compressed; and although, as in *Diastylis*, there is the appearance of a rostrum, yet it is the result, as shown in the description of the animal, of a monstrous development of the lateral angles of the mandibular section of the carapace,—a circumstance which gives a peculiar and eccentric feature to the whole family, that of the

* Cirripedia, vol. ii. p. 107, note †.

posterior portion of the carapace surrounding the anterior, which consequently appears to be situated in the middle instead of at the anterior extremity of the carapace, and its importance is so lessened in degree as to impoverish the character of the appendages which it supports. Thus the eyes, instead of being efficient organs, supported upon peduncles, are so reduced in size and converged together as not to be distinguishable from a single organ; a circumstance which, together with the known habits of the animal, induces me to believe that they are subterranean Crustacea, living chiefly in muddy and sandy soils.

The antennæ are peculiar, sometimes one or other being rudimentary or obsolete, but never, as far as I know, developed upon the type of those of the Macroura.

Again, the mandibles are developed upon a type so decided in their character, that their form alone would be sufficient to demonstrate that they do not belong to the true Macroura; each organ being furnished with a molar tubercle similar to that of the Amphipoda, and not supplied with a flagellum. The maxillæ are developed upon the type of the Stomapoda rather than the Amphipoda. This is equally correct with regard to the maxillipeds and the five succeeding pairs of appendages.

The abdomen consists of seven segments, which, with the exception of the penultimate, are generally destitute of appendages, although in the genera *Bodotria* and *Venilia* they are attached to every segment, and the whole animal assumes, in each of these two genera, a character more normal in its condition.

Thus it will be seen, that the segments are developed as in the adult animal; and the appendages also, I think, possess a similar signification. But should these not be admitted as sufficient evidences of the maturity of the animals, they can further be supported by the fact recorded by Mr. Goodsir, that he had taken the female *Cuma* with "spawn,"—a circumstance that I have corroborated by obtaining a *C. truncatula* with ova in the pouch, and also a specimen of *Diastylis Rathkii* with larvæ fully developed in the same position. This latter specimen was taken by G. Barlee, Esq., in the Isle of Arran.

The female has attached to two pairs of legs four plates, analogous to those found in the Amphipoda, which overlap each other, and form a pouch in which the ova and the undeveloped larvæ are protected during incubation.

The larva quits the pouch in a form resembling the parent—at least so near, that, with the assistance of a most efficient microscope, I have failed to distinguish any difference. Those in the pouch at the same time were of two sizes, as if it contained the young of separate ages, or distinct broods.

The male in *Diastylis*, if not in the other genera, is capable of being recognized by the two pairs of short styliform processes attached to the two anterior segments of the abdomen, analogous to those of the higher types of Crustacea.

Having traced the forms of the *Diastylidæ* and compared the same with that of the larva of a Macroura-form Decapod, and having, moreover, shown that the former are in a condition to continue their species, I think I am in a position to assume that they are Crustacea of adult forms, and that, consequently, they are not the young of any of the Decapoda, and that they form several genera in a family essentially characteristic. It now becomes necessary to see where, among Crustacea, this family should be placed, and the comparison of the dissected animal with that of others may lead to an approximation of the truth.

The carapace is developed upon the type of the Podophthalma, whereas the eyes are sessile; but in some of the Macroura, as in *Athanas* and *Alpheus*, the peduncles are rudimentary: therefore it is but legitimate to assume that the organs are formed upon the same type, but rudimentary in character, in the *Diastylidæ*,—reduced to this form by the subterranean (?) habits of the animal and the eccentric development of the carapace from the normal form.

The antennæ are generally more or less abortive, and all are typically below the Macroura; although in some species, as in *Diastylis*, there may be observed in the lower antenna an organ which can only homologize with the olfactory organ of the Decapoda (fig. 5 *a*).

The mandibles are developed upon the type of those of the Amphipoda rather than upon those of the Macroura or the Stomapoda, although they assimilate to the latter somewhat in the development of the internal lever-like process for the attachment of muscles. The maxillæ and posterior members all approximate the Stomapod type, as exemplified in the *Mysidæ*, whereas the abdominal segments, except in *Bodotria* and the closely allied genus *Venilia*, are mostly wanting.

Taking these several distinctions into consideration, there can, I think, be little doubt,—

1st. That the animals are adult Crustacea.

2nd. That they belong to the suborder Stomapoda.

3rd. In that suborder they rank after the *Mysidæ*, that is, they hold the lowest position known among the Stomapoda; but that they indubitably belong to that suborder,—not to the suborder Decapoda Macroura, as suggested by Goodsir, and repeated with doubt in the 'British Crustacea.'

EXPLANATION OF PLATES XIII. XIV. & XV.

[The numbers attached to the details of figures I. III. and V. indicate the same parts throughout.]

PLATE XIII.

Fig. I. *Diastylis Rathkii.*

2. Carapace seen from above; showing the manner in which the lateral angles, *a*, *a*, meet, without uniting, in front of the antennal segments, *b*.
3. Carapace seen from beneath, with the gnathopoda in position.
4. *a*. Upper antenna, attached to the carapace, seen from below.
5. Lower antenna; *a*. olfactory organ.
6. Mandible.

7 & 8. Maxillæ.

10. Maxilliped; *a*. branchial sac.

11 & 12. 1st and 2nd gnathopoda (2nd and 3rd maxillipeds).

13 & 14. Two anterior pairs of thoracic legs.

15, 16 & 17. The three posterior pairs; *a*. hairs.

18. Appendages of the two anterior pairs of abdominal segments in the male.
19. Caudal segments and appendages.
20. Section of shell.
21. Gizzard-like structure of stomach.

PLATE XIV.

Fig. II. *Cuma scorpioides.*
Fig. III. *Eudora truncatula.*
Fig. IV. *Cuma Edwardsii.*
Fig. V. *Halia trispinosa.*

PLATE XV.

Fig. V. *Halia trispinosa* continued.
Fig. VI. *Bodotria arenosa* (after Goodsir).
Fig. VII. *Venilia gracilis.*
Fig. VIII. Larva of *Hippolyte varians.*

1. Eyes.
2. Upper antenna.
3. Lower antenna.
4. Pair of larval feet (the first maxilliped of adult).
5. One of the two next pair.

XLII.—*Description of a new species of* Sphærium *found near London.* By Dr. J. E. GRAY, F.R.S., P.B.S. &c.

THESE shells were first brought to me at the British Museum by an intelligent collector, Mr. John Rowse of Brownlow Street, Endell Street. He discovered them on the 17th of May, in the Grand Junction Canal near Kensal Green, and the following day most kindly furnished me with several living specimens for examination. They are not abundant in the locality named.

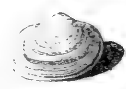
They are decidedly distinct from any of our British specimens, but bear a very great resemblance to *Cyclas rhomboidea* of Say, found in the rivers of North America.

We have unfortunately only a single specimen of this species in the British Museum, which was sent from the Ohio by Mr. Anthony. This example only differs from the specimens found by Mr. Rowse in the front side being rather attenuated and produced, while in the British specimens this part of the shell is regularly rounded; but I have no means of ascertaining whether this is the usual state of the species, or only an accidental variation in the individual we possess, and one can scarcely believe, without better proof, that the same species should be found in Europe and the United States; therefore I shall for the present consider it as distinct.

The species is intermediate in size and form between *Sphærium rivicola* and *S. corneum.*

Sphærium pallidum.

Shell oblong, pale whitish yellow on the circumference, slightly concentrically striated, rounded before, rounded and rather truncated behind; sides rather swollen, evenly convex; the cardinal edge rather produced, nearly straight, and slightly compressed on each side the umbo; the umbo regularly convex, rather in front of the middle of the shell, sometimes slightly crumpled.



S. pallidum.

The foot very large; the siphons elongate, united nearly to the tip; the apices conical, the upper the smallest.

The young are compressed, rather rounded, gradually becoming more gibbous and elongated as they increase in size.

Inhabits Grand Junction Canal near Kensal Green.

The largest specimens are $\frac{14}{24}$ of an inch long, $\frac{11}{24}$ high, and $\frac{7}{24}$ thick. The average-sized specimens are $\frac{1}{2}$ inch long, $\frac{1}{4}$ thick, and $\frac{9}{24}$ high.

The living specimens emitted when in confinement several young shells about 1 line long.

May 20, 1856.

XLIII.—*Descriptions of eight new species of Birds from South America.* By PHILIP LUTLEY SCLATER, M.A., F.Z.S. &c.

1. SYNALLAXIS CASTANEA.

S. brunnescenti-castanea unicolor: plaga magna gutturali nigra: loris obscuris: mento fulvescenti-albido: remigibus intus nigricantibus: cauda unicolore castanea longissima; rectricibus tantum octo et harum una utrinque extima brevissima.

Long. tota 5·5; alæ 2·3; caudæ 4·1 poll. Angl.

Hab. in vic. urbis *Caraccas* in Venezuela.—*Mus.* Brit., Paris.

There are several specimens of this fine *Synallaxis* in the British Museum, where it first attracted my notice. The beautiful series of birds recently transmitted by M. Levraud, the French Consul at Caraccas, to the Museum of the Jardin des Plantes at Paris (which I have lately had the opportunity of inspecting through the courtesy of the Directors of that establishment), contains a single example of the same bird, which has enabled me to assure myself of its locality.

This is one of the species of this form that shows the greatest '*rapprochement*' towards *Sylviorthorhynchus*, the tail being composed of eight rectrices only, and the outer pair of these being abnormally small.

Diglossopis, gen. nov.

Diglossopis, genus novum *Diglossæ* proximum, et rostro simili sed productiore; mandibulæ superioris apice non uncinata sed supra mandibulam inferiorem fortiter incurva: hac autem rectissima, acutissima, nec seorsum curvata: alis modicis, remigibus tertia et quarta longissimis, secunda quintam æquante et primam paulo superante: cauda modica quadrata: pedibus *Diglossæ* assimilibus.

2. Diglossopis cærulescens.

D. cærulescenti-cinerea fere unicolor, subtus in ventre dilutior: alis caudaque intus nigricantibus: loris et rostri ambitu obscuris: rostro nigro: pedibus brunneis.

Long. tota 6·0; alæ 2·9; caudæ 2·3 poll. Angl.

Hab. in vic. urbis *Caraccas* in Venezuela.

Mus. Bremensi et Parisiensi.

Dr. Hartlaub first pointed out this curious bird to me when I was on a visit to Bremen in 1854 and inspecting the well-ordered collection of birds in the museum of that city. The single specimen there is without indication of locality, and I was consequently unwilling to describe it. I never met with this species again until quite lately among the before-mentioned series of birds sent to Paris by M. Levraud from Caraccas.

I think there is no doubt that it ought to form the type of a new genus of *Diglossinæ*.

3. Diglossa indigotica.

Diglossa indigotica, J. & E. Verreaux, MS.

D. indigotico-cærulea unicolor: loris nigris: alis caudaque nigris cærulescenti-viridi limbatis: rostro et pedibus nigris.

Long. tota 4·3; alæ 2·2; caudæ 1·4 poll. Angl.

Hab. in rep. Equatoriana.

MM. J. & E. Verreaux have kindly supplied me with a specimen of this beautiful *Diglossa* as yet undescribed, and for which I retain their MS. name. It must be placed next to *D. personata*, a common species in Bogota collections, from which it may be distinguished by its smaller size, want of the black face, and the dark velvety purple hue of the blue colouring.

4. Anabates infuscatus.

A. supra fumoso-brunneus, capitis pennis medialiter vix pallidioribus : tectricibus caudæ superioribus et cauda tota intense ferrugineis : subtus sordide albus ; crisso autem rufescente, abdomine cinerascente, paulolum tincto : tectricibus alarum inferioribus ochracescenti-rufis : rostro nigricanti-brunneo ; mandibula inferiore flavescente : pedibus brunneis.
Long. tota 7·5 ; alæ 3·6 ; caudæ 3·0 poll. Angl.
Hab. in Peruvia Orientali.

Obs. Affinis *Anabatæ leucophthalmo*, sed supra et subtus multo minus rufescens.

5. Anabates lineaticeps.

A. supra fumigato-brunneus, capite nigricantiore : capitis, interscapulii et tectricum alarum pennarum scapis pallide ochracescenti-albis, lineas longitudinales formantibus : alis caudaque clare ferrugineo-rufis : primariorum parte mediali nigra, interna cum tectricibus subalaribus pallide cinnamomea : corpore subtus albo, cinnamomeo tincto : cervice antica striis quibusdam parvulis nigris irregulariter perfusa : rostro recto, mandibulæ superioris apice uncinata, colore flavido, culmine nigro : pedibus fuscis.
Long. tota 7·5 ; alæ 3·6 ; caudæ 3·0 poll. Angl.
Hab. in Peruv. Orientali.

These two *Anabatæ* are from a large collection received by MM. Verreaux of Paris from the Upper branches of the Peruvian Amazon in 1854.

6. Myiadestes venezuelensis.

M. supra chocolatino-brunnea : capite antico et laterali cinerascentioribus : loris nigris : subtus saturate schistacea, abdomine medio albescentiore, hypochondriis brunnescentibus : remigum nigricantium basi interiore alba, exteriore fulvescente, vittam pallidam trans alarem formante ; harum quoque marginibus exterioribus versus apices pallide fulvis : cauda nigricante : rectricis unæ utrinque extimæ dimidio apicali interno albo : secunda quoque et tertia (sed hac multo minus) albo terminatis : rostri brunnei basi flava : pedibus pallidis.
Long. tota 6·7 ; alæ 3·4 ; caudæ 3·0 poll. Angl.
Hab. in vic. urbis Caraccas in Venezuela.—*Mus.* Parisiensi.

There is an example of this apparently undescribed *Myiadestes* in the collection lately sent to Paris by M. Levraud from Caraccas. It is of the same form as *M. obscurus* (Lafr.) from Guatimala and S. Mexico.

The only birds likely to belong to this form hitherto known as inhabitants of South America are *Ptilogonys griseiventer* and *P. leucotis* described in Tschudi's 'Fauna Peruana.'

I may mention that the latter bird is quite distinct specifically from *Hypothymis leucogonys*, Licht. (*Cichlopsis leucogonys*, Cab.), with which it has been united by Prince Bonaparte in his 'Conspectus,' though they may perhaps be referable to the same genus.

7. Pipreola melanolæma.

P. clare viridis: capite toto cum gula et pectore saturatissime nigro-viridibus, vix a nigro distinguendis: tænia angusta hanc colorem undique nisi in nucha marginante cum ventre medio crissoque flavis, ventre laterali flavo variegato: alis caudaque nigris viridi extus limbatis; tectricibus alarum majoribus flavo, secundariis autem dorso proximis et rectricibus albo terminatis: tectricibus subalaribus flavescenti-albidis: rostro pedibusque rubris.

♀ viridis, sicut mas, sed non cucullata, abdomine flavo variegato, medialiter pure flavo: alis caudaque sicut in mari coloratis.

Long. tota 7·8; alæ 3·6; caudæ 3·1 poll. Angl.

Hab. in Venezuela, Caraccas.

Mus. Heineano, Parisiensi, P. L. S. &c.

This is the Venezuelan representative of *P. riefferi*, so common in Bogota collections, from which it may be distinguished by its larger size, much darker head and throat, and the brighter edging of the wing-coverts.

I am now acquainted with seven species strictly referable to this beautiful form of *Cotingina*: viz. (1) *viridis* (d'Orb.)—a female of a species of which I have not yet seen the male—ex Bolivia; (2) *riefferi* ex Bogota; (3) *melanolæma*; (4) *aureipectus* ex Bogota et Venezuela; (5) *elegans* (Tschudi) ex Peruv.—usually united to *aureipectus*, but quite distinct; (6) *formosa* ex Venezuela; (7) *sclateri* ex rep. Equatoriana.

8. Chiroxiphia regina.

Pipra regina, Natt. in Mus. Vindob.

C. nigra, dorso cæruleo: crista in medio pileo flava.

Hab. Borba, Rio Madeira in imp. Brasil.

Obs. Similis *C. pareolæ* sed crista flava nec rubra.

There are three examples of this Manakin in the Imperial

Museum at Vienna, brought by the celebrated traveller and naturalist Natterer from the vicinity of Borba on the Rio Madeira, and numbered 833 of his collection. The bird closely resembles the well-known *C. pareola,* but has the crest yellow. Natterer's notes upon this species are: "From the underwood, rather near the ground; solitary."

I believe it has never yet been published.

XLIV.—*On* Scissurella *and* Schismope. By J. Gwyn Jeffreys, Esq., F.R.S.

To the Editors of the Annals of Natural History.

Gentlemen,

Although I knew that naturalists were, like poets, a "genus irritabile," I confess that I was not quite prepared for Mr. Woodward's attack on me in your last Number.

He says that, because he *thinks* he has discovered an error, and had protested in vain against it, he was bound to publish. I beg leave to dispute the conclusion, if not the whole of the premises.

When I showed Mr. Woodward specimens of the *Scissurella striatula* of Philippi (which I had much pleasure in presenting him with), he called my attention to the conversion of the fissure into a foramen when the shell became adult. We then referred to Sowerby and Philippi; and I went to the Library of the British Museum and consulted D'Orbigny's Memoir. Mr. Woodward having informed me that he did not intend to publish on the subject, I did so, and mentioned in the March number of the 'Annals' that he had pointed out to me the peculiarity in question, and at the same time I cited D'Orbigny's Memoir.

About a fortnight afterwards, in consequence of Mr. Clark having expressed his opinion that *Scissurella* was synonymous or identical with *Trochus,* I made the further communication which appeared in the 'Annals' for last month; and I then went fully into the matter, being backed by the undeniable authority of Dr. Gray. This, Mr. Woodward calls seeking to justify my position by the "testimony of persons unacquainted with the facts of the case"!

Mr. Woodward admitted to me that he had never previously seen any species of *Scissurella* except *S. crispata*; and as he does not state that he has since seen any other, his *belief* that certain species which were described and figured by D'Orbigny, Sowerby and Philippi (eight in number) are varieties of one and the same species, I leave to the judgment of your readers.

The well-known accuracy of the late Mr. Sowerby makes it needless to do more than repeat his statement, that the species which he called *elatior* and *concinna* were found in the "Calcaire grossier." Whether those species, or the *S. decussata* and *elegans* of D'Orbigny, are *extinct*, is another question, with which Mr. Woodward is probably not more familiar.

If Mr. Woodward would take the trouble of reading again my paper in the 'Annals' for April, he will, or ought to, be convinced that his remarks as to the separation of *Schismope* from *Scissurella* were unnecessary and uncalled for, because D'Orbigny and Sowerby evidently took their characters of what they regarded as the same genus from different and uncongeneric species.

My reason for wishing Mr. Woodward, instead of myself, *in the first instance*, to refer to D'Orbigny, was simply that he, and not I, might have the credit (if any) of making this separation. I am therefore sorry that he should have put such a strange construction upon our conversation.

I never heard of any "protest" from Mr. Woodward until I saw his letter in print.

Yours obediently.

J. Gwyn Jeffreys.

Montagu Square, London, 21st May 1856.

P.S. Since writing the above, Professor King has reminded me that in his "Monograph of the Permian Fossils of England" (pp. 213 and 214), he satisfactorily made out *Scissurella* to be the same as *Pleurotomaria*, and that Mr. Morris, in his "Monograph of the Mollusca from the Great Oolite," follows him in that view. It can hardly be said that these naturalists are also "unacquainted" with the subject, so far as regards the palæontological part of it. Professor King quite approves of the separation of *Schismope* from *Scissurella*, although he suspects the former may approach too closely to Deslongchamp's genus *Trochotoma*.

XLV.—*On the Orang-Utan or Mias of Borneo.* By Alfred R. Wallace.

Having spent nine months in a district where the Mias is most abundant, and having devoted much time and attention to the subject, I wish to give some account of my observations and collections, and particularly to record their bearing on the question of how many species are yet known from Borneo.

I have altogether examined the bodies of seventeen freshly killed Orangs, all but one shot by myself. Of eleven of these

I have preserved the skins, either in spirits or dried. Of seven I have perfect skeletons, and of the remainder the skulls; and of all, the sex, colour and other external peculiarities were accurately noted at the time, as well as all the principal dimensions. I have besides two other skeletons and two skulls, the sex and external characters of which are determined on the authority of Europeans or natives who saw them when freshly killed. Of this extensive series sixteen are fully adult, and their skulls are therefore strictly comparable with each other, nine of them being males and seven females. They were moreover all obtained in a very limited tract of country watered by the same small river and of very uniform physical features. We may therefore assume, unless the contrary can be supported by the very strongest evidence, that the male and female specimens are sexes of the same species, whether they be one or more.

The males procured by me may be divided into two groups, differing considerably both in the external characters and in those of the cranium. The first and most abundant is the large animal known among the natives as the "*Mias pappan*" or "*Mias chappan,*" the latter name being used by the Dyaks as well as that of "*Mias Zimb,*" while the former is, on the authority of Sir James Brooke, a name applied to it by the Malays. It is known by its large size and by the lateral expansion of the face into fatty protuberances or ridges over the temporal muscles, which have been mistermed *callosities,* as they are perfectly soft, smooth and flexible. Five of this form measured by me varied only from 4 feet 1 inch to 4 feet 2 inches in height from the heel to the crown of the head, the girth of the body from 3 feet to 3 feet $7\frac{1}{2}$ inches, and the extent of the outstretched arms from 7 feet 2 inches to 7 feet 8 inches; the width of the face from 10 to $13\frac{1}{2}$ inches. The colour and length of the hair varied in different individuals and in different parts of the same individual; some possessed a rudimentary nail on the great toe, others none at all, but they otherwise present no external differences on which to establish even varieties of a species. Yet when we examine the crania of these individuals we find remarkable differences of form, proportion and dimension, no two being exactly alike. The slope of the profile and the projection of the muzzle, together with the size of the cranium, offer differences as decided as those existing between the most strongly marked forms of the Caucasian and African crania in the human species. The orbits vary in width and height, the cranial ridge is either single or double, either much or little developed, and the zygomatic aperture varies considerably in size. This variation in the proportions of the crania enables us satisfactorily to explain the marked difference presented by the single-crested and double-crested skulls, which have been thought to prove the existence of two large species of Orang. The external surface of the skull varies considerably in size, as do also the zygomatic aperture and the temporal muscle; but they bear no necessary relation to each other, a small muscle often existing with a large cranial surface and *vice versâ*. Now those skulls which have the largest and strongest jaws and the widest zygomatic aperture, have the muscles so large that they meet on the crown of the skull and deposit the bony ridge which separates them, and which is highest in that which has the smallest cranial surface. In those which combine a large surface with comparatively weak jaws and small zygomatic aperture, the muscles on each side do not extend to the crown, a space of from 1 to 2 inches remaining between them, and along their margins small ridges are formed. Intermediate forms are found in which the ridges meet only in the hinder portion of the skull. The form and size of the ridges are therefore independent of age, being sometimes more strongly developed in the less-aged animal. Professor Temminck states that the series of skulls in the Leyden Museum shows the same result.

Sir James Brooke first noticed these differences in the ridges, and finding that the Dyaks affirmed that two large species of Orang existed, very naturally concluded that they respectively belonged to them. Mr. Blyth of Calcutta has adopted this view, considering that the animal possessing the double-crested skull has the large cheek-excrescences, while that with the single-crested skull is deprived of them; but my specimens, as well as the series at Leyden, show that these various forms of skull belong to one and the same species of animal, in which view Sir James Brooke, after an examination of my specimens, perfectly coincides. I may here mention, that Mr. Blyth has since written to Sir J. Brooke acknowledging the receipt of some skeletons from Sarawak, and stating that he has found a *new species* among them distinguished by its shorter and more robust limbs and slightly projecting jaws. The great amount of variation, however, which exists in these respects among animals whose external characters are identical, would show that it is not possible to establish a new species on such grounds from a single specimen. As an instance of the extreme variation which occurs in the skull of the fully adult male Orang with cheek-excrescences, I may mention that the width between the orbits externally is only 4 inches in one specimen and fully 5 in another, while the two animals did not differ 1 inch in their total height.

The second form of male Orang which I have procured differs so remarkably from the first, that it seems well entitled to be considered a distinct species. The two fully adult specimens which I obtained were respectively 3 ft. $8\frac{1}{2}$ in. and 3 ft. $9\frac{1}{2}$ in. in height, 6 ft. 6 in. in extent of arms, and about 2 ft. 6 in. in girth of body. They possessed no signs of the cheek-excrescences, but in other respects resembled the larger kinds. The skull is smaller and weaker, and the zygomatic arches narrower than in the large species; it has no bony crest, but two faint ridges from $1\frac{3}{4}$ inch to 2 inches apart, exactly as in the *Simia Morio* of Prof. Owen, figured in the 'Transactions of the Zoological Society.' The teeth however are in proportion to the skull, of immense size, equalling, and in one case surpassing, those of the larger animals: the molars extending further backward, and the incisors and canines being set closely together, room is found for them in a much smaller jaw. The great canine teeth are quite as large as in most specimens of the larger animal, and of exactly the same form. These animals the Dyaks called "Mias Kassu."

The adult females, five in number, examined by me exhibit a remarkable uniformity among themselves, and a striking difference compared with the large males. In size they vary only from 3 ft. 6 in. to 3 ft. 7 in. in height, from 2 ft. 4 in. to 2 ft. $6\frac{1}{2}$ in. in girth below the arms, and from 5 ft. 9 in. to 6 ft. $5\frac{1}{2}$ in. in extent of arms. None possess any cheek-excrescences, some have and some want the nail on the great toe, the colour varies considerably, but the external characters are in general remarkably similar to those of the smaller males before mentioned, from which they only differ in a stature from $1\frac{1}{2}$ in. to 3 inches lower. Their crania are either equal to or slightly less than those of the small males; but their teeth differ remarkably from those of all the males, in the canines being comparatively small, and of the peculiar subtruncated form, dilated at the base, which is represented in the plate of *Simia Morio* before alluded to. With that plate most of these crania exactly agree; I presume therefore that it represents a female specimen, and that the peculiar form of canine tooth is characteristic of the female sex. The question then remains, to which of the two forms of male animal are these the females. From a careful examination of my specimens I am induced to consider that most of those, the crania of which equal in size those of the small males, may be referred to the larger species, while one or two, slightly smaller in all their dimensions, but remarkable for having the two middle incisors in the upper jaw larger than in the other specimens, may be considered as the females of the smaller species, the male of which has also those teeth larger than in the animals which possess huge crested skulls and cheek-excrescences. These smaller females so exactly correspond with Prof. Owen's figure, that there is no doubt of their belonging to the same species, the adult male of which will, I believe, now be made known for the first time. The skins of the two small males and of the females, now on their way to England, in spirits, will, when strictly compared, serve to determine accurately the characters of the two species of Bornean Orang, *Simia Satyrus* and *S. Morio.*

The Dyaks of N.-Western Borneo, however, have names for three species of Mias, although I could never find any one who could determine them with precision. All the animals with large cheek-excrescences form the "*Mias chappan,*" but they declare that females are also found of the same form. Authenticated female specimens, however, with cheek-excrescences do not exist in Europe, and if they ever do occur, seem far too rare in proportion to the males to be any other than an accidental variety in which the one sex has assumed characters generally confined to the other. All Orangs of smaller size and without cheek-excrescences are called by the Dyaks *Mias Kassu,* and my small males and females are undoubtedly of this kind; but these people have asserted that every female I shot was a *Mias Kassu,* so that I am rather inclined to think that they have regarded the larger males as distinct species from the smaller and differently formed females. In one case however they said that a female was a *Mias chappan,* though it possessed no cheek-excrescences, nor differed from the other females except in having the skin of the throat rather more loose and inflated than usual,—a character generally very prominent in the large males. The third kind they call the *Mias rambi,* and they say it equals the "chappan" in size, but has no cheek-excrescences and very long hair. This seems very rare, and is probably one of the large species in which the excrescences have been little or not at all developed. One of my females they asserted with hesitation to be a "rambi," but I could not perceive that it in any way differed from the others except in a much paler colour than usual.

The conclusions therefore at which I have arrived are as follows:—

1. That two species of Orang have been ascertained to exist in Borneo.

2. The differences between them are well marked in the males, but much less distinct in the females.

3. That all the females are characterized by the small-sized skull without prominent ridges and by their subtruncated dilated canine teeth.

4. The males of both species possess large conical canines.

5. That the form, size and proportions of the crania, and the size and position of the teeth, vary in each individual to such an

extent, that these variations alone cannot be taken to mark distinct species.

Most of these conclusions are fully supported by Prof. Temminck, from an examination of the very extensive series of specimens in the Leyden Museum, though, from not possessing specimens of the smaller male, he was unable to detect any specific difference in the females.

Prof. Owen, in his admirable papers published in the 'Transactions of the Zoological Society,' has described the apparent confusion in the position of the second set of teeth in the jaws of the young animal, and observes that it seems wonderful that they should all fall into their proper places in the adult, without those irregularities which are so frequent in Man. My specimens however prove that such irregularities are very frequent, as more than one-half of my crania exhibit them in a greater or less degree. In two cases a sixth molar tooth occurs on one or both sides of the jaw; the incisors are often unsymmetrical and the whole jaw is frequently oblique, in one case so much so, that while the upper canine closes inside the lower on one side of the jaw, it is outside on the other.

A striking peculiarity, not, I believe, hitherto noticed, exists in the mammæ of the female, which are scarcely perceptible even when giving suck. In two specimens which I shot with their infant young, the nipples rose from a breast not more developed than in the male animal.

The preceding observations might have been very much extended, but the object has been merely to give some account of the writer's observations and collections, believing that no definite and certain conclusions can be arrived at without a comparison of his materials with those which already exist in England and at Leyden, a comparison which he looks forward to making on his return.

Sarawak, Dec. 1855.

XLVI.—*On* Prof. Huxley's *attempted Refutation of* Cuvier's *Laws of Correlation, in the Reconstruction of extinct Vertebrate Forms.* By H. Falconer, M.D., F.R.S. &c.

The printed Proceedings of the Royal Institution contain a full abstract of the principal part of an evening lecture, delivered by Prof. Huxley, on the 15th February last, "On Natural History, as Knowledge, Discipline, and Power," authenticated with his initials, and thus leaving no doubts as to the authorship. It contains some statements which are so remarkable,—emanating from one who is at the same time a Professor of Physiology, and an officer on the palæontological staff of the Museum of Economic Geology,—as to require some notice.

The temptations of a popular lecture are notoriously so great, to produce effect instead of merely giving instruction, and to heighten sober fact with a little gilding, that a considerable allowance is usually extended to discourses addressed to large mixed audiences. If the banquet is plain, to go down well, it requires some strong seasoning. But there is a limit to this kind of consideration; and when a man of science, of recognized standing, assails generally admitted principles and established reputations, in a discourse of this nature, which comes before the world in the permanent form of publication, it is no longer entitled to indulgence, but becomes a fair subject of legitimate criticism.

Nearly three-fourths of Mr. Huxley's abstract are devoted to the first head, viz. Natural History regarded as *knowledge*, the leading feature of which is an attempt to refute the principle propounded by Cuvier, that the laws of correlation which preside over the organization of animals, guided him in his reconstruction of extinct forms. It is to this part of the lecture that the remarks now offered have reference.

By the common verdict of mankind, George Cuvier has been considered one of the most successful investigators of natural knowledge, in all time. His principal claim for this rank rests upon his having been the founder and architect of philosophical palæontology. He not only laid the first stone, but he constructed, and covered over, the edifice. What has been accomplished by his successors, has been merely to fill up, and embellish the details of the interior; this much he left to them as an express legacy. The general results of his researches, and the principles upon which they were conducted, were set forth in the "Discours préliminaire," which, taking due account of the state of knowledge at the time, and the wide scope of the argument, has hitherto been held up as a model of exhaustive philosophical inquiry, conveyed in a strain of chastened didactic eloquence, such as has not yet been surpassed in the literature of natural history.

That in some important respects Cuvier was behind the progress of zoological science in his day, is undeniable; as also that he arrived at some wrong palæontological conclusions. This is not to be wondered at; the real marvel being, that in achieving so much in a new field, he erred so little. But Mr. Huxley assails him on very different and much higher grounds. "The prince of modern naturalists," it is alleged, "did not himself understand the methods by which he arrived at his great results." "His master-mind misconceived its own processes." "Whatever Cuvier himself may say, or others repeat, it seems quite clear that the principle of his restorations was *not* that of the physiological correlation or coadaptation of organs."

Such strong assertion should be well supported; for, besides the attack upon Cuvier and his followers, the very foundations of palæontology, as they have hitherto been understood, are assailed. Let us now see whether soundly or otherwise. Mr. Huxley, after showing up the pretensions and shortcomings of the alleged philosophical principle, supplies the blank with a substitute of his own, namely, " A law of the invariable coincidence of certain organic peculiarities established by induction;" or, in other words (when the definition and illustrative cases are analysed), empirical observation. In order to put the case fairly, and guard against the risk of misapprehension, a long extract must be made:—

* * * "Is this utilitarian adaptation to a benevolent purpose, the chief, or even the leading feature of that great shadow, or, we should more rightly say, of that vast archetype of the human mind, which everywhere looms upon us through nature? The reply of natural history is clearly in the negative. She tells us that utilitarian adaptation to purpose is not the greatest principle worked out in nature, and that its value, even as an instrument of research, has been enormously overrated.

" How is it then, that not only in popular works, but in the writings of men of deservedly high authority, we find the opposite dogma—that the principle of adaptation of means to ends is the great instrument of research in natural history—enunciated as an axiom? If we trace out the doctrine to its fountain-head, we shall find that it was primarily put forth by Cuvier, the prince of modern naturalists. Is it to be supposed then that Cuvier did not himself understand the methods by which he arrived at his great results? that his master-mind misconceived its own processes? This conclusion appears to be not a little presumptuous; but if the following arguments be justly reasoned out, it is correct:—

" In the famous 'Discours sur les Révolutions de la Surface du Globe,' after speaking of the difficulties in the way of the restoration of vertebrate fossils, Cuvier goes on to say:—

" 'Happily, comparative anatomy possesses a principle whose just development is sufficient to dissipate all difficulties; it is that of the correlation of forms in organized beings, by means of which every kind of organized being might, strictly speaking, be recognized, by a fragment of any of its parts.

" 'Every organized being constitutes a whole, a single and complete system, whose parts mutually correspond and concur, by their reciprocal reaction to the same definitive end. None of these parts can be changed without affecting the others; and consequently each taken separately indicates and gives all the rest.'

"After this, Cuvier gives his well-known examples of the correlation of the parts of a Carnivore, too long for extract, and of which therefore his summation merely will be given :—

"'In a word, the form of the tooth involves that of the condyle; that of the shoulder-blade; that of the claws: just as the equation of a curve involves all its properties. And just as by taking each property separately, and making it the base of a separate equation, we should obtain both the ordinary equation and all other properties whatsoever which it possesses; so, in the same way, the claw, the scapula, the condyle, the femur, and all the other bones taken separately, will give the tooth, or one another; and by commencing with any one, he who had a rational conception of the laws of the organic œconomy, could reconstruct the whole animal.'

"Thus far Cuvier; and thus far, and no further, it seems that the compilers, and copiers, and popularizers, and *id genus omne*, proceed in the study of him. And so it is handed down from book to book, that all Cuvier's restorations of extinct animals were effected by means of the principle of the physiological correlation of organs.

"Now let us examine this principle; taking, in the first place, one of Cuvier's own arguments and analysing it; and in the second place, bringing other considerations to bear.

"Cuvier says—'It is readily intelligible that Ungulate animals must all be herbivorous, since they possess no means of seizing a prey (1). We see very easily also, that the only use of their fore-feet being to support their bodies, they have no need of so strongly formed a shoulder; whence follows the absence of clavicles (2) and acromion, and the narrowness of the scapula. No longer having any need to turn their fore-arm, the radius will be united with the ulna, or at least articulated by a ginglymus and not arthrodially with the humerus (3). Their herbivorous diet will require teeth with flat crowns to bruise up the grain and herbage; these crowns must needs be unequal, and to this end enamel must alternate with bony matter (4): such a kind of crown requiring horizontal movements for trituration, the condyle of the jaw must not form so close a hinge as in the Carnivora; it must be flattened; and this entails a correspondingly flattened temporal facet. The temporal fossa which will have to receive only a small temporal muscle will be shallow and narrow (5).'

"The various propositions are here marked with numbers, to avoid repetition; and it is easy to show that not one is really based on a necessary physiological law:—

"(1.) Why should not ungulate animals be carrion-feeders? or even, if living animals were their prey, surely a horse could run down and destroy other animals with at least as much ease as a wolf.

"(2, 3.) But what purpose, save support, is subserved by the fore-legs of the Dog and Wolf? how large are their clavicles? how much power have they of rotating the fore-arm? (4, 5.) The Sloth is purely herbivorous, but its teeth present no trace of any such alternation of substance.

"Again, what difference exists in structure of tooth, in the shape of the condyle of the jaw, and in that of the temporal fossa, between the herbivorous and carnivorous Bears? If Bears were only known to exist in the fossil state, would any anatomist venture to conclude from the skull and teeth alone, that the white bear is naturally carnivorous, while the brown bear is naturally frugivorous? Assuredly not; and thus, in the case of Cuvier's own selection, we see that his arguments are absolutely devoid of conclusive force."

Our first remark is, where and by whom has the principle of the "*utilitarian* adaptation to purpose*" been used as an instrument of research? Mr. Huxley avers that its value as such has been enormously overrated! If so, by whom has it been ever used? From the prevalence of adaptations and mechanisms in nature, suited to the production of certain ends, we reason up to the agency of an all-wise, powerful and benevolent Designer. But the inference is a product, not an *instrument* of the research; and to call it the latter, is simply a misuse of terms.

The same objection applies to what Mr. Huxley designates as "the opposite dogma—that the principle of adaptation of means to ends is the great instrument of research in natural history." The generalization in this case also is a *result*, not an *instrument*, of the research.

Mr. Huxley contrasts the two as opposite dogmas. Wherein, we would ask, lies the opposition? Hot and cold, dry and moist, sweet and sour, are in ordinary language opposites; and in medicine, theorists speak of the *opposite dogmas* of the humoral and mechanical, the chemical and vital pathologies. They are obviously opposed, because the one is inconsistent with, and of a contrary nature to, the other. But there is nothing of like opposition and incompatibility in the two dogmas or principles as enunciated by Mr. Huxley. So far from such being the case, the first is merely a more advanced stage of the second. In the

* The employment of the term in this sense is by Mr. Huxley.

one, we satisfy ourselves by observation of the necessary correlation of the parts to effect a common end; in the other, we speculate from these premises, as to whether or no they furnish proofs of a Supreme Designer. We may stop short at the former stage without going further; but we cannot arrive at the second without having gone through the first. The two principles, therefore, have never been employed as instruments of research in natural history, nor are they, in their nature, opposites.

In disquisitions of this kind, precision of thought and expression is so essential, that it seemed necessary to clear the ground of these preliminary objections, before coming to the gist of Mr. Huxley's argument, namely, that the law of reciprocal relation between the organs of animals is *not* the principle which guided Cuvier in his reconstruction of extinct forms.

Mr. Huxley first takes the beautiful illustration given by Cuvier, of the correlation of the parts in a Carnivore, quoting the summary; and he attempts to refute it by asking, "What difference exists in the structure of tooth, in the shape of the condyle of the jaw, and in that of the temporal fossa, between the herbivorous and carnivorous Bears? If Bears were only known to exist in the fossil state, would any anatomist venture to conclude, from the skull and teeth alone, that the white bear is naturally carnivorous, while the brown bear is naturally frugivorous? Assuredly not; and thus in the case of Cuvier's own selection, we see that his arguments are absolutely devoid of conclusive force."

Can it be believed, after this, that the case in question is *not* that of Cuvier's selection? But such is really the fact. In stating the proposition to be demonstrated, Cuvier puts it thus: "If the intestines of an animal are organized so as *only* to digest flesh, and the flesh fresh," then these correlative conditions are involved, viz.: its jaws must be constructed to devour a prey; its claws to seize and tear it asunder; its teeth to cut it up and divide it; its organs of motion to pursue and catch it; its organs of sense to recognize it at a distance; and it must also be endowed with the instinct to conceal itself and lay toils for its victims. "Such will be the conditions of the carnivorous habit; every animal destined for such habit will infallibly have them in combination, for its race could not subsist without them." But the Bears have *not* their "intestines organized *only* to digest fresh flesh;" nor their claws to seize a prey and tear it asunder; nor their teeth only to cut up and divide it; nor their organs of motion to pursue and catch it; nor have they the instinct to conceal themselves and entrap it. What was obviously in Cuvier's mind was, a pure typical digitigrade carnivore like the Tiger, which rigidly fulfils the terms of the proposition, and every one of the conditions set forth as involved in it. The Bears are heavy cumbrous animals; their teeth are not purely carnivorous, but mixed*; their feet are plantigrade; and their habit of diet, when they are regarded in the mass, is omnivorous. We have known the same species, a brown bear, to browse on young grass like an ox; to devour the flesh of a slaughtered deer left in the forest; and to kill and eat a tame pheasant that came within its reach. Nature has given mixed teeth, and a mixed organization throughout, to match the mixed habits of the genus. Technically they are ranked, in some classifications, as among the Carnivora; but competent naturalists divide the order of *Feræ* into three groups, excluding the Bears and their allies, under the designation of *Plantigrada,* from the *Carnivora,* which comprise the *digitigrade* Dogs, Cats, Hyænas, &c. How then is Mr. Huxley warranted in asserting, that the Bears were "*the case of Cuvier's own selection*"? In every demonstration of a subject, and in ordinary instruction, we select the simplest problems; and having mastered them, we next proceed to the more complicated or mixed. Cuvier took the pure and simple case: Mr. Huxley fixes upon him the mixed.

Let us now take the case as put by Mr. Huxley, and suppose that the brown and white bears were only met with in the fossil state; but with the proviso of the other living species being known to us as at present. The comparative anatomist would, we believe, be led to infer that the polar bear had been more carnivorous than the brown bear, and the latter more of a vegetable feeder than the former. The polar bear differs more from all the other bears in the form of the skull, than these do from one another; and the differences are all in the direction of a more carnassial type. In proof that this is not a rash or unguarded assertion, it can be shown that comparative anatomists have not hesitated, in the cases of certain extinct fossil bears, to form conclusions as to their habits of diet upon the osteological evidence. Thus: "From the greater proportional size and more complicated tubercular surface of the posterior molar teeth, especially in the upper jaw, and from the greater complication on the crown of the smallest persistent molar in the lower jaw, one might be led to suppose that the *Ursus spelæus* fed more on vegetables than the grisly bear does" (Owen, Brit. Foss. Mamm. p. 101). The evidence furnished by the skull confirms this guarded inference: it deviates widely in form from that of the polar bear. Again: "The above remarkable modification of the crowns of the molar teeth of the lower jaw, indicates this great extinct bear (of the Sewalik Hills) to have been more car-

* Their molar teeth generally manifest in both jaws a tuberculate grinding surface. Owen, Odontog. vol. i. p. 501.

nassial than the *Ursus spelæus*, or any of its existing congeners" (Owen, Odontography, vol. i. p. 501). The same conclusion had been previously arrived at by the original describers of this species, from the combined indications of the skull and teeth*. Here then are two fossil bears, the one of which is inferred to have been more of a vegetable feeder, and the other more carnivorous, from characters of correlation presented by their skulls and teeth;—being practical refutations of the assertion made by Mr. Huxley. It is true that the legitimacy of the deductions may be questioned or denied: all that can be said in reply is, that if the propositions, positive and negative, are considered according to the degree of their respective probability, the verdict of every competent judge will be in favour of the former. Of more than this, a case of the kind does not admit.

Mr. Huxley next takes in hand the opposite case of the *Ungulate Herbivora,* as put by Cuvier. They present the simplest and most unmixed types of the strictly vegetable feeders, and their organization is modified throughout, in a series of adaptations in contrast with those presented by the *Digitigrade Carnivora,* and in necessary correlation with each other (i. e. *necessary* in the sense of being demonstrable in such a way that the contrary involves an absurdity and is inconceivable). We will take Mr. Huxley's objections in the order suggested by the analysis. Cuvier states that: "Their herbivorous habit will require teeth with flat crowns to bruise up the grain and herbage; this crown must needs be unequal, and to this end enamel must alternate with the bony materials." Mr. Huxley attempts to refute the generality of the proposition by the case of the Sloth. He says, "The Sloth is purely herbivorous, but its teeth present no trace of any such alternation of substance." It will be shown in the sequel, that they *do* present such alternation; but the first remark that is suggested is, that in an argument where there is an express specification of the premises, it is inadmissible to adduce a case that does not come within the terms. Cuvier specifies the *Ungulata* (including the Pachydermata, Solidungula, and Ruminantia): Mr. Huxley meets him with the Sloth, which, although herbivorous, does not belong to either, but to the order *Bruta,* comprising animals very different in their habits and organization from the *Ungulata.* The mass of the species in the one order is constructed for extreme speed, to escape from their predaceous enemies; while the progression of the mass in the other is extremely slow, but strictly in unison with their habits and wants. Instead of presenting *a narrow scapula, with no acromion and no clavicle* (conditions expressly specified by

* Asiatic Researches, vol. xix. p. 200.

Cuvier), the Sloth has a *very broad* scapula, *an enormously prolonged acromion, and a clavicle.* A portion of the functions of its fore-arm is modified after the plan presented by the Tiger, instead of that of the *Ungulata*. The habits of the Sloth, although herbivorous, required it, and the *necessity* under the law of correlation worked out the means*. The detailed demonstration would be tedious; but it is wholly unnecessary, as every comparative anatomist is familiarly acquainted with it, and probably no one better than Mr. Huxley. So far as the applicability of this objection to the case in point is concerned, it is clearly of a still more exceptionable character than that of the Bears *contra* the typical Carnivora.

But the special force of Mr. Huxley's objection lies in the absence of enamel from the teeth of the herbivorous Sloth. The adduction of the instance is ingenious; yet the objection in reality is more specious than valid. The molars of the Sloth consist of an irregular cylinder of soft and open-grained ivory (vascular dentine of Owen), which is so permeated by vascular or medullary canals, that it has been compared structurally to the teeth of certain fishes; this central mass is encased in a shell of compact hard ivory (unvascular dentine of Owen), closely resembling (it is said) that of the human tooth†; and outside of this shell there is a layer of cement harder than the central mass, but softer than the shell of ivory. The cement by use wears away, so as "to form a bevelled edge," while the central mass becomes depressed, the edge of the shell projecting between them. The crown thus presents *three alternate materials of unequal hardness*, resulting in an unequally worn surface, being the very end to be attained, in the case put by Cuvier; the only difference being, that in the Sloth a shell of hard ivory is substituted for the ordinary shell of hard enamel. And so exactly does this shell, to the naked eye, simulate the appearance of enamel, that Cuvier and every other naturalist down to 1837 described it either as being enamel or analogous to it. Enamel is equally absent from the teeth of the whole of the *Megatheroid*

* "Toutes ces choses se déduisent l'une de l'autre selon leur plus ou moins de généralité, et de manière que les unes sont essentielles et exclusivement propres aux animaux à sabot, et que les autres, quoique également nécessaires dans ces animaux, *ne leur seront pas exclusives, mais pourront se retrouver dans d'autres animaux, où le reste des conditions permettra encore celles-là.*" (Cuvier, Discours prélim. p. 50, 4to edit.) Alter the words "animaux à sabot" into "animaux carnivores," and the clause in italics is applicable to the fore-arm of the Sloths. It were easy to show, that the construction of the Sloths, so far from weakening the evidence as to the law of necessary correlation, does, in fact, furnish the strongest arguments in favour of it.

† Owen, Odontography, vol. i. p. 330.

Edentata, as from the Sloths. But so little do the united instances furnish a case of means inadequate to the end, that Clift, in 1836, supplied Buckland with a drawing of the teeth of Megatherium in opposition, in which the hard shell is figured and described as enamel, and the harder parts of the reversed teeth are shown to be brought in contact with the softer, in such a manner, that mastication is performed and maintained by a series of wedges "like the alternate ridges on the rollers of a crushing-mill," and accompanied by a property, the perfection of all machinery, namely, that of maintaining itself perpetually in perfect order by the act of performing its work*.

Enamel, therefore, although structurally absent, is *functionally* present in the substituted shell of hard ivory. The force of Mr. Huxley's objection is thus narrowed to the use in the Sloth of a material different from the ordinary one. Does this furnish any good argument against the law of correlation? In physics analogous cases of substitution are met with; for instance, in Mitscherlich's isomorphous salts, wherein certain bases may be substituted indifferently, but the combinations will always result in the same function, *i.e.* crystallize in the same geometrical form. No one has on this account doubted the constancy of the laws of crystallization. In predaceous birds, the teeth and jaws of the Carnivora are replaced by the mandibles and hooked bill; but the claw of the Eagle is, notwithstanding, as much in correlation with the bill, as the retractile claw with the scissorial carnassial tooth in the Tiger, the types of construction being different.

Mr. Huxley's next objection is startling. He asks: "Why should not ungulate animals be carrion-feeders? or even, if living animals were their prey, surely a horse could run down and destroy other animals with at least as much ease as a wolf." There are certain Ungulata which do sometimes eat flesh and carrion. The Hog is an example. Cases have been asserted on respectable evidence of its even having eaten young children. But the molar teeth, unlike those of the typical Ungulata, are tubercular or mammillated, not flat, and they differ otherwise. "Among the extinct aberrant forms" (in the Suidæ) "the *Hippohyus* presents almost a ruminant pattern of the grinding surface, while the *Chæropotamus* manifests in its whole dentition a close resemblance to the plantigrade Carnivora." "Nothing as yet is known of the incisors of the *Chæropotamus*; the rest of the dentition closely resembles that of the Peccari; but the premolars are more simple, and the canines, by their size, shape and direction, and the lower jaw by the backward prolongation of its angle, alike manifest a marked approximation to the

* Buckland, Bridgewater Treatise, p. 148.

Ferine type. The occasional carnivorous properties of the common Hog are well known, and they correspond with the minor degree of resemblance which this existing Pachyderm presents to the same type*." On the other hand, "The essential characteristic of the dentition of the true Bears is the development, in the lower jaw, of the true molar teeth to their typical number in the placental Mammalia, and their general manifestation, in both jaws, of a tuberculate grinding surface†." In other words, the Hog and some of its allies, in certain respects, diverge in their structure from the ungulate towards the carnivorous type; while conversely, the Bears similarly diverge from the carnivorous type towards the Ungulata; the result being the same,—that is, regarded in the mass, they become omnivorous. But the exceptions, so far from being inconsistent with the law of correlation, furnish fine illustrations of the manner in which its details are carried out, in contrasted cases of mixed types.

But as regards the pure herbivorous Ungulata—say the Horse—with flat grinding teeth when in full wear, the fitting reply to the first part of Mr. Huxley's query would be—Why should not a pair of millstones serve as well to cut up broad cloth as a pair of scissors? The typical Ungulata have their molars constructed on the grinding principle,—the Carnivora on the scissorial; and both physicists and naturalists know, upon a very wide induction, that the antecedents and consequents in these cases are not reciprocals. As to the second part of the query, the teeth and correlative organs tell us that the speed of the Horse is to enable him to run away from his predaceous and other enemies—not to run down, seize, and destroy other animals. Nature, like a thrifty housewife, has endowed him with organs of locomotion suited to his wants, and not gone beyond them.

The last objection raised by Mr. Huxley is, "What purpose, save support, is subserved by the fore-legs of the Dog and Wolf? how large are their clavicles? how much power have they of rotating the fore-arm?" Every one has seen a dog gnawing a bone. If there is flesh or gristle on it, his paws (*i.e.* the prehensile function of the combined clavicle, scapula, and fore-arm) enable him to place the object in the most favourable position for his jaws to act. If it is flat, like a blade-bone, he can raise it edgewise and so on; being selective acts of manipulation, which are impossible to the Horse with his less artificially endowed fore-arm. All this is familiar and elementary knowledge; the only marvel is, that one should have to adduce the facts at the present day in such an argument.

* Owen, Odontography, vol. i. p. 562. † *Ibid.* p. 501.

Mr. Huxley then brings certain other considerations to bear. Taking the case of a crustacean fossil impression, he shows that the restoration of the extinct form is founded on the invariable concurrence of the peculiar many-ringed body and jointed limbs, with a certain form of the jaws, and certain relations of the muscles, nervous system, and other internal organs, to the exo-skeleton. He adds, "For any physiological necessity to the contrary, the creature might have had its mouth, nervous system and internal organs arranged like those of a fish." The general statement is quite correct, but the corollary is a manifest fallacy; for if, in the adduced instance, the creature had had its mouth, nervous system and internal organs arranged like those of a fish, it would have ceased to be a crustacean and have become a fish. Mr. Huxley, with the skeleton of a hawk before him, might as well say that, for any physiological necessity to the contrary, that creature might have its jaws with teeth, and its internal organs arranged, like those of a tiger. Nature has formed living beings upon certain types, which constitute the basis of methodical nomenclature, and the correlation of part to part, and organ to organ, is adjusted in subordination to those types.

The fallacy involved in his next instance is still more obvious: "If we turn to the botanist, and inquire how he restores fossil plants from their fragments, he will say at once, that he knows nothing of physiological necessities and correlations. Give him a fragment of wood, and he will unhesitatingly tell you what kind of a plant it belonged to; but it will be fruitless to ask him what physiological necessity combines *e. g.* peculiarly dotted vessels with fruit in the shape of a cone and naked ovules, for he knows of none. Nevertheless his restorations stand on the same logical basis as those of the zoologist.

"Therefore, whatever Cuvier himself may say, or others may repeat, it seems quite clear that the principle of his restorations was *not* that of the physiological correlation or coadaptation of organs. And if it were necessary to appeal to any authority save facts and reason, our first witness would be Cuvier himself, who in a very remarkable passage two or three pages further on ('Discours,' pp. 184, 185) implicitly surrenders his own principle."

Now, plants have only organic or vegetative life, limited to nutrition and reproduction. But animals, besides this *organic*, have *sensorial* life superadded. Supposing a question were raised as to the reality of sensorial life, what would be thought of the naturalist who would turn to the botanist and say, "Your plants assuredly have not got sensation, perception, and voluntary motion, therefore animals are not likely to have them"? The argument drawn by Mr. Huxley *from* instances of empirical relation in the vegetable kingdom *against* there being necessary or reciprocal relation in the higher classes of the animal kingdom, if it means anything, is exactly of this character. The truth being, that in both plants and animals there are two kinds of relation between the constituent parts or organs: the one *empirical,* of which we know the invariable constancy, although, so far as our present knowledge goes, we cannot show the reason; the other reciprocal, of which we equally know the constancy, and at the same time can demonstrate the necessity. Physiology takes cognizance of both; and as a general expression of the phænomena it may be stated, *that the necessary relations are more numerous and obviously manifested in the ratio of the higher organization of the living form.* Hence the paramount importance of the principle of reciprocal relation as a guide in mammalian palæontology.

So far as regards the terms above quoted, in which the supposed refutation of the Cuvierian principle is summed up, rarely in the history of science has confident assertion been put forward, in so grave a case, upon a more erroneous and unsubstantial foundation. Later palæontologists are brushed aside with still lighter consideration. They are *les moutons que suivent* "the compilers, and copiers, and popularizers, and *id genus omne.*" It is some consolation to this *pecus ignobile* to reflect, that Professor Owen has been among their number. Mr. Huxley holds him up in the s quel, as furnishing a bright example (of which more anon) of empirical deduction; but it must be admitted, that the Hunterian Professor's numerous works, and reiterated avowals, somewhat compromise him as a rational correlationist *.

Let us now consider what was the method actually followed by Cuvier in the determination and restoration of extinct fossil forms. He first examined, through every organic detail, a vast number of living forms, derived from every class and order of the Vertebrata, with infinite labour and assiduity, during thirty years. In the spirit of pure induction, he ascended from the aggregate of the particular observations to general conclusions; namely, that certain laws of correlation invariably preside over the organization of animals. He found that these laws were classifiable under two heads: 1st, what he called *rational* (i.e. general) laws, wherein the correlation is demonstrable as being necessary and reciprocal throughout the parts, just as the form of a piston must be a reciprocal of the cylinder in which it

* Mr. Owen flies his hawk at a more ambitious quarry in original research; but it is not too much to expect that he may on some occasion record his protest against Mammalian Palæontology being asserted to rest merely on empirical correlation, in a pithy foot-note.

works; 2nd, *empirical* laws, where the constancy of the correlation is invariable, but the cause is not manifested; such as that Ruminants alone should have cloven feet and horns on their frontals, concurrently with certain peculiarities in their teeth: thus establishing a harmony—constant, yet wholly inexplicable—between remote organs apparently unconnected; or, to use the definition of Mr. Huxley, "the invariable coincidence of certain organic peculiarities established by induction."

Having thus arrived at the general conclusions from observation on living animals, Cuvier, in the spirit of the same inductive philosophy, then applied the inverse process of deduction to the fossil remains: *i.e.* from the ascertained general, he reasoned down to the unknown particular, and thus attained those wonderful results, which have been well characterized by a great living writer as being "among those rare monuments of human genius and labour of which each department of exertion can scarcely ever furnish more than one, eminent therefore above all the efforts made in the same kind*." Throughout his great work there is that continual alternate use of the *inductive* and *deductive* method, which, Herschel remarks, is essential to the successful process of scientific inquiry. The case of all others to which he most proudly referred, was the determination of the Eocene Opossum of the Paris basin. The crushed skeleton of a minute quadruped was found in a slab of gypsum, and Cuvier employed the following process of analysis for its identification:

1. The teeth, and skeleton throughout, indicated a mammifer.
2. The elevation of the coronoid apophysis above the condyle, and the form of the acute posterior angle of the lower jaw, indicated a predaceous animal.
3. The general construction of the skeleton excluded the *Cheiroptera*.
4. The elevation of the condyle above the horizontal line of the teeth eliminated the ordinary Carnivora, such as Dogs, Cats, Martens, &c.; but was consistent with placental Insectivora, such as the Mole and Hedgehog, and likewise with Opossums and other marsupials.
5. The molar teeth also were consistent with both placental and implacental Insectivora.
6. The height and width of the coronoid apophysis, and the peculiar inflection of the posterior angle of the lower jaw, eliminated the placental Insectivora, leaving *Didelphys* and other marsupials.
7. Special characters of the teeth excluded all the other marsupials except *Didelphys* and *Dasyurus*.

* Brougham, Dissert. vol. ii. p. 113.

8. The number of the incisors excluded *Dasyurus,* leaving only *Didelphys.*

9. The sum of all the characters throughout the skeleton, and each of them taken separately, indicated *Didelphys.*

10. Therefore the fossil animal was a *Didelphys,* like the non-prehensile tailed Opossums, which are now restricted to the American continent.

If, in turn, we analyse the process, it is obvious that the result was obtained, first by determining the class, and then eliminating, by a series of successive steps, every differential condition, down to a single residual form; and if we examine the nature of the correlations upon which the successive steps were founded, it will be seen that most of them were of the *necessary* order, and but few of the *empirical.* Cuvier was confident, upon the evidence, that the conclusion was sound: but a *crucial instance* remained, by which to verify it. If the extinct form was an Opossum, it must have had a marsupial pouch, and to sustain the pouch, marsupial bones were necessary. He summoned some competent friends to witness the expected verification. A portion of gypsum was cleared away from the slab by the graver, at a sacrifice of some of the vertebræ, and a pair of marsupial bones, concealed in the matrix, were brought to light, resting in their natural position above the edge of the pubis. Thus, after determining the class, the first step in the further analytic deduction rested upon a *rational* or necessary correlation, and so also did the last, crowning the identification. When referring, afterwards, to this signal triumph, the great anatomist quietly remarked: "Je laisse cet article tel qu'il a paru d'abord, dans les annales du Muséum, comme un monument, selon moi assez curieux, de la force des lois zoologiques, et du parti que l'on peut en tirer."

Let us next examine what the true principle is, according to Mr. Huxley. It is not denied, that in palæontology, legitimate consequences may be deduced from the laws of living form: on the contrary, the whole science is admitted to be built on them. But the process of restoration depends, "*not* on the physiological correlation or coadaptation of organs;" but, "first, on the validity of a law of the invariable coincidence of certain organic peculiarities established by induction; secondly, on the accuracy of the logical process of deduction from this law." Now, the ability to demonstrate a proposition, or to infer a legitimate deduction, may be a measure of the capacity of the individual, but it is no criterion of the abstract truth of either. The second clause may therefore be struck out, as self-evident and superfluous. The principle is thus limited to "the invariable coincidence of certain organic peculiarities." This invariable coincidence may be, as has been shown above, either *empirical* or *necessary*. Cuvier, like a true interpreter of nature, employed both indifferently in his restorations, according as they were presented to him, and professed it. This important fact is *nowhere* recognized by Mr. Huxley, who argues the case throughout as if Cuvier had excluded the empirical and admitted only of necessary correlations. He, on the other hand, denies any share to the latter, and attributes the whole weight to the former. This is also implied by the antithesis between "physiological correlation or coadaptation of organs" (Cuvier), and "invariable coincidence of organic peculiarities" (Huxley). The same is manifested in the references to the sculptured pollen-grains, the forms and colours of flowers, the relation between the dotted vessels and naked ovula in the Gymnosperms, and the crustacean illustration. They are all empirical, so far as science can at present show. The special instance adduced is of the same nature: "Professor Owen's determination of the famous Stonesfield mammal is a striking illustration of this" (*i. e.* of reasoning from the law, by the logical process). "A small jaw of a peculiar shape was found, containing a great number of teeth, some of which were imbedded by double fangs in the jaw. Now these laws have been inductively established—

"(*a.*) That only Mammals have teeth imbedded in a double socket . . . . (*empirical*).

"(*b.*) That only Marsupials have teeth in so great a number imbedded in so peculiarly formed a jaw . . . . . . (*empirical*).

"By deduction from these laws to the case in question the legitimate conclusion was arrived at, that the jaw belonged to a Marsupial mammal."

Mr. Huxley has been as unhappy in this instance as with the Sloth, for it so happens, that the observed characters do not bear out this asserted deduction. The Stonesfield mammal *par excellence* is the genus *Amphitherium*, which shows the greatest number of teeth (sixteen on either side of the lower jaw), while *it wants* the peculiar marsupial inflection of the posterior angular process, or, at least, does not exhibit it in a greater degree than the placental Mole and Hedgehog. The balance of the evidence therefore "turns the scale in favour of its affinities to the placental Insectivora*." On the other hand, the second Stonesfield genus discovered long afterwards, *Phascolotherium*, has fewer teeth (only twelve on either side of the lower jaw), while *it does* exhibit the marsupial inflection of the angular process. "On reviewing, therefore, the whole of the osteological evidence, it will be seen that we have every reason to presume that the *Amphitherium* and *Phascolotherium* of Stonesfield re-

* Owen, Brit. Foss. Mamm. p. 61.

present both the Placental and Marsupial classes of Mammalia* (*i. e.* the former Placental, the latter Marsupial).

In all the sciences of observation, a great part of our knowledge, at an early stage, is, and must needs be, empirical. It is the same in physics as in natural history. But the constant effort of every philosophical mind is to extinguish the empirical character of the phænomena, and bring them within the range of a rational explanation. Every successful effort of this kind is regarded as so much fertile land reclaimed from the sterile domain of the ocean; and there is an irrepressible revulsion of feeling on seeing the dykes breached for a fresh submergence. In astronomy, Kepler's laws of the planetary motions remained for upwards of a century purely empirical; but at length they were proved to be a necessary consequence of the Newtonian system. Bode's law of the progression of the magnitudes of the planetary orbits still remains empirical. In physiology, animal heat, and the phænomena of sensation and voluntary motion, remained for many ages purely empirical. The most untiring application was devoted to them until the problems were, in a greater or less degree, rationally solved. The name of Charles Bell is imperishably connected with one of these solutions; for mankind has invariably received with a grateful triumph every instance where the demonstration of a great principle has superseded empirical darkness; and such was the feeling with which it recognized Cuvier's announcement and demonstration of the zoological laws of reciprocal relation as furnishing a guide in the reconstruction of extinct vertebrate forms. It is a rare spectacle to see empiricism chosen by preference.

Considering the pre-eminent services of Cuvier and the estimation in which they have hitherto been held, it might have been expected that Professor Huxley, in placing himself in collision with such an antagonist, would have taken every pains to arrive at an accurate appreciation of the position which he combated, and that he would have stated the case impartially; "modeste tamen et circumspecto judicio de tantis viris pronuntiandum est." But we fail to detect the indications of either. The case is only put in part, and the luminous exposition of the great anatomist is met by special pleading, and technical or light objections, beside the real scope of the argument. The result is, that after the encounter the law of correlation stands exactly as Cuvier found and left it,—inscribed by nature in indelible characters on the organization of every living and extinct vertebrate form, and wholly uninjured by its latest assailant.

* Lyell, Manual, 5th edit. p. 313.

Throughout Mr. Huxley's *brochure* there runs a strain of extolment of what is empirical in natural history at the expense of the rational. Let him be the great expounder of its æsthetics, if he likes,—every one will cheer him on. But he must beware of attempting to put back the hand of the rational dial, for every arm will be against him. The circulation of the blood has been stoutly denied in Britain within the memory of thousands now living. Strange events of this kind make their appearance periodically in all the sciences. They are anachronisms, which startle by their unexpectedness, and then pass into oblivion. How different were the aspirations of Cuvier! "Avec cette dernière précaution," (*i. e.* le habitude de ne se rendre qu'à l'évidence, ou du moins de classer les propositions d'après le dégré de leur probabilité) "il n'est aucune science que ne puisse devenir presque géométrique: les chimistes l'ont prouvé dans ces derniers temps pour la leur; et j'espère, que l'époque n'est pas éloignée où l'on en dira autant des anatomistes."

One other remark is necessary. Although the principle of correlation is borne out by a cumulative mass of evidence that is irresistible, it must not, in practice, be pushed too far in palæontology. There are numerous instances on record, in which, in attempting to determine extinct forms from a single bone or tooth, or from imperfect materials, very erroneous conclusions have been arrived at; among others, even by Cuvier himself. And since his time, the same lower jaw, presenting nearly the whole series of teeth, has been referred, by different eminent comparative anatomists, to a fish, a reptile, and a mammal! When these cases are examined under the light of improved knowledge, they furnish no grounds to weaken our confidence in the constancy of the zoological laws of correlation; but an emphatic warning to interpret the evidence carefully, leaving no part of it out, and to eschew hasty conclusions where it is inadequate.

De Blainville, smarting under the sting of some signal misinterpretations committed by himself, unceasingly inveighed against the sufficiency of a single fossil bone for the reconstruction of the form. At the present day, some molar teeth of a fossil mammifer have been met with in the Trias of Stuttgart. The cast of one of them has been shown to one of the most competent living authorities, who, it is stated, "is not able to recognize its affinity with any mammalian type, recent or extinct, known to him." But when *Microlestes antiquus* is better known, upon more copious materials, we may have every confidence, judging from past experience, that its teeth will be found to be in perfect harmony with the rest of its organization, and amenable to the laws of zoological correlation.

XLVII.—*Descriptions of three new species of* Paludomus *from Burmah, and of some forms of* Stenothyra (Nematura) *from Penang, Mergui, &c.* By W. H. Benson, Esq.

The forms first to be described belong to the genus *Paludomus* proper of Swainson (recently deceased at New Zealand), who was unacquainted with the Cingalese forms added by Reeve, and since separated chiefly with reference to the opercula. This circumstance, and not the applicability of Reeve's character, which is far from expressing the true features of the operculum, properly warrant Mr. E. Layard's restriction of Swainson's name to the shells which present a close affinity to *P. conica*, Gray. In a paper contained in the Proc. Zool. Soc. for 1854, Mr. Layard stated that, with the addition of the position of the nucleus in the operculum, Reeve's characters sufficiently describe it; but, even thus amended, the author has omitted the essential character separating it from *Paludina*, as pointed out to him in a communication dated in April 1852, when I accompanied the information with the distinctive characters of the divisions *Tanalia*, Gray, and *Philopotamis*, Lay., under the names of *Serenia* and *Heteropoma*, and with figures of the opercula of the three genera. The fact is that the nucleus of *Paludomus* proper, unlike that of the similarly horny and concentrically striate operculum of *Paludina*, is subspiral, and analogous to the testaceous one of *Bithinia*. I had prepared a memoir on the subject, with illustrations of the variations of the opercula in *Paludomus* and the *Melaniadæ*, which has been partly anticipated by the paper already before the public.

The genus *Paludomus* requires revision, especially with respect to the unfigured species, which demand more strictly defined characters. It will be found also that several species belong to it, of which the affinity was unsuspected by the describers; among them *Melania obesa*, Philippi, which is really an inhabitant of the vicinity of Bombay, not of Australia, and which may possibly be the same as *P. parva*, Layard; then the Egyptian *Cyclostoma Bulimoides*, Olivier, which has the true typical operculum of *Paludomus*, and which is singular in the genus from presenting a perforated base; lastly, *Melania lutosa* of Souleyet from the lower part of the Hooghly River near Calcutta. Both Philippi and Souleyet notice the concentric striation of the operculum in the shells which they doubtfully referred to *Melania*, overlooking however the structure of the nucleus. In the Atlas to the 'Voyage of the Bonite,' Souleyet gives a figure of the animal, which curiously illustrates its affinity to both *Melania* and *Paludina*.

The ungulate operculum of *Tanalia*, Gr., is analogous to that of the marine genus *Purpura*, and the animal (of which I was, in the early part of 1853, kindly furnished with an interesting sketch by Mr. Frederick Layard of the Ceylon Civil Service) fully bears out the separation of the shell. It may, indeed, be a question whether *Tanalia* belongs to the *Paludomidæ* at all. On the other hand, the subspiral operculum of *Philopotamis*, Lay., seems rather to indicate its place to be among the *Melaniadæ*, from the spiral and subspiral types of which family it differs in having the nucleus removed towards the right side of the base; the formation of the shell alone exhibiting a relation to the *Paludomidæ*. The subspiral opercula of the American forms *Anculosa*, *Gyrostoma*, and *Amnicola*, all point rather to the *Melaniadæ* than to *Paludomus*. Reeve, who was right in his conjecture respecting the affinity of *Melania obesa*, Ph., to *Paludomus*, has erred respecting that of *M. Grüneri*, Ph., inasmuch as, according to the assertion of Philippi, its operculum consists of six spiral turns.

I may add the following characters of the restricted genus from my inedited paper above referred to.

Paludomus, Swainson.

Testa plerumque imperforata, globoso-ovata, ovato-oblonga, vel ovato-acuta, fere solida, glabra, spiraliter sulcata, vel lirata, interdum spinuloso-costata, epidermide cornea induta; apertura subverticali, ovato-acuta, callo parietali munita, margine columellari crasso, arcuato, basali integro, interdum subeffuso.

Operculo corneo, concavo; nucleo subspirali insulari, submediano, ad sinistram sito, striis lamellatis concentricis partem majorem disci usurpantibus, circumdato.

The genus occurs in Ceylon, Southern India, Gangetic India to the eastward of a line drawn from Sikkim to the mouth of the Hooghly, in the Burhampooter in Assam, and in the hill-streams which flow into that river from the eastward, in Burmah, and Sumatra.

I possess from North-eastern India, besides *P. conica*, Gray, *lutosa*, Soul., *Stephanus*, nobis, and *Paludinoides*, Reeve, four other species which I cannot, with any degree of certainty, refer to published descriptions; and from Southern India two species in addition to *P. obesa*, Ph.

I may remark cursorily that Swainson's name having reference to the *dwelling-place* of the genus in marshes, the specific names ought to bear a feminine termination.

1. *Paludomus labiosa*, nobis, n. s.

Testa ovato-globosa, læviuscula, oblique tenuiter et obsolete spiraliter striata, versus suturam 2–3-sulcata, luteo-olivacea, nigrescenticastaneo fasciata, fasciis tribus latioribus; spira brevi, apice eroso; anfractibus 2 superstitibus convexis, ultimo $\frac{3}{4}$ testæ superante; apertura obliqua, ovata, superne acute angulata, fauce quadrifasciata, peristomate tenui, acuto, margine dextro superne declivi, medio valde arcuato, columellari incrassato, dilatato-appresso, extus fuscato, intus albido, compressiusculo; callo parietali mediocri. Operculo typico.

Long. 13, diam. 11 mill. Apert. 10 mill. longa, $7\frac{1}{2}$ lata.

Hab. in rivulis vallis Tenasserim. Teste W. Theobald.

2. *Paludomus ornata*, nobis, n. s.

Testa ovato-conica, solidiuscula, læviuscula, striis remotis obsoletis cincta, infra suturam marginatam bisulcata, luteo-olivacea, fasciis 4 fusco-castaneis, suturali angusta, secunda latissima, quarta inconspicua, ornata; spira conica, apice eroso; anfractibus 4 superstitibus convexis, ultimo $\frac{2}{3}$ testæ vix superante; apertura vix obliqua, ovata, fauce cæruleo-albida, 4-fasciata, superne angulata, angulo intus calloso; peristomate tenui, acuto, marginibus callo albo junctis, columellari subrevoluto, angusto, albo. Operc. —— ?

Long. 18, diam. 13 mill. Apert. 13 mill. longa, 8 lata.

Hab. in regno Burmanico. Teste W. Theobald.

3. *Paludomus regulata*, nobis, n. s.

Testa ovato-acuta, solidiuscula, regulatim distincte spiraliter sulcata, interstitiis latis planatis, minutissime confertissimeque decussato-striatis, sulcis 2–3 prope suturam latioribus profundioribus, pallide lutea, fasciis sub quatuor, tertia latiori, ornata; spira elata, conica, apice acuto; anfractibus 6, convexiusculis, ultimo dimidium testæ vix superante; apertura verticali, ovata, superne angulata, albida, intus 4-fasciata, peristomatis margine dextro recto acuto, ætate intus vix incrassato-marginato, parietali calloso, columellari versus basin subdilatato, appresso. Operc. ut in sp. typ.

Long. 19–24, diam. 12–14 mill. Long. apert. majoris 13, lat. 9 mill.

Hab. ad Thyet-Myo Burmanorum. Detexit W. Theobald.

Genus Stenothyra, Benson, Annals, Ser. 2. vol. xvii. p. 342.
Nematura, ejusdem, Journ. As. Soc. Calc. vol. v. p. 781.

1. *Stenothyra cingulata*, nobis, n. s.

Testa vix rimata, ovato-fusiformi, compressiuscula, nitida, lineis remotiusculis spiralibus, leviter impressis, puncticulatis cingulata, translucente pallide cornea vel hyalina; spira elongata, ovato-acuta, apice acuto, fulvescente, sutura profunda; anfractibus 5, superioribus convexis, ultimo ventre longiori convexiusculo, antice descendente, subtus rotundato, $\frac{2}{5}$ longitudinis testæ æquante; apertura vix obliqua, ovata, superne angulata, peristomate acutiusculo. Operculo —— ?

Long. 5, diam. 3 mill.

Hab. ad insulam Penang. Detexit Dr. Theodore Cantor.

This shell was found by Dr. Cantor in company with *St. glabrata,* A. Adams, but more rarely. Its narrower elongated form distinguishes it from all previously described species. The sculpture has some resemblance to that of *St. polita,* Sow., and to that of the species next to be described.

2. *Stenothyra monilifera,* nobis, n. s.

Testa subperforato-rimata, oblongo-ovata, compressiuscula, nitidiuscula, sulcis confertioribus, dense puncticulatis, spiralibus impressa, fusco-cornea, fascia pallida supra mediam ornata, versus apicem obtusulum hyalinum rubente, spira convexo-conica, sutura profunda, canaliculata; anfractibus $4\frac{1}{2}$ convexis, ultimo subsoluto, $\frac{3}{7}$ testæ æquante, antice valde descendente, subtus rotundato, periomphalo subcompresso; apertura obliqua diagonali, rotundato-ovali, sulco profundiori ab anfractu penultimo divisa, peristomate obtusulo, callo parietali superne solum conspicuo. Operculo corneo-pellucido, apice ad dextram spectante.

Long. $4\frac{1}{2}$, diam. 3 mill.

Hab. ad Mergui Burmanorum. Teste W. Theobald.

Distinguished from the last by its form, more developed sculpture, colour, want of polish, and peculiar umbilical rimation.

3. *Stenothyra foveolata,* nobis, n. s.

Testa vix rimata, ovato-acuta, spiraliter foveolato-striata, striis versus basin confertissimis, spira conica, apice acuto, sutura mediocri; anfractibus 5 convexiusculis, ultimo ad ventrem planiusculo, $\frac{1}{3}$ testæ æquante, antice descendente, basi rotundato; apertura obliqua, rotundato-ovata, peristomate obtuso, margine parietali sulco mediocri ab anfractu ventrali separato. Operculo —— ?

Long. 5, diam. $3\frac{1}{4}$ mill.

Hab. in Gange fluvio, prope Sikrigali. Teste Capt. T. Hutton.

This shell has reached me in a weathered condition, so that the colour and the normal condition of the surface cannot be exactly described. Its form, however, and the pitted lines seem to mark it as a distinct species. In form it resembles the small *St. puncticulata,* A. Adams, from the Eastern Isles; but in that species the puncticulate lines are faint and distant, and not closely set even towards the base, while a scarcely compressed ridge runs down by the side of the slightly impressed rimation and joins the columellar margin below it, a feature not found in the Gangetic shell. Another *Stenothyra* resembling *foveolata* in the characters of the aperture, and marked with delicately puncticulate lines, was found with it, but, from the imperfection of the spire, its identity with it cannot be safely declared. The degree of closeness between the lines is about the same, and the surface is of a pale horn-colour, as in some specimens of *St. Deltæ,* like which also it presents a faint oblique striation. These shells are important as showing the occurrence of the genus at a distance of 300 miles from the sea, and 200 miles above the extreme influence of the tides.

4. *Stenothyra frustillum*, nobis, n. s.

Testa vix rimata, minima, ovato-conoidea, politissima, sub lente obsoletissime oblique striatula, albida, translucente, spira convexo-conoidea, apice obtusulo, sutura leviter impressa; anfractibus 4 convexiusculis, ultimo ventricosiore, minime compresso, dimidium testæ non æquante, antice descendente, basi rotundata; apertura subrotundata, marginibus peristomatis acutiusculis. Operc. —— ?
Long. $1\frac{1}{2}$, diam. 1 mill.
Hab. in Australia. Mus. Cuming.

5. *Stenothyra strigilata*, nobis, n. s.

Testa non rimata, oblongo-ovata, solidiuscula, nitidula, oblique obsolete striatula, creberrime spiraliter sulcata, lineis brevissimis obliquis excavatis (punctorum loco) sulcos occupantibus, fusco-nigrescente; spira ovato-conica, apice eroso, sutura impressa; anfractibus 4 superstitibus convexiusculis, ultimo dimidium testæ æquante, antice valde descendente basi rotundata; apertura ovata, subverticali, intus livide cærulescente, peritremate obtuso, margine parietali intus callo, superne subito desinente, munito, dextro intus longitudinaliter sulco marginato. Operculo tenui translucente, concaviusculo, corneo, intus costa albida marginato.
Long. 7, diam. 4 mill.
Hab. in Insula Borneo. Mus. Cuming.

This is the largest known species of the genus, and is a fine addition to it. The cross linear sculpture of the furrows is different in character from that of the several species which present puncticulate or foveolate lines.

The operculum of *Stenothyra* has a calcareous skeleton or basis, covered internally and externally by a horny layer, which led to its designation by myself in 1836, and A. Adams in 1851, as horny. According to Philippi, Gray states it to be calcareous, and, on fracture, it will be found to be brittle, and that in some species it does not yield to the knife like a horny substance, the calcareous matter being predominant; while in other very thin and pellucid opercula the horny part is in excess. On the whole, this part may be considered rather as of a mixed character than as either strictly calcareous or horny. The structure of the operculum is subspiral, and more analogous to that of *Assiminia* and *Hydrobia* than to that of *Bithinia*.

More extended characters of a few of the described species will add to the information already possessed respecting this curious little genus. I shall begin with the typical species—

Stenothyra Deltæ, Benson.

Testa vix rimata, globoso-conica, læviuscula, oblique exilissime striata, striis obsoletis spiralibus minutissimis, versus basin remotioribus, decussata, pallide fulva, albida, vel cornea translucente; spira conica, acuminata, apice subtili, sutura impressa submarginata; anfractibus $5\frac{1}{2}$, superioribus convexis, sequentibus convexiusculis, ultimo ventricoso, compresso, $\frac{2}{5}$ testæ æquante, antice descendente, supra aperturam arcuatim striato, basi compresse rotundata; apertura obliqua, ovato-circulari, superne indentata, peristomatis margine dextro acutiusculo, columellari et basali expansiusculis, parietali intus callo inconspicuo superne truncato, munito, extus sulco impresso marginato; operculo corneo, limbo albido.

Long. 4–5, diam. $2\frac{1}{2}$–$3\frac{1}{2}$ mill.

Hab. in locis lutosis fluvii Hooghly prope Calcutta Bengalensem, satis copiose; necnon in lacu salso prope Balliaghat, ligno natanti adhærentem ipse detexi.

Syn. *Nematura Deltæ*, Bens. Journ. As. Soc. 1836, vol. v. p. 781; Sow. Charlesw. Mag. 1837, vol. i. p. 217.

I found it alive in both the places named; also a dwarf variety in an aqueduct, supplied by a steam-engine from the river, in front of the Town Hall, at Calcutta.

Stenothyra glabrata, A. Adams.

Testa omnino imperforata, ovato-conica, lævissima, nitidissima, fusco-cornea vel olivacea, spira conica, apice acutiusculo, sutura impressa, submarginata; anfractibus 5 convexiusculis, ultimo ventricosiori, latere sinistro sæpius gibbosulo, antice descendente, $\frac{2}{5}$ testæ æquante, basi rotundata; apertura obliqua, rotundato-ovata, superne angulata, peristomate recto, obtuso, plerumque nigrescente. Operculo typico, concaviusculo, fusco.

Long. 3–$5\frac{1}{2}$, diam. 2–$3\frac{1}{4}$ mill.

Hab. in paludibus Insulæ Penang. Detexit Dr. Theo. Cantor.

Syn. *Nematura glabrata*, A. Adams, Pr. Z. Soc. July 22, 1851; et var. *olivacea*, ejusdem, loc. cit.

Nematura polita, Bens. MSS., nec Sow.

This shell, of which I have examined at least eighty specimens, when divested of the reddish-brown earthy coating which generally covers it, may be at once recognized, by its polish, dark suite of colours, and freedom from sculpture and umbilical rimation, independently of its form, which is more elongate than the Gangetic species; also by the gibbosity of the left side of the ventral volution, and the comparative absence of lateral compression. It varies much in size. It was communicated to me by Dr. Cantor in 1842, and has been diffused under the MS. name above quoted, both in England and on the Continent. That name however was transferred, by some accident, to the following shell, under the impression that it had been so named by Sowerby. This circumstance may lead to some confusion, but the very different characters of the two species will permit of rectification on a cursory comparison.

Stenothyra polita, Sowerby.

Testa arcuato-rimata, ovato-pyramidata, lævi, exilissime confertim oblique striata, striis antice fortioribus, punctis (interdum elongatulis) lineas remotas spirales interruptas efformantibus, fusco-castanea vel castanea, spira elongato-conica, sutura impressa, apice acuminato; anfractibus $5\frac{1}{2}$, supremis valde convexis, ultimo antice celeriter descendente, $\frac{2}{5}$ testæ æquante, ventre majori planato, latere sinistro compresso, angulato, basi transverse cristato-carinata, circa periomphalum compresso-cingulatum sulcis nonnullis, peritrema transgredientibus, insculpta; apertura vix obliqua, ovata, superne leviter angulata, peristomate undique planato, callo parietali mediocri pallido. Operculo concavo, albido, duriori, epidermide fusco-castaneo induto.

Long. $6\frac{1}{2}$, diam. major $4\frac{1}{2}$, min. 3 mill.—Sp. mus. nost.

Hab. in paludibus Insulæ Singapore. Detexit amicus Dr. J. F. Bacon.

Syn. *Nematura polita*, Sow. teste A. Adams, Pr. Z. S. 1851.

Dr. Bacon sent me a single specimen from Singapore, from the marshes of which island he procured many species of *Auriculadæ*, including some new shells lately described by Pfeiffer. The specimen is more characteristic, and darker in colour than the typical one transmitted by Mr. Cuming from his collection for comparison. The species is easily known by its pinched carinate base, form, and peculiar sculpture. On the back of the shell the puncta are closer, and more disposed to form impressed continuous lines than on the flattened front.

Stenothyra minima, Sow.,

Charlesworth's Mag., April 1837, vol. i. p. 217, fig. 22 *b*, where this shell was very cursorily described as *Nematura minima*, Sowerby, in the following terms:—

"This is about one-fifteenth of an inch in length, and is translucent; it has a smooth polished surface and a small umbilicus, and it is of a light brown colour."

It was subsequently described by Mr. Arthur Adams in the P. Z. S. July 1851, as follows, and was erroneously recorded as N. minima, *Benson*:—

"N. testa parva, cornea, semipellucida, ovali; spira subproducta; polita, fasciis rufis subobsoletis ornata; apertura orbiculari, peritremate simplici. Mus. Cuming."

A specimen is now before me from Mr. Cuming's cabinet, which presents the following characters:—

Testa breviter distincte rimata, ovato-conica, sub lente oblique striatula, nitida, pellucida, albido-fulvescente; spira conica, apice obtuso, sutura late marginata; anfractibus 4 convexiusculis, ultimo antice breviter descendente, ventre convexiusculo, latere sinistro compresse angulato, basi rotundata; apertura verticali, subcirculari, superne angulata, peritremate acuto. Operc. —— ?

Long. 2, diam. 1 mill.

Sowerby says that many specimens were found in the collection of Mr. George Humphreys, in a box of minute shells which he had marked, "From the W. I." No species has yet been recognized in the western hemisphere, so that "Western India" may possibly have been originally intended. An examination of the other shells in the box might have thrown some light on the question.

The shell cited by M. Albert Mousson, in his 'Moll. von Java,' as the Javanese representative of Quoy's and Gaimard's *Paludina ventricosa* from Celebes, and which forms another species of *Stenothyra*, may be distinguished from *St. minima*, which it about equals in size, by its more ovate form and less conic spire, by the greater descent of the last whorl anteriorly above the aperture, by the lengthened sulcus which separates the peristome from the body whorl, the deeper non-marginate suture, the more tumid ventral part of the last whorl, the absence of compression at the left side, and finally by its pale horny colour and duller surface. I owe this form to the kindness of M. Mousson.

Including *St. puncticulata*, A. Adams, P.Z.S. 1851, I have now before me eleven good species of the genus from Mr. Cuming's and my own collection. Sowerby has figured (*loc. cit.*) a fossil species from Grignon. The Delta of the Irawadi, the Siam and Anam rivers, the embouchures of streams in the islands of the Eastern Archipelago, and the waters of Southern India and Ceylon, ought to add materially to the list, when properly explored for these minute and interesting shells.

Cheltenham, 5th June 1856.

XLVIII.—*On the Minute Structure of certain Brachiopod Shells; and on Vegetable Cell-Formation.* By William B. Carpenter, M.D., F.R.S., F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen, University Hall, London, May 19, 1856.

Prof. King having introduced into his "Notes on Permian Fossils," in the 'Annals' for April last, certain comments upon former statements made by me respecting the intimate structure of the shells of Brachiopods, which must, if unnoticed, tend to diminish the value attached to them by those who have hitherto relied upon my assertions, I must beg you to admit the following reply, which shall be as little personal as the tone taken by Prof. King will permit me to make it.

In the 'Annals' for December 1843, I first published the fact, which had been nearly a year previously communicated to the Royal Society, that the shells of many Brachiopods are traversed by large perforations, passing from one surface to the other, the external orifices of which may be detected as minute punctations; and I mentioned that this character presents itself in all the recent *Terebratulæ* which I had examined, with the exception of the *T. psittacea*, which, as is now well known, has been since separated as one of the two recent types of the genus *Rhynchonella*. In the 'Reports of the British Association' for 1844, I entered much more fully into this point, embodying the results of more extended examinations into the structure of the shells of fossil Brachiopoda, and giving thirteen figures of the minute organization of recent and fossil shells of this group, drawn under magnifying powers varying from 75 to 250 diameters, by that very accurate microscopic draughtsman, Mr. S. W. Leonard. Save for a want of perfection in the printing-process, these figures could scarcely be surpassed at the present time.

In his 'Monograph of the Permian Fossils of England,' published by the Palæontographical Society in 1850*, Prof. King took upon himself, upon no other evidence than that of the examination of the *surfaces* of various Brachiopods with a Stanhope lens, to throw discredit upon my previous statements; asserting that punctures, though much more minute than those in the *Terebratulidæ*, occur in every species of *Rhynchonella* which had passed under his notice; and adding, "I doubt their absence in any Brachiopod whatever."

* I am obliged to call attention to this date, which I take from the title-page, for a reason which will presently appear. The work was issued as the publication of the Pal. Soc. for 1849; but (according to the practice of the Society) it was not delivered to the members until the following year.

Having been requested by Mr. Davidson to contribute a Memoir on the intimate structure of the Shells of Brachiopoda to his admirable Monograph of that group in course of publication by the Palæontographical Society, I re-entered upon the investigation with no desire but that of contributing to the establishment of the truth; and made microscopic sections of many additional specimens, with which Mr. Davidson kindly supplied me,—the total number of sections examined (nearly all of which are preserved in my cabinet) being about *three hundred.* In the course of this inquiry, the *presence* of perforations in *Terebratulidæ,* and their *absence* in *Rhynchonellidæ,* was established as the character of so large a number of species of both tribes, that I thought myself justified in stating these as distinctive characters of the shells of these two groups respectively. A remarkable confirmation of their validity, and an important lesson as to the fallacy of *superficial* observations upon this point, were afforded by the apparently-exceptional cases of *Stringocephalus* and *Porambonites.* The former had been previously regarded as a non-perforated genus, and had been associated on other grounds with the *Rhynchonellidæ;* examination of microscopic sections, however, satisfied me that its shell was perforated; and the letter in which I communicated to Mr. Davidson this at first sight anomalous fact, was crossed by one from him to me, mentioning that he had been led by the researches of Prof. Suess to consider the affinities of *Stringocephalus* as being rather with the *Terebratulidæ,* and inquiring as to the presence or absence of perforations; so that both sets of characters came again into complete harmony. The place of *Porambonites* being undoubtedly among the *Rhynchonellidæ,* the existence of perforations (which had been thought to be unmistakeably indicated by the very regular punctations of the surface) was an apparent anomaly of no small importance; this, however, was at once removed by the examination of microscopic sections of the shell, since it was found to be as destitute of perforations as any true *Rhynchonella.* The case of *Trematis* was one of the same kind, the punctations being there also quite superficial; constituting, in fact, a peculiar kind of 'sculpture.'

I thought it right, in stating these and similar facts, to give an emphatic warning against *superficial* observations upon this point, and to express my surprise that Prof. King should have ventured, upon such evidence, to affirm the universal existence of perforations in the shells of Brachiopoda; especially without having examined one of the most common of the recent types of the group, namely *Rhynchonella psittacea,* in which the absence of perforations, as described and figured by me in 1844, can be verified without the slightest difficulty. "To myself personally," I added, "it is a matter of entire indifference whether Prof. King does or does not admit the correctness of my observations; but I would submit, that the interests of science are not very likely to be promoted by this easy setting-aside of observations made with every advantage of first-rate instruments and careful preparation of specimens, in favour of glances with a hand-magnifier at shells whose surfaces are peculiarly liable to present deceptive appearances."

As Prof. King made no reply to these observations at the time they were published, I hoped that he acquiesced in their justice, and that the question between us might be regarded as settled. It now appears, however, that I was premature; since, after the lapse of two years, Prof. King returns to the charge; not so much, however, to maintain his former assertions, as to justify himself for having discredited mine. He now admits the non-existence of perforations in *Rh. psittacea*, and, by implication, in other *Rhynchonellidæ*; but he considers the case of *Rh. Geinitziana* to be an unquestionable exception to the universality of non-perforation in that genus,—both valves of this species being "as distinctly and regularly perforated as those of any *Terebratulidæ*." By the kindness of Mr. Davidson, I have had the opportunity of examining one of Prof. King's own specimens, as well as an authentic specimen of this species which he has received from Baron von Schauroth; and I am bound to admit that both these specimens bear out Prof. King's statement, so far as can be judged by external appearance. I have not felt at liberty, however, to damage these specimens to the extent necessary for determining the question whether the superficial pittings extend through all the layers of the shell, and are therefore the homologues of the perforations of *Terebratulidæ*. Supposing, however, this should prove to be the case, it would still have to be determined whether, in spite of its external characters, this species be a true *Rhynchonella*, or whether it should be separated as a sub-type of that genus, which, like *Spirifer*, *may* contain both perforated and non-perforated species, or whether, like *Stringocephalus*, it should be found to be more related in its internal structure, as well as in the texture of its shell, to the *Terebratulidæ*.

The question of the accuracy of my *observations* on this point is one quite distinct from that of the accuracy of my *generalizations*. I have given, in my Memoir, the evidence on which the latter seemed to me to be at least provisionally established; but I myself remarked at its conclusion, on the necessity of a far more extended examination of species than I had been myself able to make, before these generalizations could be regarded as established. I shall be, therefore, as ready as any one to withdraw them, when they shall be proved to have been premature; but until the structure of the species now in question shall have been fully investigated, I must claim a suspension of the verdict.

Prof. King attempts to justify his scepticism as to my former statement of the non-perforation of certain Brachiopods, on the plea that "fossilization had so obliterated the tissue of many shells, as to render the detection of it an impossibility; and it was also conceived, that some shells were more prone than others to become thus altered." This argument is, of course, quite inapplicable to the case of *Rh. psittacea*, which I had described as the type of the non-perforated group. Further, it will be seen on reference to pars. 36 and 44 of my "Report" for 1844, that I distinctly recognized the existence of this metamorphic action as obscuring the structure of certain shells of this group; and I have never spoken confidently about the presence or absence of perforations, save where the intimate structure of the shell was so perfectly preserved as to leave no possible doubt about the matter. Where the place of the passages which exist in Prof. King's imagination is found to be occupied, not by fossilizing or metamorphic substance, but by the peculiarly characteristic structure of the Brachiopod shell, I venture to affirm that there can be "no mistake."

The greater part of Prof. King's note, however, seems intended to turn the tables upon me, by showing that my original account of that structure was so incorrect, as tested even by my own subsequent description of it, that no confidence whatever was to be placed in it; and also, to claim for himself the merit of setting me right. I shall not occupy your space by a detailed justification of myself as to this matter, but shall simply draw attention to the following points.

In my original "Report" I did not minutely describe the peculiar microscopic *appearances* of these Brachiopod shells, considering that my figures spoke for themselves; but the special object of that "Report" being to establish the organic structure of Shell, I offered an *interpretation* of them (based on the idea of plications in the shell-membrane), which at that time seemed to me to be borne out by the facts I had ascertained by the decalcification of recent shells and examination of the organic residue. Subsequent examination having led me to doubt the validity of this interpretation, I did not reproduce it in my "Memoir" of 1854, but confined myself to a description of the *appearances*, which will be found to be accordant in all essential particulars with my figures of 1844. As I never saw the Memoir of Vicomte D'Archiac referred to by Prof. King, it is not to that accomplished palæontologist that my abandonment of my former heresy is attributable. And that Prof. King has no ground for charging me with adopting *his* corrections without acknowledgment, will appear from the following quotation from the article "Shell," which I contributed to the 'Cyclopædia of Anatomy and Physiology' (vol. iv. pp. 563, 564):—"When thin sections are microscopically examined, they present a very peculiar texture (shown in the figure), which might be referred either to long flattened cells, or to plications in the shell-membrane. . . . . The cells, if cells they be, must be excessively flattened, and no vestige of them can be traced in the decalcified shell; whilst, on the other hand, *the membranous residuum does not give any distinct indication of having been plicated with the regularity necessary to produce such a remarkable appearance.*" Now this passage was written in 1848 or early in 1849, consequently long before the publication of Prof. King's Monograph.

I must trespass a little further upon your space, for the purpose of requesting your readers to suspend their judgment upon the question on which Prof. Henfrey has pronounced (in your last Number, p. 417) a very positive opinion in opposition to mine,—namely, the value to be attached to Mr. Wenham's observations on the process of cell-development in plants. No one has a higher estimate than myself of Prof. Henfrey's acquirements in vegetable physiology; but since I happen to know that Mr. Wenham's conclusions are borne out, as to certain important particulars, by the testimony of other independent observers, who will probably ere long make public the facts they have witnessed, I venture to believe it possible that Prof. Henfrey may be mistaken. What I considered to be the essential point in Mr. Wenham's observations was this,—that a mass of protoplasm may resolve itself into cells by a process of vacuolation in the parts which are to be the cell-cavities, and of consolidation in those which are to become the cell-walls, essentially corresponding with that which takes place in the development of a single cell from a "gonidium" or any other isolated particle of protoplasm. That this doctrine does not agree with Prof. Henfrey's general ideas of the process of cell-formation, is no more proof that it is wrong, than the denial of the sexual nature of the antherozoids of Cryptogamia by Prof. Schleiden proved that doctrine to be invalid. When Mr. Wenham's observations shall have been *shown* to be incorrect *as to the essential point just mentioned,* I shall be quite ready to retract the "endorsement" which I gave to them.

I am, Gentlemen,
Yours sincerely,
William B. Carpenter.

BIBLIOGRAPHICAL NOTICES.

General Outline of the Organization of the Animal Kingdom, and Manual of Comparative Anatomy. By Thomas Rymer Jones, F.R.S. Second edition. London, Van Voorst, 1855. 8vo.

On the Continent, and especially in Germany, every important fact in the anatomy and development of animals is sure, in the course of a year or two from its discovery, to find itself embodied, with its consequences upon zoological classification, in one of the numerous manuals of Zoology or Comparative Anatomy with which the press of that country teems. Everything is thus brought within the reach of the student, who, at the commencement of his course, has merely to buy one of the most recent of these works, in order to place himself pretty nearly in possession of the actual state of the science.

To the English student, however, none of these advantages are offered; amongst the few books of this class and of any reputation, the best was probably the first edition of the work which we have now before us, and this, notwithstanding its undoubted merits, could by no means be regarded, even at the time of its publication, as perfectly free from faults. These, the interval of fourteen years which had elapsed since the book first made its appearance in the world, had certainly not tended to diminish, and it was therefore with no small satisfaction that we learnt that a new edition was forthcoming, as in it we fondly hoped that the English student might at last obtain an idea of the vast progress that has been made in Zoology within the last few years, without the necessity of resorting to foreign literature for this purpose.

In this hope, however, we regret to say we have been disappointed. In his second edition Professor Rymer Jones clings with astonishing pertinacity to the grouping adopted in his first, and if we are to take his book as our standard, zoological classification has made but little progress since the days of Cuvier; for we cannot see that the division of the Cuvierian Radiata into *Acrita* and *Nematoneura*, or the substitution of new names for the other three primary groups of that author, constitutes any great step in advance.

Retaining his old primary divisions, it is but just to say, however, that our author has sacrificed a little to the spirit of the times; but even where this is the case, he seems to be hampered by his prejudices in favour of his former views:—thus he adopts the group of the *Protozoa*, but still places it as a class of his *Acrita*; and the different sections into which these simple creatures are divided are mentioned in such a manner that it is utterly impossible to understand what comparative value the author attributes to them. Moreover he has actually introduced amongst the *Protozoa* a description of the *Spermatozoa*, a somewhat unnecessary addition one would think, especially as the author himself tells us that they are not independent organisms. Another step in the right direction is the adoption of the Class of *Hydrozoa* for the Hydroid polypes and Acalephs.

When we look into the remaining groups of the *Acrita* and *Nema-*

toneura, we find that the contents of these two great sections are positively identical with those of Cuvier's *Radiata*. The Flat-worms (*Cestodea* and *Trematoda*) are placed amongst the *Acrita*, and the Round-worms amongst the *Nematoneura*, and the latter division also contains the *Bryozoa*, *Rotifera* and *Epizoa*. The retention of the latter in such a situation is certainly calculated to astonish one, considering how well established is the close resemblance, we might almost say identity, between the young state of these anomalous parasites and the Entomostracous Crustacea; and we must confess that we cannot understand why the class of *Epizoa* should be condemned to figure so low in the scale of animal existences, whilst the epizootic genus *Nicothoë* occupies an aristocratic position amongst the *Crustacea*. Equally inadmissible is the position assigned to the *Cirrhopoda* amongst the *Heterogangliata* (or *Mollusca*), in spite of the positive demonstration that we possess of their Annulose nature;—indeed we can only impute the retention of this unfortunate group of Crustaceans amongst such unsuitable neighbours, to some confusion of ideas on the part of Professor Rymer Jones, as he actually figures a complete Homogangliate nervous system as characteristic of the Cirrhopods, and places them in his list of the Homogangliate (or Annulose) Classes, at the end of his general chapter on Classification. It would almost seem as though Professor Rymer Jones were of opinion that the position of the *Cirrhopoda* in the Animal Kingdom might as well be settled by the ingenious device of tossing up, proposed, as we are told, by some truly American Statesman for the adjustment of the little difficulties existing between this country and the United States.

We should hardly have dwelt at such length upon these defects in a work which notwithstanding them possesses a great claim to consideration, but for the circumstance that the author leaves it to be inferred by his reader that the system adopted in it is *the* system, whilst he must be well aware that, so far from its being adopted by the majority of zoologists and comparative anatomists, it furnishes anything but a true picture of the generally received views of zoological classification. But the reader may seek in vain in the pages of this thick volume for anything like an admission that a different mode of arrangement is practicable, or for a confession that other writers place particular groups in a position different from that assigned to them by Professor Jones,—the nearest approach to anything of the kind consisting in references to resemblances between the *Epizoa* and *Rotifera* and the *Crustacea*, and a statement regarding the *Cirrhopoda*, that "it will not be surprising, if, after reading the details connected with their structure, some naturalists should prefer to regard them as belonging to the Homogangliate rather than to the Heterogangliate division." We should think it by no means surprising; but we are rather surprised that, when he went so far, our author could not tell his readers, that the conclusion at which he more than half expected them to arrive was the one now generally adopted by the first zoologists both at home and abroad.

It may be urged, that as Professor Rymer Jones's work only professes to treat of the comparative anatomy of animals, the question of classification is one of secondary importance as far as he is concerned; but this plea can hardly be admitted, inasmuch as a comparative anatomy must of necessity take a zoological classification for its foundation, and the nearer the truth we can bring this, the better will be our representation of the "organization of the Animal Kingdom."

Notwithstanding the faults above referred to, Professor Rymer Jones's work will be found to contain a most valuable outline of the structure and development of the different classes of animals, although it is to be regretted that, in the consideration of the latter portion of the subject, his unfortunate views of classification again step in, and certainly prevent his giving that importance to the earlier stages of some groups which they deserve, if indeed they have not induced him rather to throw them into the background, as matters of comparatively little consequence. The same circumstance of course prevents the reader from finding any reference in the pages of this book to the doctrine of a retrograde metamorphosis, which not only applies to such groups as the *Epizoa* and *Cirrhopoda*, but is also adapted to throw much light upon the position in nature of other anomalous animals, which have generally been puzzles to zoologists. As a general rule, however, the information seems to have been pretty carefully brought down to the present time, although we notice several omissions of greater or less importance in different parts of the work. One or two of these we may mention, as we can hardly understand how Professor Rymer Jones could have made them. Under the Cephalopodous Mollusca, we find not the slightest reference to those curious spermatophora the *Hectocotyli*; and in his description of the *bulbus arteriosus* in Fishes, our author states that it is of a muscular nature, although Professor Müller has shown that it is nothing of the kind in the ordinary fishes: and in mentioning the existence of the numerous valves in the arterial bulb of the Sharks, &c., he has taken not the least notice of the occurrence of the same structure in the Ganoid Fishes, although it is upon this character that the order *Ganoidea* now reposes. We can hardly suppose that Professor Rymer Jones is in utter ignorance of Müller's admirable paper upon the Ganoid Fishes, which has been published about twelve years, and must attribute his omitting to take any notice of it to its having in some way slipped from his memory.

However, with all these omissions and an occasional misstatement of minor importance, there can be no doubt that Professor Rymer Jones's volume contains an immense amount of valuable information, well put together, and adorned with all that elegance of language for which the author is particularly distinguished. As in his previous edition, he commences with the lowest forms of animals and proceeds from these upwards in the scale of existence to the Vertebrata, a mode of arrangement which certainly has many advantages. The numerous woodcuts with which the work is profusely illustrated are of the highest excellence and very well printed, whilst the general utility of the book is greatly increased by the admirable double index, consisting in fact of two separate tables of contents, one giving a list of the subjects treated of in the order in which they occur in the subsequent pages; whilst the other or "Physiological Index" takes the different organs or their functions as the basis of its arrangement, and furnishes references to the particular paragraphs in which their nature in the various groups of animals is described, thus enabling the reader to trace any one function or organ from its first appearance to its full development.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 8, 1855.—G. R. Waterhouse, Esq., in the Chair.

Mr. Gould exhibited a portion of a collection of birds formed by Mr. Hauxwell in a district lying on the eastern side of the Peruvian Andes, in the neighbourhood of the River Ucayali, one of the tributaries of the Upper Amazon. Mr. Gould observed, that the exploration of this particular district had been one of the earliest objects of his own ornithological ambition, but that until within the last few years no naturalist had visited it. The splendid collection sent by Mr. Hauxwell, of which the birds exhibited to the Meeting formed a part, fully bore out the anticipations entertained by Mr. Gould, that when explored it would prove one of the richest and most interesting ornithological districts with which we are acquainted.

Amongst the birds exhibited were some *Cotingas*, differing from the ordinary species found in the lower countries of Brazil, and remarkable from the splendour of their colouring, together with species of *Phœnicercus, Rhamphocelus*, &c., of the most dazzling brilliancy. As a contrast to these, Mr. Gould exhibited a series of dull-coloured *Thamnophili*, also contained in this collection, and remarked that this striking difference in the coloration of birds inhabiting the same locality was due almost entirely to their different degrees of exposure to the sun's rays; the brilliantly coloured species being inhabitants of the edges of the forests, where they fly about amongst the highest branches of the trees, whilst the others form a group of short-winged insectivorous birds, which inhabit the low scrub in the heart of the dense humid jungle, where the sun's rays can rarely, if ever, penetrate.

Mr. Gould also remarked, that the colours of the more brilliant species from the banks of the Ucayali, a district situated towards the centre of the South American continent, were far more splendid than those of the species representing them in countries nearer to the sea, and from this circumstance he took occasion to observe that birds from the central parts of continents were always more brilliantly coloured than those inhabiting insular or maritime countries. This rule applies equally to birds of the same species, the Tits of Central Europe being far brighter in colour than British specimens. Mr.

Gould had observed that the like difference existed between specimens of the same species inhabiting Van Diemen's Land and the continent of Australia. He attributed this principally to the greater density and cloudiness of the atmosphere in islands, and countries bordering the sea; and in further illustration of the influence of light upon colour, he stated, that the dyers of this country are never able to produce tints equal in brilliancy to those obtained by their continental rivals, and that in England they never attempt to dye scarlets in cloudy weather.

Description of a new Species of Ruticilla from Erzeroum. By John Gould, F.R.S. etc.

Ruticilla erythroprocta, Gould.

Forehead black; crown of the head clouded silvery-grey; back, shoulders, throat, chest, and the upper part of the abdomen, jet-black; lower part of the abdomen, upper and under tail-coverts dull red; tail-feathers dull red, except the two middle ones, which are brownish-black; wings both above and beneath brownish-black; some of the secondaries slightly fringed with silvery-grey; bill and feet black.

Total length, $5\frac{1}{2}$ inches; bill, $\frac{5}{8}$; wing, $3\frac{1}{4}$; tail, $2\frac{5}{8}$; tarsi, $\frac{7}{8}$.

Hab. Erzeroum.

Remark.—Nearly allied to, and about the size of, *R. Tithys*; but differing from that species in the under surface of the shoulder being darker, and the lower part of the abdomen being red instead of greyish-white.

In my own collection.

Notes on the Birds of Western India. By Lieut. Burgess.

Family Rallidæ.

Genus Fulica, L.

Fulica atra. Bald Coot.

I found some of these birds breeding on the Singwa tank, situated about eighteen miles north of the station of Ahmednuggur, on 21st August, 1849. I obtained three eggs and three nestlings, which were marked as follows: head, neck, breast and back covered with bright orange-red, hair-like feathers; beak crimson, tip white; lower part of the back dark lead-colour, nearly black; near the beak the face was covered with bright scarlet pustules; irides brown; legs and feet dark lead-colour. The young birds swam with surprising rapidity. I was attracted at first by the unusual movements of the old birds, who swam backwards and forwards with great swiftness at some distance from the nest, showing great uneasiness, and when I was handling their young appeared quite distracted.

The egg is rather more than $2\frac{1}{10}$ in. in length, by nearly $1\frac{5}{10}$ in. in width, of a stone-colour, spotted with numberless small specks of brown, and some larger spots of dark brown and grey.

Family Scolopacidæ.

Genus Scolopax.

Subgenus Rhynchæa (Cuv.).

Rhynchæa picta (Gray). Painted Snipe.

I quite think that the Painted Snipe breeds in the Deccan, or at least some few of them, as I have had both male and female birds sent to me in the middle of July, which were shot near Ahmednuggur. The female was in remarkably rich and beautiful plumage. It is very probable that some breed annually in the rushy grounds bordering the large tank at Singwa.

Subgenus Scolopax.

Scolopax nemoricola. Solitary Snipe of the Neilgherries.

Dr. Jerdon in his Catalogue says, "It is a rare visitant to the Neilgherries during the cold season, and has not, as far as I am aware, been killed elsewhere in the Peninsula." I believe the Snipe mentioned in the following note, which I made at Nassick, to be the same bird :—

"Solitary, or rather, a very large Snipe, shot at Nassick by Lieut. Boddam of the Engineers : a very fine specimen ; the plumage of a very dark dim colour, and the tints on the scapulars not very bright. Shot 5th January, 1847."

Family Charadriadæ.

Genus Charadrius.

Charadrius pluvialis. Golden Plover, L.

I have never met with this Plover in the Deccan, but shot them on the sandy plains near Kurachee in Scinde. Dr. Jerdon says, that it "is but rarely met with in the Peninsula. I have only seen it on two or three occasions on the banks of large rivers on the table-land, and on grass plains near the sea-coast, usually in small flocks of five or six. I have seen specimens killed in the neighbourhood of Madras in the breeding plumage, viz. with the whole under surface of the body deep black. It therefore most probably breeds in this country."

Charadrius minor, Wagl. Lesser Ringed Plover.

I believe the egg sent with this paper to be that of the Lesser Ringed Plover ; if so, this bird breeds in the Deccan in the month of April, laying its eggs on sand-banks in the middle of the larger rivers. The egg forwarded was from a sand-bank in the river Bheema. These pretty little lively birds are common in the Deccan, resorting to the beds of streams and sandy shallows and banks of rivers. They are difficult birds to shoot, being very restless, continually taking short flights, and running about with great activity along the water's edge ; their food consists of worms, small shells and grass; they lay as many as three eggs I believe; the eggs are deposited on the bare sand The egg is rather more than $1\frac{1}{10}$ in. in length, by $\frac{8}{10}$ths of an inch in width, of a rich stone colour, spotted and streaked with grey and two shades of brown.

Genus Vanellus.

Vanellus bilobus (Gmel.). Yellow Wattled Lapwing.

I have had frequent opportunities of seeing this Lapwing on the open bare plains which it frequents, and have obtained specimens, but never to my knowledge succeeded in procuring its eggs, though I have had the eggs of Plovers brought to me in numbers. Dr. Jerdon says, "I found the eggs of this bird on one occasion on a grass plain on the west coast in the month of September; they were of a light salmon colour with dusky spots, four in number, and laid on a slight depression of the ground." This Lapwing utters a plaintive cry when on the wing; it feeds on small beetles, white ants, &c., picking up small pieces of stone or crystal to assist the action of the gizzard.

Vanellus Goensis (Lath.). Red Wattled Lapwing.

This common Lapwing is as partial to water as the last-mentioned is to dry sandy plains; indeed I do not recollect ever to have seen it at any distance from water. It is very common in the Deccan, and may be easily recognized by its oft-repeated cry of—"Dick did *you* do it—Dick, Dick did you do *it*." As soon as March has well set in they pair, and the female commences laying; she generally chooses the banks of rivers and small streams. On a sand-bank in the midst of the river Bheema, one of the large rivers of the Deccan, I fell in with the nest of this bird—if a small heap of dry gravel with a hollow in it can be called a nest—it contained four eggs. During the breeding season these birds, vociferous at all times, become doubly so, acquainting every one with the fact that their nest is near. I have had their eggs brought to me as late as 19th May. On the 27th May a man brought me three young ones, apparently just released from their imprisonment; their plumage was as follows:—Irides dark hazel; wattles dark brown, nearly black; the whole body covered with down, that on the head and neck brown with spots of black; the front of the neck, breast and belly white; a black streak runs along the sides from the wing to the tail; on the nape of the neck there was a black patch, and another cravat-shaped patch of black on the fore part of the neck and throat; legs and feet dark lead colour.

This Lapwing, like many of the Sandpipers, has a curious fashion of elevating and throwing forward the head, much like the motion of bowing. It is equally active by night as by day, filling the air with its taunting cry of "Did *you* do it." If you should fire at and miss one of them, he goes off with, and his companions fly round you with the insulting cry of "Did you do it;" or, as Dr. Jerdon has it, "Pity to do it." The food of this bird consists of grass and small insects; it also picks up small pieces of crystal to help digestion. The egg varies much in size; one sent measures $1\frac{8}{10}$ in. in length, by rather more than $1\frac{2}{10}$ in. in width, of a yellow stone colour, spotted and dashed with grey and dark sepia.

Genus Œdicnemus (Cuv.).

Œdicnemus crepitans. Thick-kneed Plover.

This bird is tolerably common amongst the stony hills and undulating grounds of the Deccan. It is more active by night than by day, at which time its plaintive call is heard. I had for some time a young bird in my tent; during the day it used to remain quiet, but when evening began to draw on its restlessness commenced, and it used to run round and round the tent with great rapidity, uttering a single sharp querulous note. The Thick-knee feeds on small beetles and other insects, as also small particles of grass, taking down small stones to help the action of the gizzard, which is of a strong texture. They breed during the months of March and April, laying two eggs varying in colour, 2 in. in length, by rather more than $1\frac{4}{10}$ in. in width, of a stone colour, blotched and spotted with dark sepia-brown, and a few under spots of dark grey. In some eggs the blotches are more of an olive-brown.

Œdicnemus recurvirostris (Swains.).

On the 5th April, 1849, I found two young birds of what I then took to be the young of *Œdic. crepitans*, on a large sand-bank in the middle of the river Bheema. At the same time I thought it a very strange place for a bird found in dry stony places to breed in. In March 1850, I shot a specimen of *Œdicnemus recurvirostris* on the same river, some distance higher up; I therefore think it most probable that they were the young of *Œdic. recurvirostris*, and not of *Œdic. crepitans*. Had I, at the time I found them, known that the former bird was to be found on that river, I should have examined carefully the shape of the bill. The testes in the male specimen shot in March were in a turgid state. I brought away the young birds above mentioned; one was much smaller than the other, but much more active. They were both, if I remember right, covered with a greyish down. For fear of their dying through not getting proper food, I returned them to their sandy hollow the next day. The gizzard of the full-grown bird contained the bones of some small animal.

Genus Tachydromus.

I believe the egg now exhibited to be that of the Courier Plover, *Tachydromus Asiaticus*. Two of them were found in a field in a slight hollow of the ground in the month of April. Of the breeding of this bird Dr. Jerdon says—"It breeds in the more retired spots during the hot weather, laying three eggs of a pale greenish-yellow colour, much blotched and spotted with black, and also with a few olive spots; they are deposited in a slight hollow." The Courier is abundant on the plains of the Deccan, frequenting sandy bare spots in flocks; they have a peculiar habit of running for a distance at great speed, then suddenly stopping and erecting the body, then starting off as before.

Subgenus Glareola.

Glareola orientalis (Leach).

I came across this pretty little Pratincole when shooting on a stony bank in the river Bheema. There were numbers of them flying about like swallows, and as they mobbed me, I concluded that they had nests, but though I made most diligent search could not find any. I procured a pair of birds: the eggs in the ovaries of the female were large: the crop of the female was filled to a great size with a species of small black beetle. This occurred in the month of March.

May 22, 1855.—Dr. Gray, F.R.S., in the Chair.

Descriptions of four new or little-known Tanagers. By Philip Lutley Sclater, M.A.

1. Arremon erythrorhynchus, Sclater.

A. olivaceus: capite nigro; vitta mediali verticis, nucha cervicisque lateribus cinereis; superciliis et corpore subtus albis: torque gutturali angusta nigra: lateribus cinerascentibus: campterio flavo: pedibus albis: rostro elongatiore, incurvo, rubro.

Long. tota 5·8, alæ 3·0, caudæ 2·7.

Hab. in Nova Grenada, Bogota.

I have to thank Mr. Gould for allowing me to describe this new *Arremon*, which is from his collection. It is closely allied to my *Arremon spectabilis* (P. Z. S. 1854, p. 114. pl. 67) from Quixos, but may be distinguished by its more lengthened incurved and brilliant orange red-bill, and the yellow bend of the wing.

2. Tachyphonus xanthopygius, Sclater.

Tachyphonus xanthopygius, Sclater, P.Z.S. 1854, p. 158. pl. 69 (♀).
Lanio auritus, DuBus, Bull. Ac. Brux. Feb. 1855 (♂ et ♀).

♂ niger: tergo flavo: fascicula post-superciliari coccinea: carpo summo dilute flavo: tectricibus subalaribus albis.

Long. tota 6·1, alæ 3·5, caudæ 2·5.

♀ nigro-cinereus, subtus dilutior; axillis et tectricibus subalaribus albis: tergo flavo.

Hab. in Nova Grenada, Bogota.

I described the female of this fine Tanager at the meeting of this Society on the 25th of July last year. M. Parzudaki of Paris has lately received several examples of both sexes from Bogota. A pair of these passed into the hands of the Vicomte DuBus, by whom they were characterized as new in the Bulletins de l'Académie Royale de Belgique* for February last. A male bird from the same quarter has been kindly entrusted to me for examination before being deposited in the British Museum, where the female I originally named is also to be found. I cannot agree with the Vicomte DuBus in considering this species a *Lanio*, but, after seeing the male, am the more convinced that it is a true *Tachyphonus*.

3. Tanagra notabilis, Jardine.

T. flavo-olivacea : capite undique et mento nigris, macula nuchali triangulari, a dorso linea nigra divisa, flava : alis nigris cæruleo marginatis, tectricibus autem summis dorso concoloribus : cauda nigra, margine vix cærulescente : subtus læte aurantio-flava ; rostro pedibusque nigris.

Long. tota 7·2, alæ 3·7, caudæ 3·0.

Hab. in rep. Equatoriana.

Sir William Jardine has been so good as to lend me the types of this and the following species of Tanagers for examination. They were lately procured by Professor Jameson of Quito, during a botanical excursion along the eastern range of Cordilleras to the north of Quito, and are to be described with other rare birds, the product of the same or similar expeditions, in the forthcoming number of the new series of the Edinburgh New Philosophical Journal.

The present bird is a most brilliant fourth of the little section denominated *Compsocoma* by Cabanis, easily distinguished from the others by its yellow-olive back, triangular nape-spot, black chin and orange-yellow under-plumage, and may be therefore called *Compsocoma notabilis*, if that name is used generically. The other three species of this group are—(1) *Compsocoma victorini*, with its dark olive back and elongated nape-stripe, which is common in collections from Bogota ; (2) *C. sumptuosa* (Arch. du Musée Paris., vii. p. 379. pl. 23), with the back black and uropygium olivascent, from Trans-andean Ecuador—the same locality as the present—and Peru ; and (3) *C. flavinucha*, a rare species in collections, which seems confined to Bolivia, where d'Orbigny discovered it on the eastern slope of the Andes of the province of La Paz.

4. Saltator arremonops, Jardine.

S. rufo-brunneus, olivaceo parum tinctus, pectore multo clariore et rubescentiore : capite toto mentoque nigris ; vitta mediali verticis et superciliari utrinque postice elongatis cum medio ventre cinereis : alis intus et cauda nigricantibus : rostro et pedibus nigris.

Long. tota 7·25, alæ 3·2, caudæ 3·5.

Hab. in rep. Equatoriana.

This peculiar Tanager in style of plumage and general habit cor-

* The article is entitled " Note sur quelques espèces inédites d'Oiseaux." The *Nemosia torquata* therein described (sp. 10) is my *Dacnis pulcherrima*, Rev. et Mag. de Zool. 1853, p. 480—(a true *Dacnis* to my mind) ; and, is not *Vireosylvia frenata*, DuBus, sp. 1, the same as *V. altiloqua*, Vieill.—Cassin, Birds of Cal. pl. 37. p. 221—and *Phyllomanes mystacalis*, Cab. Wiegm. Arch. 1844, p. 348 ?

responds most closely with the members of the genus *Arremon*, but the bill is altogether abnormal, the upper mandible swelling in the middle and overlapping the under, as in the genus *Lanio*, though not developed into a decided hook. But the bill is much shorter, broader and deeper than in the last-named genus, and has more general resemblance to that of some of the *Saltatores*. The wings are very short, but the only skin sent belonging to a bird in moult, the comparative length of the remiges cannot be determined.

Description of a New Sea Anemone. By E. W. H. Holdsworth, F.Z.S.

The species now to be described must be separated from the true *Actiniæ*, and may be well placed in the genus *Scolanthus*, which was proposed by Mr. Gosse for the reception of an animal obtained by him at Weymouth, and which presented the very distinctive characters of a perforated base, and the absence of a terminal adhesive disk. A description of that species will be found in the 'Annals of Natural History' for the year 1853, p. 157. These points of difference are accompanied, as might be expected, by a variation in habits, and the members of the genus will be found living buried in mud or sand, into which they retire on being alarmed, their extraordinary powers of inversion enabling them to hide at some little distance below the surface.

Scolanthus sphæroïdes.

This species, which I found tolerably abundant at Seaford, near Beachy Head, has, in expansion, the body lengthened and cylindrical, regularly striated longitudinally with fine transverse markings, the upper part sparingly covered with sucking-glands, not arranged in any definite order. Disk flat and even, but little exceeding the diameter of the body. Tentacula numerous, in three or four irregular series, the inner one containing from nine to twelve; these are the longest, and measure, when fully extended, about half an inch, or two-thirds of the breadth of the disk; the outer row consists of from fifty to sixty tentacula of the same slender tapering form as the inner ones, but are one-third shorter, the other series being intermediate in size and number. The body tapers a little posteriorly and terminates with a rounded base, having a distinct central perforation. When closely contracted, the two ends of the body are nearly alike, and the animal assumes the appearance of a more or less flattened sphere or bead, the resemblance to which is much increased by the presence of the terminal orifices.

The colour of the body is a dirty-white, and the upper portion is generally covered with particles of sand or mud adherent to the sucking-glands surrounding that part, and which help to conceal the animal when contracted, as is found to be the case with *Act. crassicornis*, and probably other species under similar circumstances. The mouth opens transversely, and from it very delicate white lines radiate to the bases of the tentacula, interspersed with two or three shades of brown in the form of stripes or spots: in some specimens a circle of very pale spots with darker margins surrounds the mouth. The base of each tentaculum is very dark and is surmounted by a broad band of white or buff, the upper portion shading off to a clear pale pellucid brown, on which are three narrow distinct white rings, their breadth and the interspaces diminishing rapidly as they approach the tip. These animals are capable of assuming a great variety of shapes, and even when fully expanded sometimes elongate themselves to the extent of $1\frac{1}{2}$ inch, or contract to little more than a $\frac{1}{4}$ of an inch. They feed readily in confinement; but those that had buried themselves in the sand appeared best able to secure their prey when placed within reach, the others on the surface often tumbling over in their endeavours to get the food into a proper position for swallowing, from not having the support of the surrounding sand or mud natural to them when buried. They were all found near low watermark, imbedded in the fine chalky mud which fills the crevices of the rocks at Seaford, their expanded disks being just level with the surface, but so nearly covered that only a faint star-like outline was visible; on being touched they instantly disappeared; and so great was their power of inversion and contraction, that on digging carefully, they were generally found about $1\frac{1}{2}$ inch deep, and having that peculiar bead-like form which has suggested the specific name of *sphæroïdes.* There was usually a depth of 6 or 7 inches of mud below them, so that they could not have been fastened to the rock; and since I have had them at home, now nearly five weeks, they have not shown the least inclination to attach themselves to the gravel, or glass sides of the tank in which they are living; three of them have burrowed into some sand on which they were placed, but the others remain on the surface, and are but rarely contracted. Soft mud is probably their natural habitat, being the most easily penetrated, and I could find no traces of any of these animals in a considerable tract of sand only a few yards from the locality whence these were obtained.

June 12, 1855.—W. Yarrell, Esq., in the Chair.

On two new Species of Humming Birds. By John Gould, F.R.S.

I bring before the notice of the Meeting two species of beautiful Humming Birds, which I believe to be new to science: they belong to that section of the *Trochilidæ* to which the generic appellation of *Heliothrix* has been given; of this form only three species have been previously characterized, namely *H. auritus, H. auriculatus,* and *H. Barroti.* One of these new species, for which I propose the specific name of *purpureiceps,* is nearly allied to *H. Barroti,* but differs from that bird in having a much shorter bill, in the blue of the head being of a paler purple, and in that hue not being confined to the crown, but extending some distance down the nape of the neck. This species was obtained from the districts near Popayan. The second species, for which I propose the name of *phaïnolæma*, has several characters in common with *H. auritus* and *H. auriculatus*; it differs, however, from both those species in the beautiful metallic-green colouring extending over the throat and front, as well as the sides of the throat. The two species may be described as follows:—

HELIOTHRIX PURPUREICEPS.

Male: Forehead, crown and nape beautiful purplish-blue; upper surface, upper tail-coverts, and upper and under wing-coverts beautiful golden-green; mark below the eye and ear-coverts black, terminating in a small blue tuft; below the black a streak of rich luminous green; wings purplish-black; central tail-feathers bluish-black; lateral tail-feathers, chin, throat, and under surface, pure white; bill black; feet flesh-colour.

Total length, $4\frac{1}{8}$ inches; bill, $\frac{5}{8}$; wing, $2\frac{1}{2}$; tail, $1\frac{3}{4}$.

Hab. Popayan.

HELIOTHRIX PHAÏNOLÆMA.

Male: Head, upper surface, upper tail-coverts, upper and under wing-coverts rich golden-green, very brilliant on the head; wings purplish-black; four central tail-feathers bluish-black; lateral tail-feathers snowy-white; below and behind the eye a lengthened mark of black, terminating in a violet-blue tuft; chin, throat and sides of the neck rich luminous green; breast and under surface pure white; bill black; feet flesh-colour.

Total length, $4\frac{1}{2}$ inches; bill, 1; wing, $2\frac{3}{8}$; tail, $1\frac{7}{8}$.

Hab. River Napo.

BOTANICAL SOCIETY OF EDINBURGH.

March 1856.—Dr. Greville, Secretary, in the Chair.

The following papers were read:—

1. "Notes on the Flora of Perth," by Dr. W. Lauder Lindsay.

"The most interesting plants of the district are probably *Scheuchzeria palustris, Moneses grandiflora, Teucrium Chamædrys*, and *Turritis glabra*; but the following also are noteworthy: *Corallorhiza innata, Epipactis latifolia, Cephalanthera grandiflora* and *C. ensifolia, Neottia Nidus-Avis, Paris quadrifolia, Erigeron alpinus, Trientalis europæa, Adoxa moschatellina, Leonurus Cardiaca, Scrophularia vernalis.*"

2. "On the occurrence of *Cladophora repens* (J. Agardh) at Malahide, Co. Dublin," by A. C. Maingay.

From the specimen now shown, it appears that Mr. W. M'Calla found this plant in Ireland in 1841, and therefore that to him is due the credit of having first collected it in this country, although he was ignorant at the time of its being a new species, and in consequence communicated it to Professor Balfour under the name of *Conferva Brownii*.

Dr. Harvey's slight doubt as to the British form of *Cladophora repens* being the same species with that described by J. Agardh is entirely dispelled by these specimens from Ireland, in which the articulations, although variable, are in general shorter than in the Jersey specimens gathered by Miss Turner, and intermediate in size between Agardh's plant and that described by Harvey.

3. "On the British species of *Arctium*," by Charles C. Babington, M.A., F.R.S. &c. (See p. 369.)

4. "Register of the Flowering of certain Plants in the Royal Botanic Garden, from 14th Feb. till 13th March 1856, as compared with the five previous years," by Mr. M'Nab.

MISCELLANEOUS.

On the Influence of the Soil on the Distribution of Plants. By M. Stur. Communicated by Count Marschall.

In a Memoir presented to the Imperial Academy of Sciences of Vienna, March 6, 1856, M. Stur, treating of the influence of the soil on the distribution of plants, gave the results of the observations made by himself in the Alpine region of Austria.

The soil on which plants live is either rocky or disintegrated. The "rocky" or solid soil is either of calcareous or of argillaceous and siliceous nature. The "disintegrated" or detrital soil is composed of fragments from the "rocky," agglutinated by mineral substances of tertiary origin; it contains therefore lime, silica, and alumina, in more or less equal portions.

The rocky soil prevails in the higher elevations of the Alpine region; the detrital soil fills up the bottoms of the valleys and depressions. The first corresponds to the continents surrounding the tertiary sea, or to the islands emerging from it; the second indicates the extension of this sea itself, as formed by drift deposited on its bottom.

The nature of the roots is an essential condition for the thriving of any plant on either of these soils. Species with annual fleshy, or with compound fasciculated, roots, or with underground stems, can only live on detrital soil; those with woody roots, with numerous ramifications, are best fitted for the rocky soil.

A comparison of the flora of the higher calcareous region with the mica-schist flora proves the plants of either of them, although equal in size, to differ so materially from each other in shape, that it must be admitted that the geological constitution of the soil has an influence on the vegetation covering its surface.

Alpine plants carried down by the streams into the plain increase in size and grow more luxuriantly in their new station. Forest-trees shrink more and more in size and shape as they reach greater elevations. Both these facts bear witness to the influence of climatal conditions on the development of vegetable life.

Cereals occur exclusively on the detrital soils of the lower region. They follow the Alpine tertiary gravel in its variations of altitude; but are only able to produce a rich harvest where they grow on a detrital soil composed of lime, alumina, and silica mixed in nearly equal proportions. This same soil is likewise the most congenial to the non-cultivated plants of the lower region. If this soil be mixed with heterogeneous substances (as salts, on the sea-shore, on the banks of saline lakes, on plains with saline efflorescence, or above saliferous rocks), new genera and species, not occurring under ordinary circumstances, make their appearance.

The pine (*Pinus abies*, L.) accommodates itself to every soil, and therefore ranges from the lower to the upper region, marking the limits between, and participating in both. Its vertical oscillations correspond to those of the cereals, and to the distribution of detrital soil accessible to atmospheric heat.

New vegetable forms, together with new rocks, make their appearance in the higher rocky regions. Such are certain species peculiar to the calcareous mica-schist, as *Artemisia nana*, Sand., *Lomatogonium carinthiacum*, Rchb., *Gentiana prostrata*, Haenke, *Herniaria alpina*, L., *Braya alpina*, Hoppe, &c.

Wherever a great variety of rocks near to, or interstratified with, each other appear within a comparatively narrow space, the plants pass from one of these soils to another, undergoing at the same time frequent alterations of form; species nearly allied to each other are peculiar to such spots, producing hybrid and intermediate forms.

The distribution of genera and species in the upper region answers exactly to the geological constitution of the soil. Calcareous and mica-schistose Alps have every one their peculiar flora. Near Windisch-Matzey and Heiligenblut the mica-schist and the calcareous mica-schist floras appear side by side. At the "Tauern" of Radstadt, where nearly all Alpine rocks are heaped together, the floras of the calciferous rocks, of the mica-schist and of the calcareous mica-schist appear simultaneously.

M. Stur appended to his memoir a catalogue of about 1000 species of plants collected by him within the Alpine region, and arranged according to their localities and to the geological constitution of their native soil.

Note on the Freshwater Dolphins of South America. By M. Paul Gervais.

It has long been known that a peculiar species of Dolphin is an inhabitant even of the upper parts and branches of the great river Amazon, to the Indians living on the borders of which it is a creature of no small importance. It was described by M. d'Orbigny as the type of a new genus under the name of *Inia boliviensis*, by which it has since been generally known; but it appears to have been previously described by Spix and Martius under the name of *Delphinus amazonicus,* whilst, according to M. Paul Gervais, it is identical with the *D. Geoffrensis* of De Blainville, who however supposed his specimen to come from Canada.

Besides the *Inia Geoffrensis,* M. Gervais states that the Amazon and its tributaries possess two other species of Dolphin, both, according to him, belonging to the restricted genus *Delphinus.* They will be described by him in the Zoological section of M. de Castelnau's Voyage in America, under the names of *D. pallidus* and *D. fluviatilis.* —*Comptes Rendus,* 28th April 1856, p. 806.

METEOROLOGICAL OBSERVATIONS FOR APRIL 1856.

Chiswick.—April 1, 2. Exceedingly fine. 3. Overcast: rain. 4. Densely clouded: fine, with low white clouds. 5. Fine: cloudy. 6. Fine: frosty at night. 7. Fine: cloudy: rain. 8. Rain. 9. Cloudy: rain. 10. Rain. 11. Fine: showery: rain at night. 12. Rain: cloudy and mild: fine. 13. Fine: cloudy: hazy. 14. Fine: rain: boisterous, with rain at night. 15. Overcast: cold north-east wind. 16. Fine, but cold: masses of white clouds. 17. Dusky white clouds: fine: cloudy. 18. Overcast: fine: cloudy. 19. Overcast: densely clouded: clear: frosty. 20. Fine: frosty at night. 21. Cloudless: very fine: hazy at night. 22. Overcast: cloudy: frosty. 23. Slight haze: cloudy. 24. Uniform haze: overcast: fine. 25. Foggy: very fine: rain. 26. Heavy rain: cloudy. 27. Rain. 28. Clear: fine: frosty. 29. Partially overcast: cloudy and cold. 30. Fine.

Mean temperature of the month	46°·48
Mean temperature of April 1855	46 ·08
Mean temperature of April for the last thirty years	47 ·13
Average amount of rain in April	1·553 inch.

Boston.—April 1. Fine: rain P.M. 2. Cloudy. 3. Cloudy: rain P.M. 4. Cloudy. 5. Fine. 6. Cloudy: rain P.M. 7. Cloudy. 8. Cloudy: rain P.M. 9. Cloudy. 10. Cloudy: rain P.M. 11. Fine: rain P.M. 12. Rain A.M. and P.M. 13. Fine. 14. Cloudy. 15. Fine. 16—19. Cloudy. 20. Fine. 21—24. Cloudy. 25. Fine. 26. Rain A.M. and P.M. 27. Cloudy. 28. Cloudy: rain P.M. 29. Cloudy: rain A.M. and P.M. 30. Cloudy.

Sandwick Manse, Orkney.—April 1—3. Bright A.M.: cloudy P.M. 4. Cloudy, drops A.M.: clear, aurora P.M. 5. Cloudy, drops A.M.: clear P.M. 6. Damp A.M.: clear P.M. 7. Bright A.M.: drops P.M. 8—10. Cloudy A.M. and P.M. 11. Showers, cloudy A.M.: clear P.M. 12—14. Cloudy A.M. and P.M. 15. Cloudy A.M.: clear, fine P.M. 16. Cloudy A.M. and P.M. 17. Showers, cloudy A.M.: cloudy P.M. 18. Showers, cloudy A.M.: clear, fine P.M. 19. Clear A.M.: drizzle P.M. 20—22. Cloudy A.M. and P.M. 23. Clear A.M.: cloudy P.M. 24. Cloudy A.M.: cloudy, fine P.M. 25. Cloudy, fine A.M.: cloudy, drops P.M. 26. Clear A.M.: hail-showers P.M. 27. Hail-showers A.M.: sleet-showers P.M. 28. Sleet-showers A.M. and P.M. 29. Sleet-showers A.M.: cloudy P.M. 30. Bright A.M.: cloudy P.M.

Mean temperature of April for previous twenty-nine years ...	43°·47
Mean temperature of this month	44 ·56
Mean temperature of April 1855	43 ·20
Average quantity of rain in April for fifteen previous years ...	1·90 inch.

The drought is quite unprecedented, only ·68 of rain having fallen for two months.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. April.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·910	29·830	29·63	29·79	29·79	68	33	39	49½	42	s.	sse.	se.	......	......	......
2.	29·793	29·692	29·40	29·73	29·63	66	42	51	48½	43	s.	s.	se.	·01	·02	......
3.	29·823	29·666	29·37	29·46	29·41	54	44	50	48½	45	sw.	s.	se.	·19	·03	......
4.	29·773	29·654	29·25	29·29	29·35	59	30	50	47½	39	sw.	s.	ssw.	......	......	......
● 5.	29·598	29·318	29·26	29·30	29·30	57	40	42	47	42	s.	s.	se.	......	......	......
6.	29·330	29·248	28·91	29·34	29·46	57	27	49	45	41	se.	s.	se.	......	......	......
7.	29·493	29·446	29·10	29·41	29·38	59	39	48	44	42½	sw.	w.	se.	·04	·10	......
8.	29·260	29·183	28·95	29·40	29·44	53	35	49	43	42½	se.	sw.	ese.	·06	......	......
9.	29·305	29·273	28·90	29·37	29·33	56	42	48	45½	42	sw.	sw.	e.	·30	·12	......
10.	29·463	29·143	28·84	29·32	29·39	60	41	48	46	43	sw.	se.	e.	·04	......	......
11.	29·654	29·552	29·24	29·48	29·53	62	47	50	46	39½	sw.	w.	ese.	·18	·14	·09
☽ 12.	29·591	29·454	28·98	29·48	29·51	63	33	51	43½	42	sw.	w.	ne.	·01	·14	......
13.	29·632	29·585	29·24	29·68	29·91	67	36	51	45½	44	s.	sw.	nne.	......	·15	......
14.	29·804	29·757	29·44	30·09	30·29	58	42	49	45	42	ne.	ne.	nne.	·16	......	......
15.	30·058	29·859	29·66	30·37	30·38	58	37	46	42½	35	ne.	ne.	......	......	......	......
16.	30·119	30·100	29·87	30·37	30·32	54	31	45	44	45	ne.	ne.	w.	......	......	......
17.	30·139	30·113	29·85	30·27	30·23	55	39	46	48	44½	ne.	ne.	nw.	......	......	·02
18.	30·103	30·058	29·77	30·04	30·15	60	31	47	47½	36	ne.	n.	calm	·02	......	·02
19.	30·238	30·123	29·79	30·12	30·13	49	25	48	44½	46	ne.	n.	w.	......	......	......
○ 20.	30·269	30·209	29·90	30·12	30·12	57	23	42·5	49½	46½	ne.	w.	w.	......	......	......
21.	30·226	30·110	29·85	30·04	30·02	62	27	48	49½	47	ne.	n.	wsw.	......	......	......
22.	30·034	29·967	29·64	29·92	29·82	56	24	55	51	47	ne.	se.	sw.	......	......	......
23.	29·907	29·872	29·50	29·76	29·82	57	37	51·5	53½	47	se.	s.	w.	......	......	......
24.	29·891	29·780	29·50	29·86	29·86	59	35	52	54	47	ne.	se.	calm	......	......	......
25.	29·695	29·591	29·34	29·72	29·68	76	35	52	54	41½	se.	e.	nne.	·22	......	......
26.	29·487	29·457	29·00	29·67	29·73	63	40	52·5	43	38	sw.	n.	ne.	·53	·36	......
☾ 27.	29·560	29·442	29·17	29·71	29·68	44	32	43	43	41	e.	ne.	n.	·14	·36	·13
28.	29·561	29·540	29·22	29·63	29·73	55	25	46	44½	40	n.	w.	nne.	......	......	·07
29.	29·610	29·568	29·21	29·76	29·86	56	31	45	42½	40	nw.	nw.	nne.	......	·06	·01
30.	29·633	29·610	29·28	29·88	29·93	57	29	47	47	40½	nw.	nw.	ne.	·07	·10	......
Mean.	29·765	29·673	29·36	29·744	29·772	58·56	34·40	48·0	46·75	42·38				1·97	1·58	0·34

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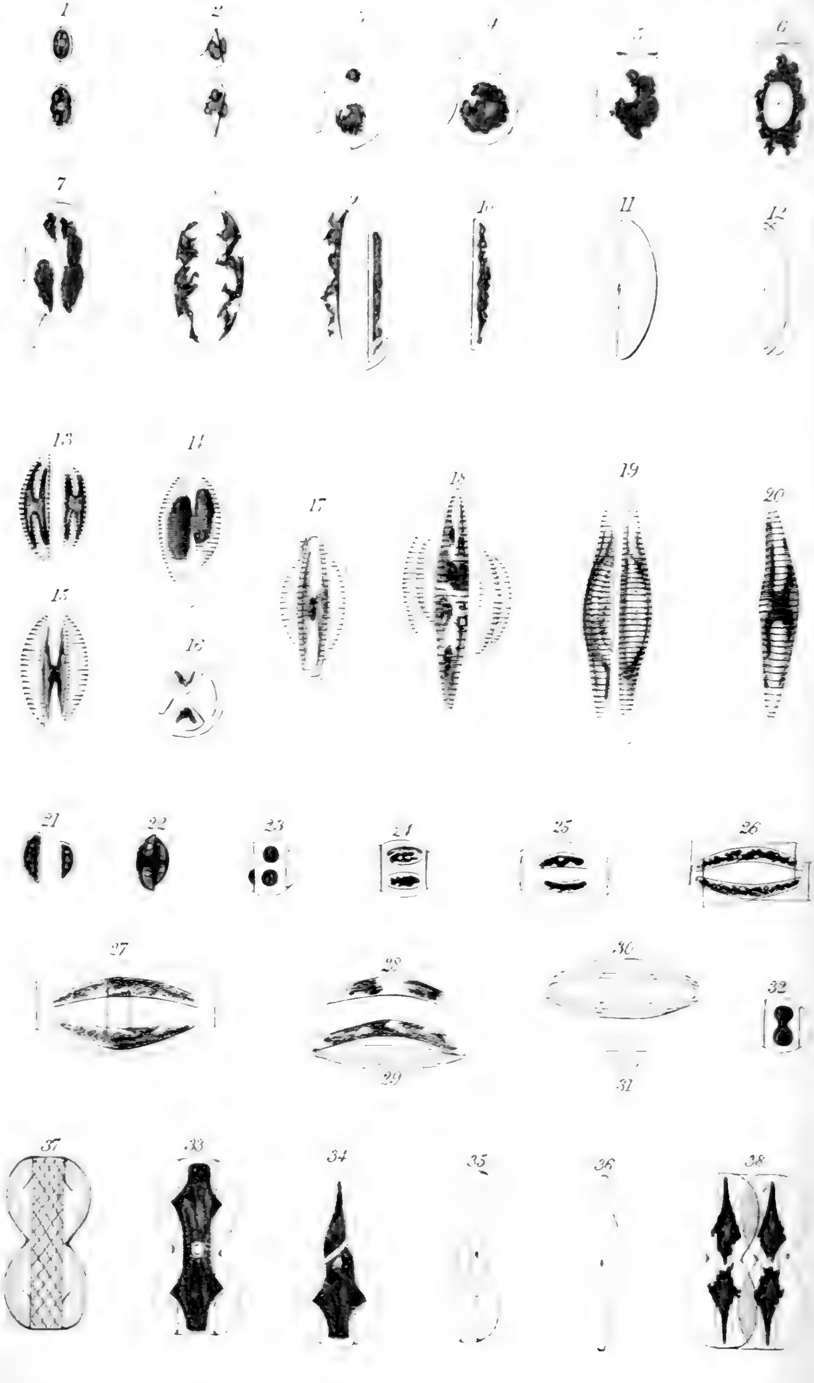
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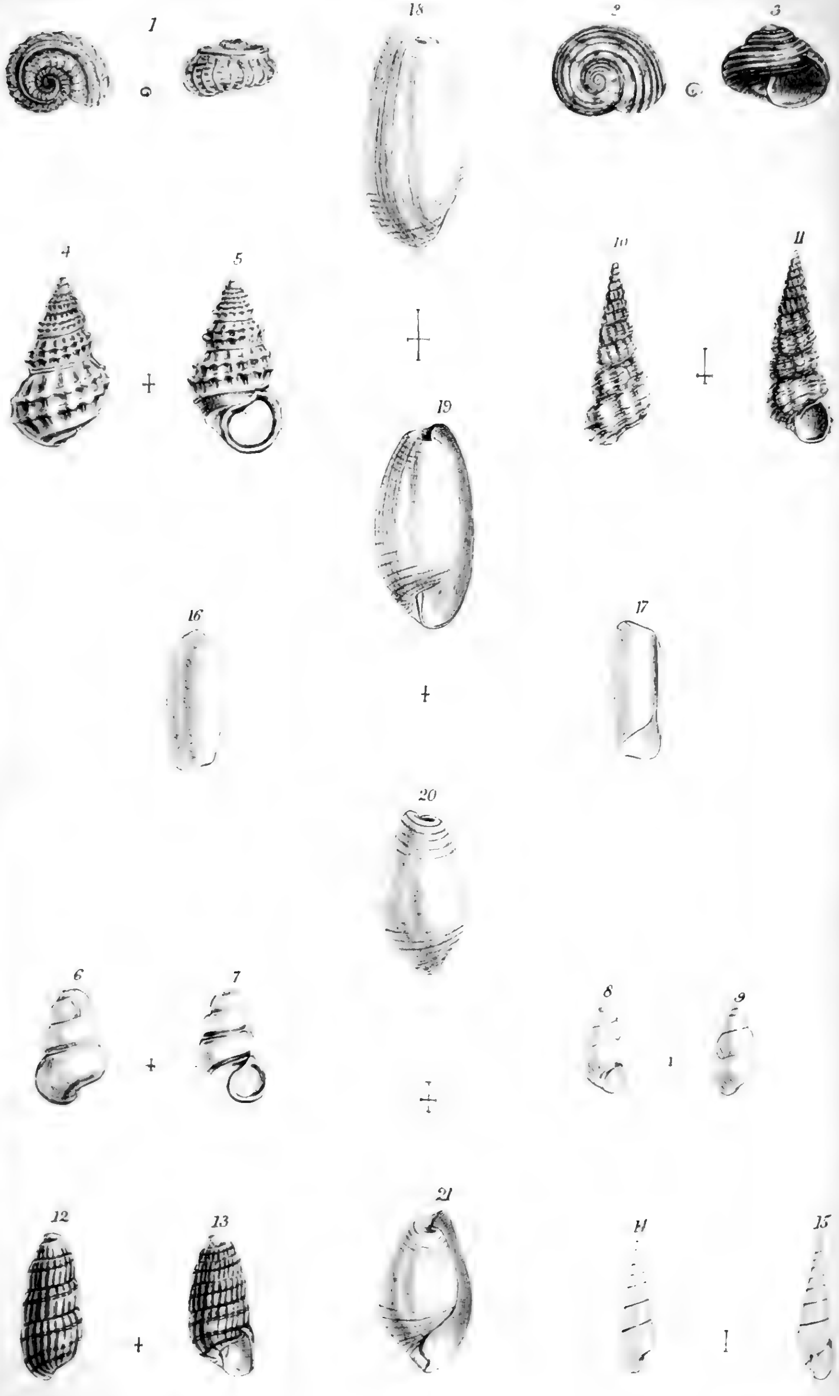

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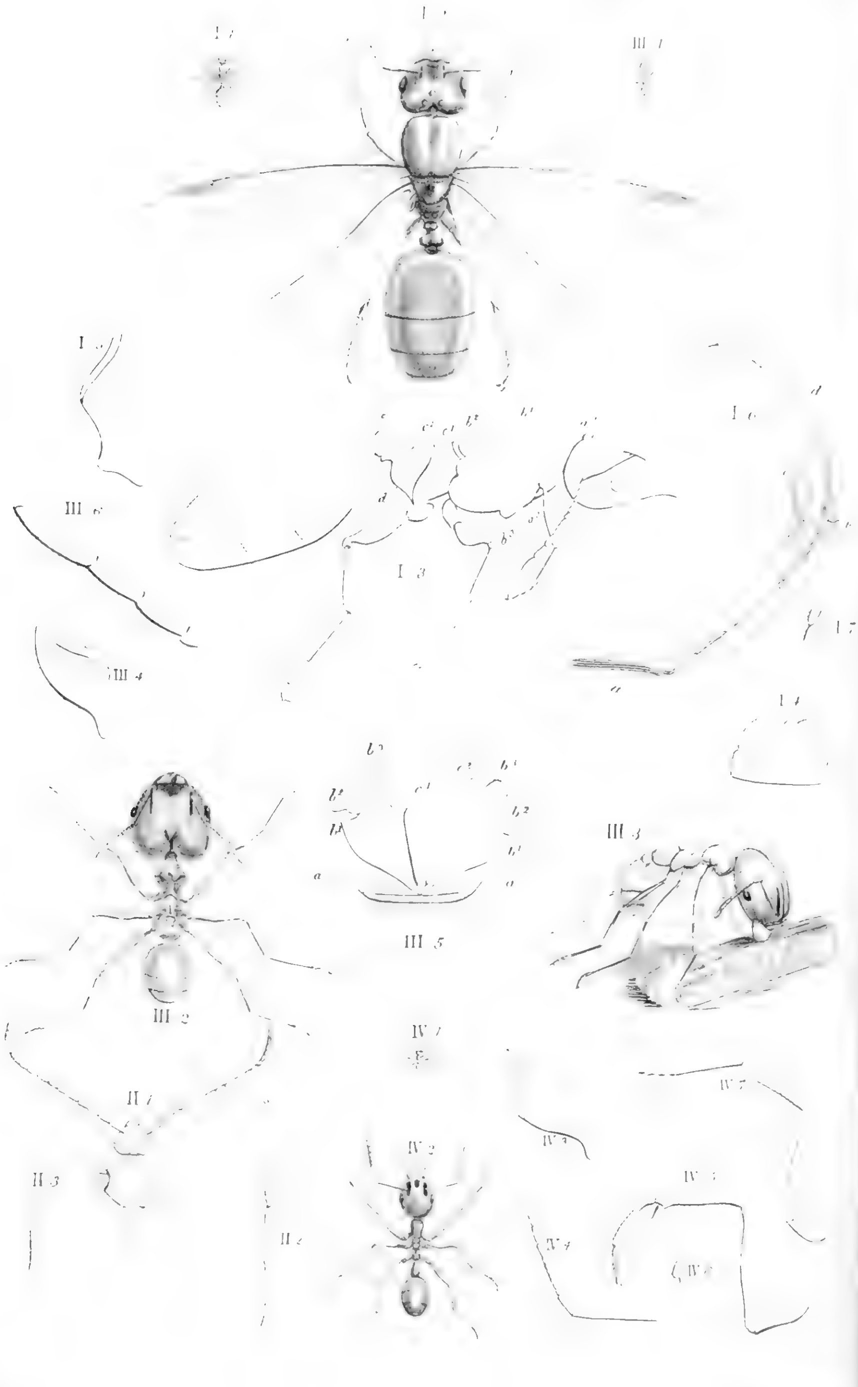

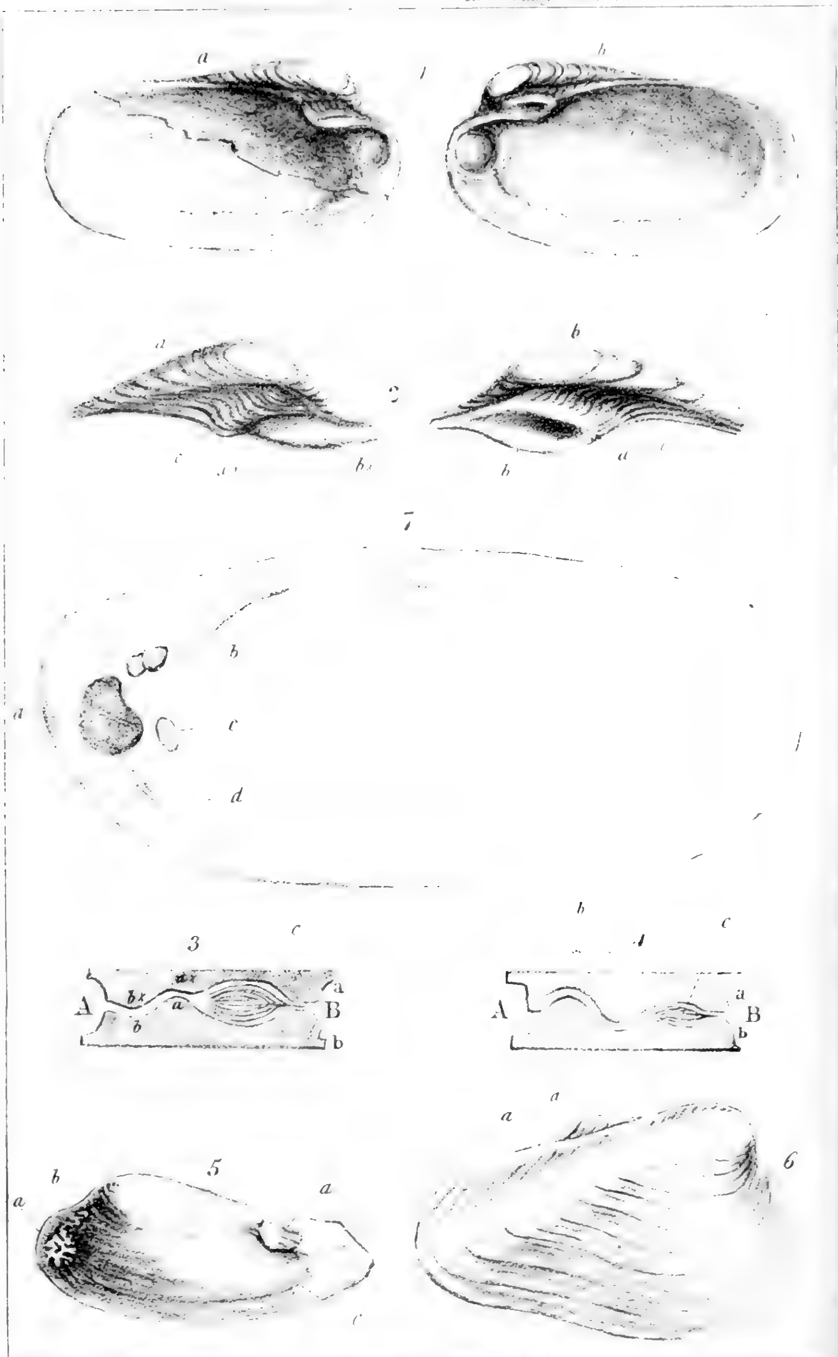

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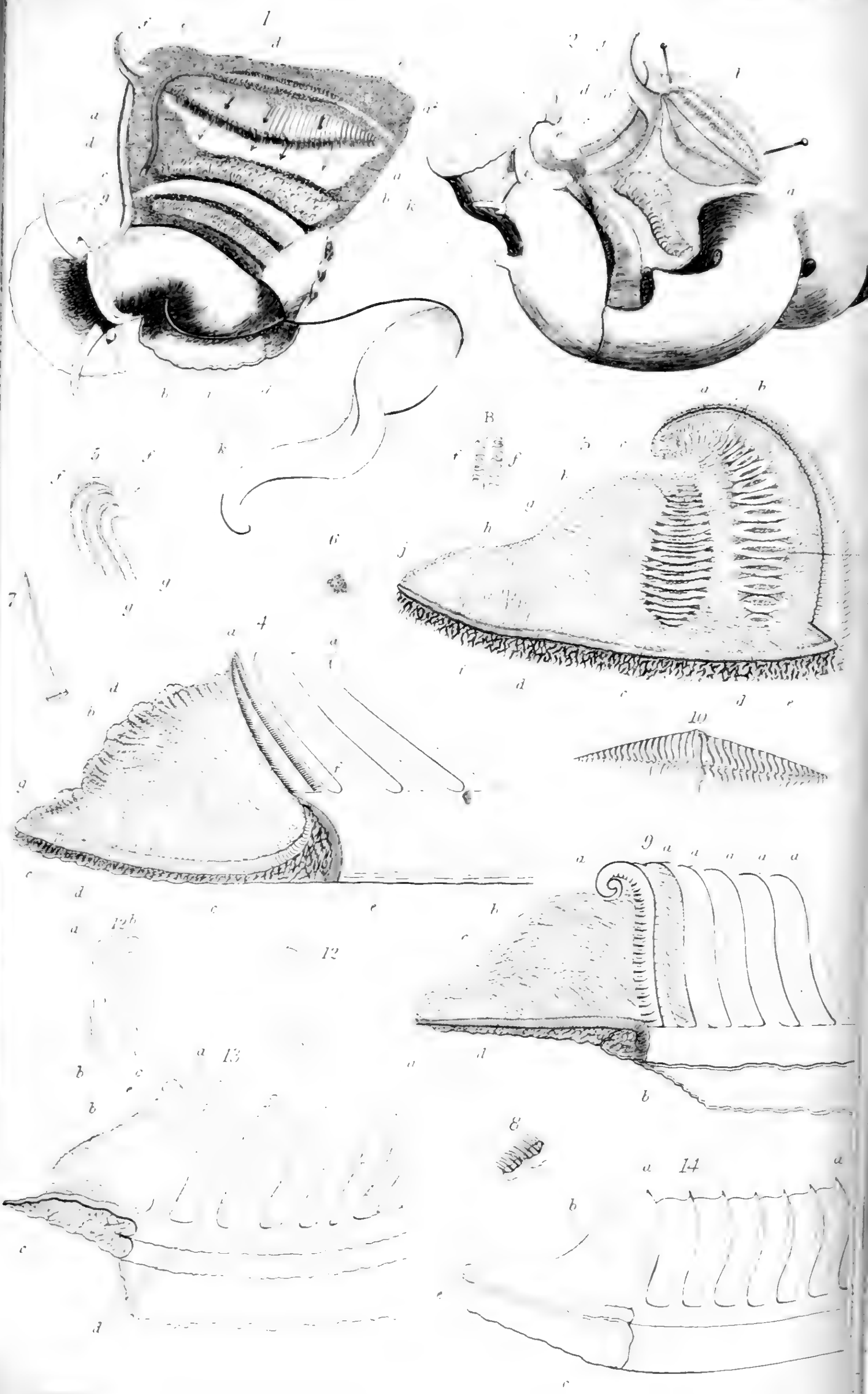

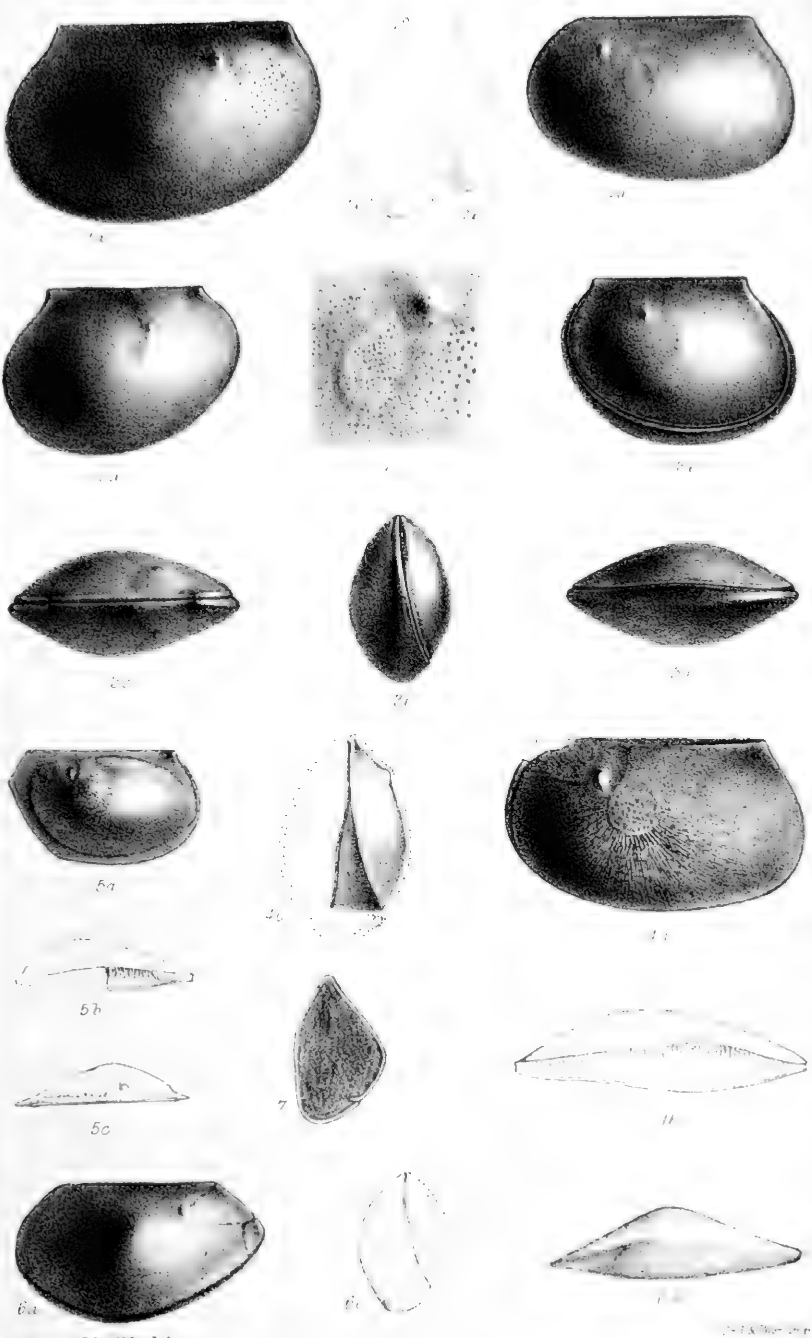

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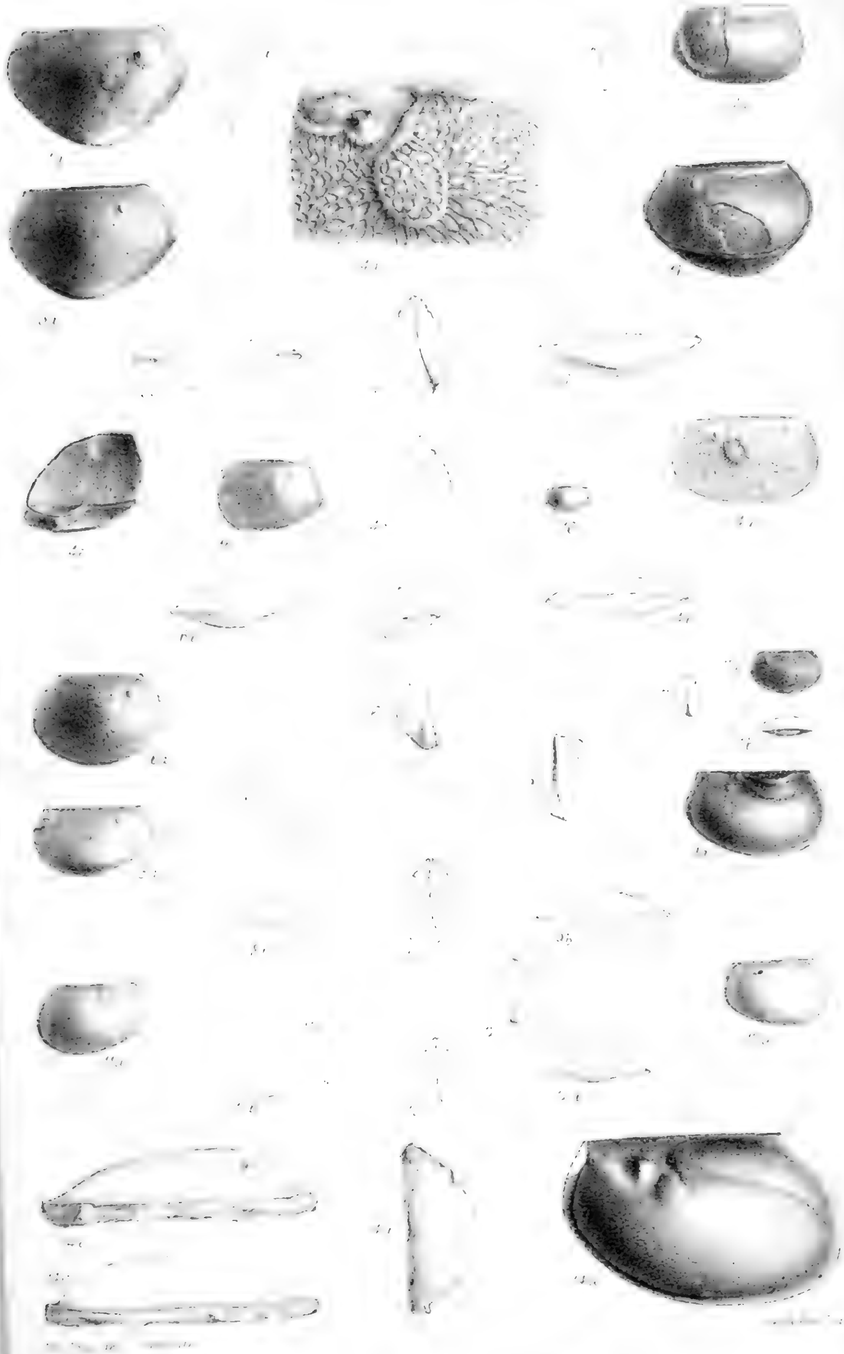

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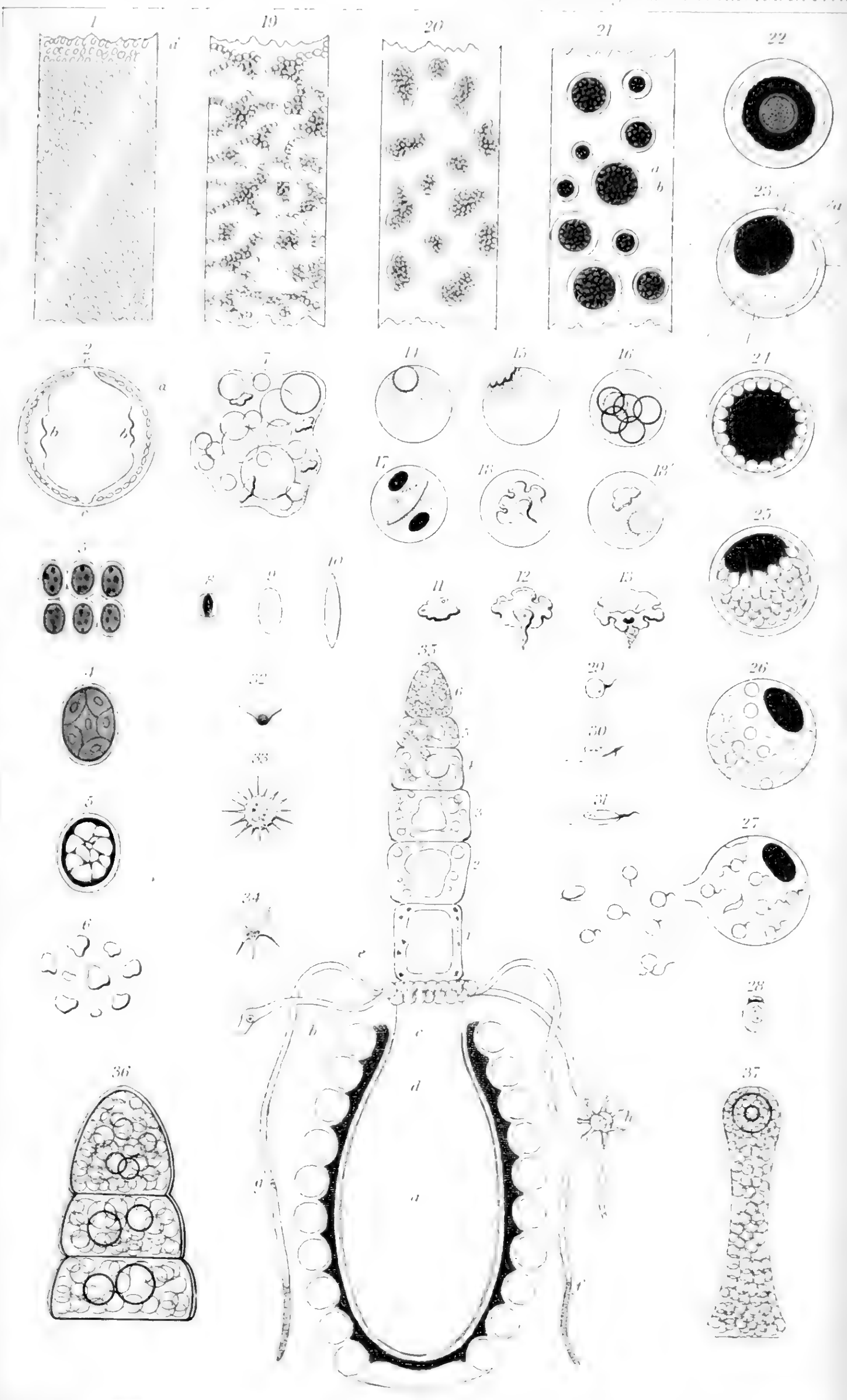

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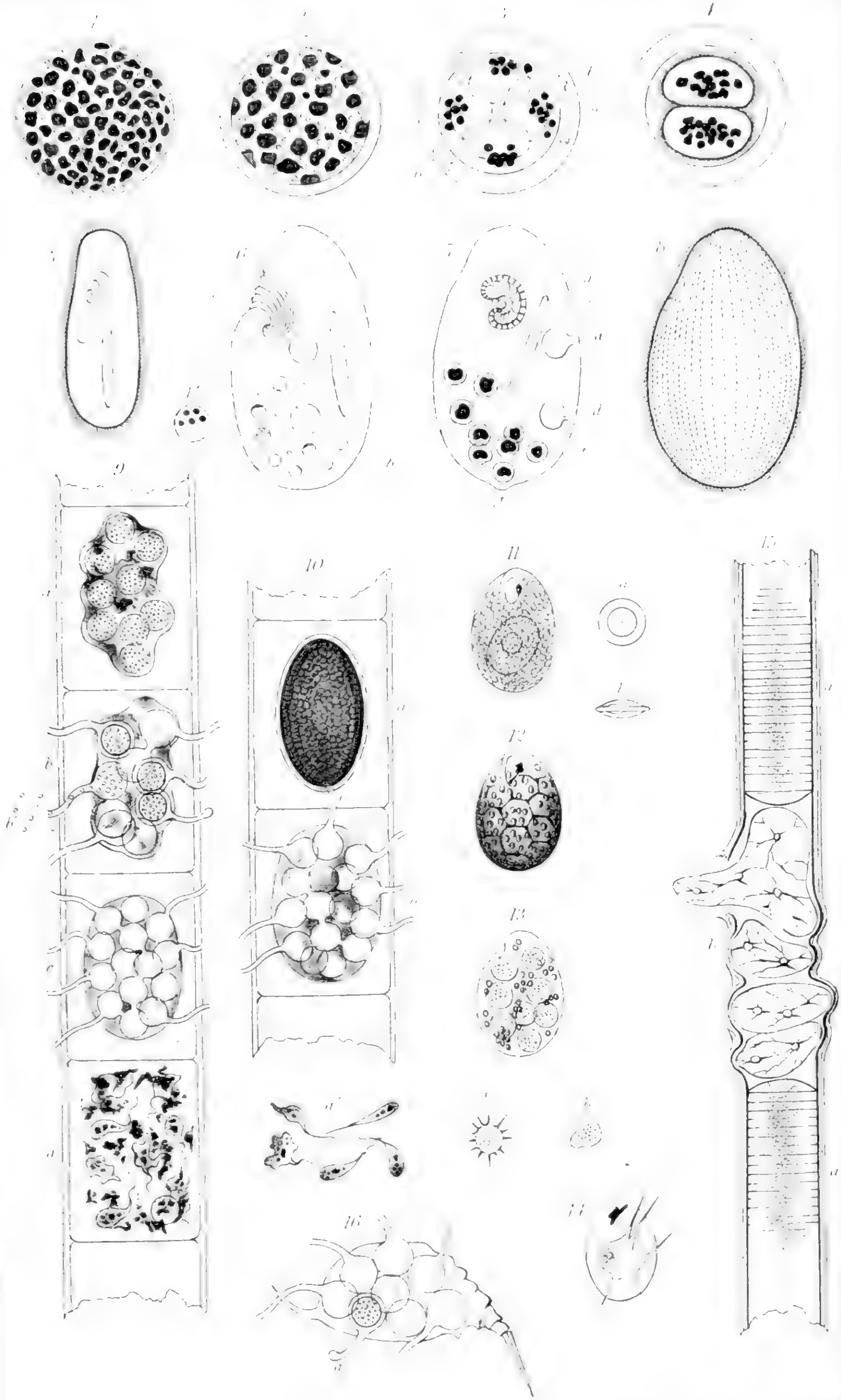

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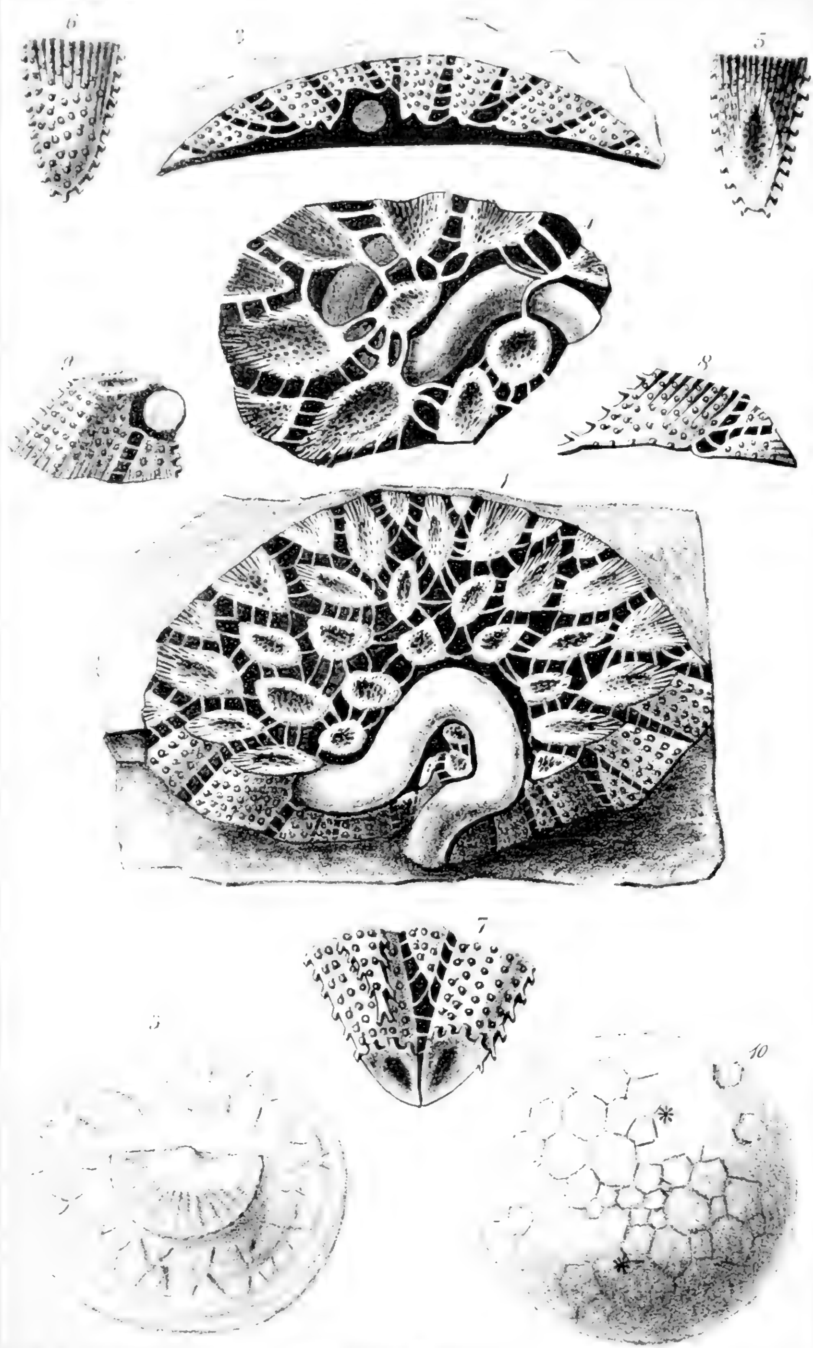

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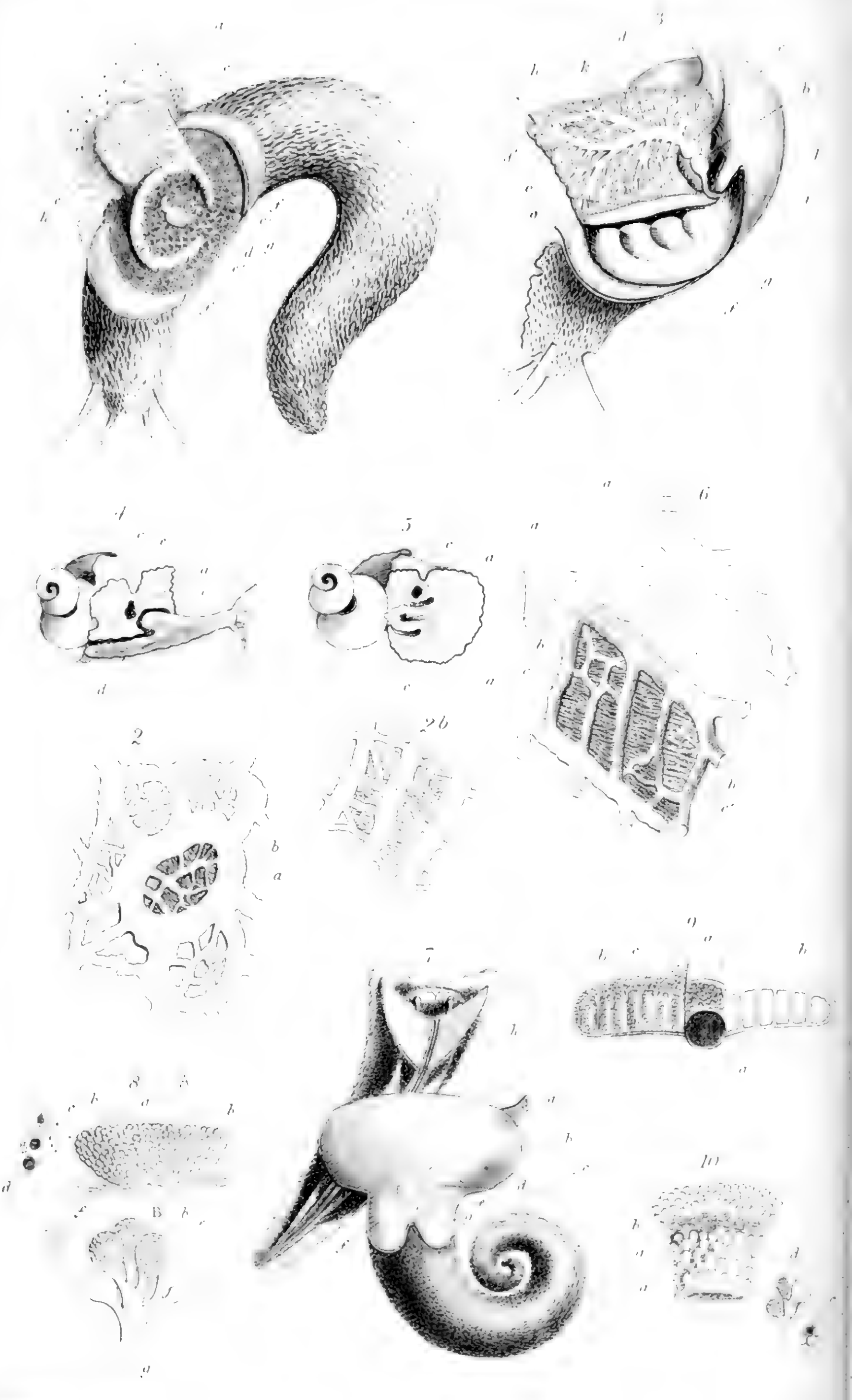
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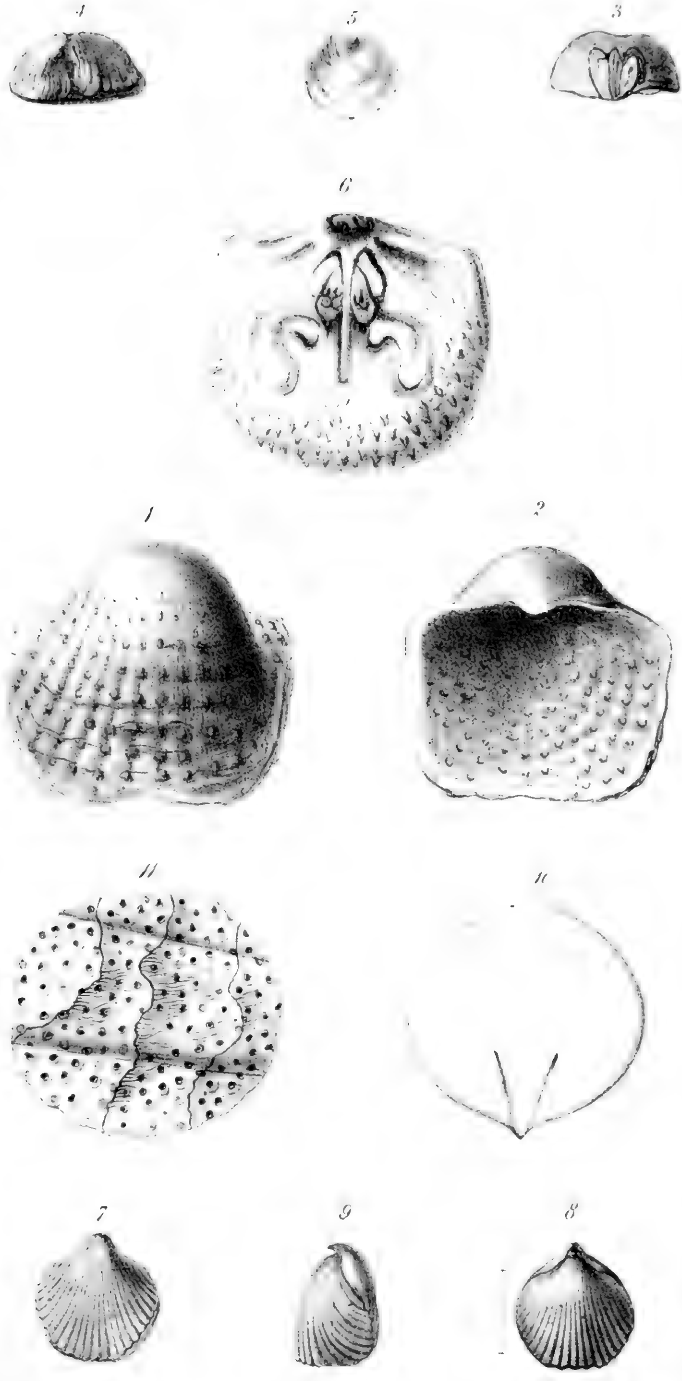
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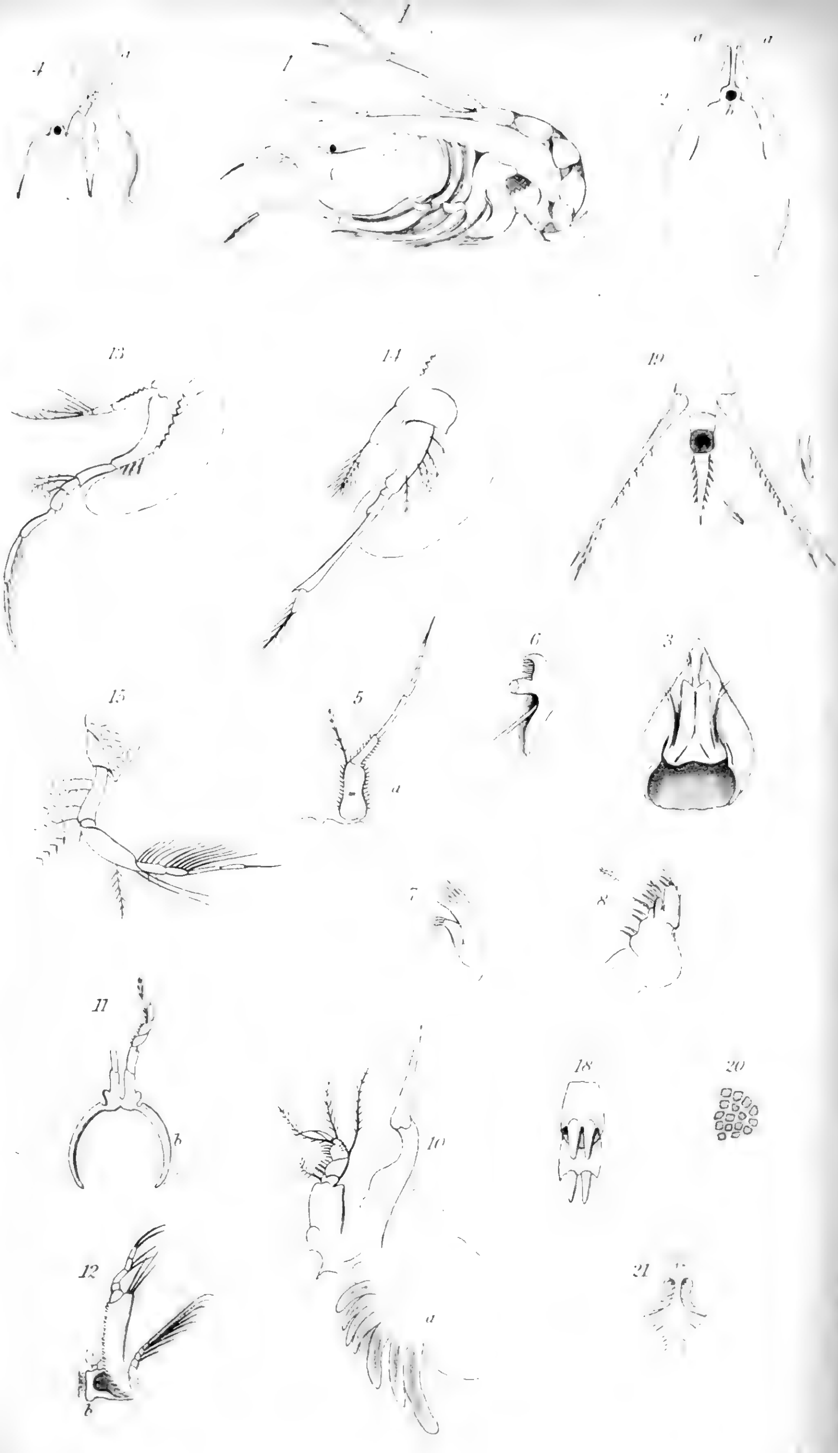

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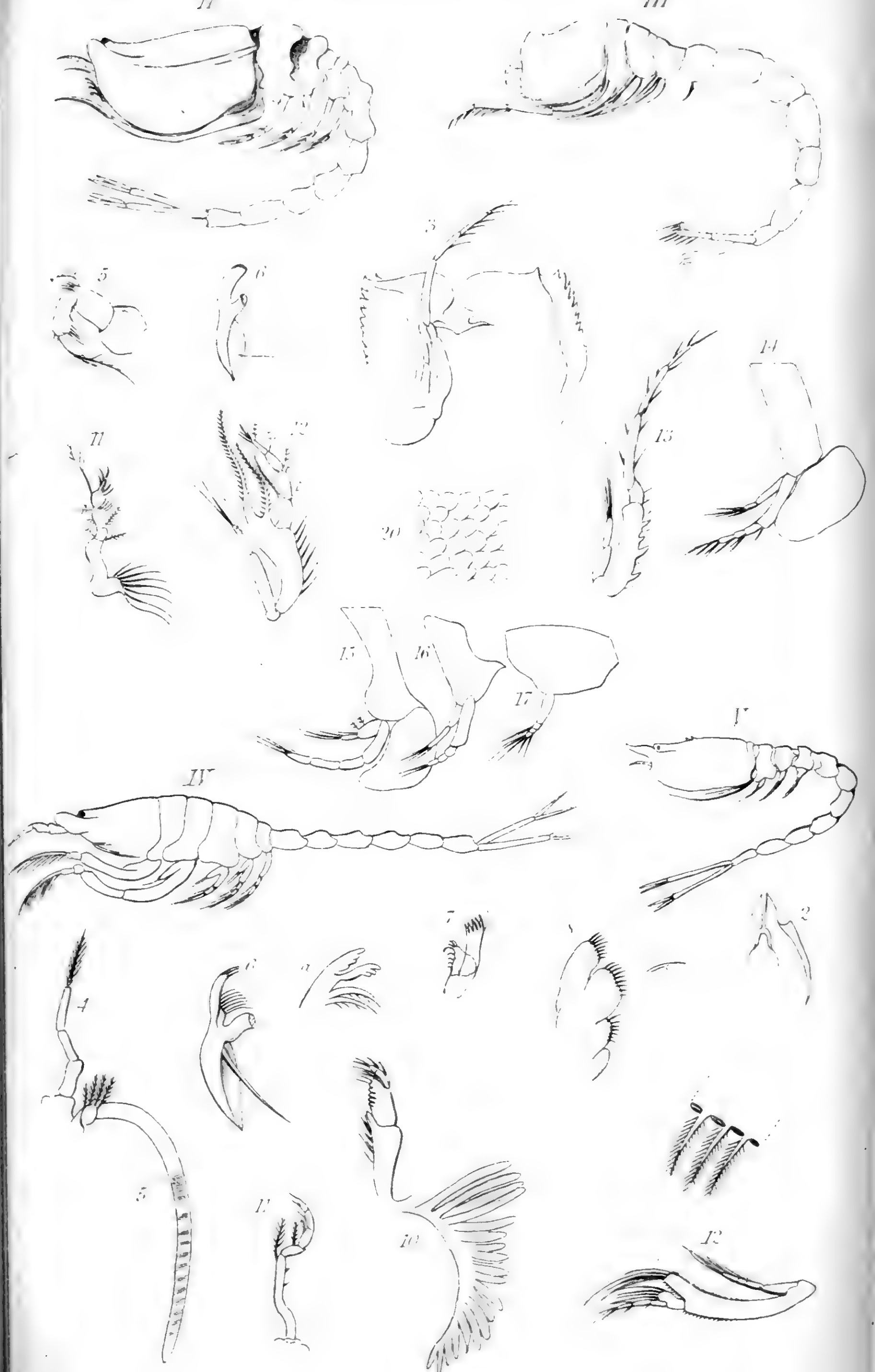

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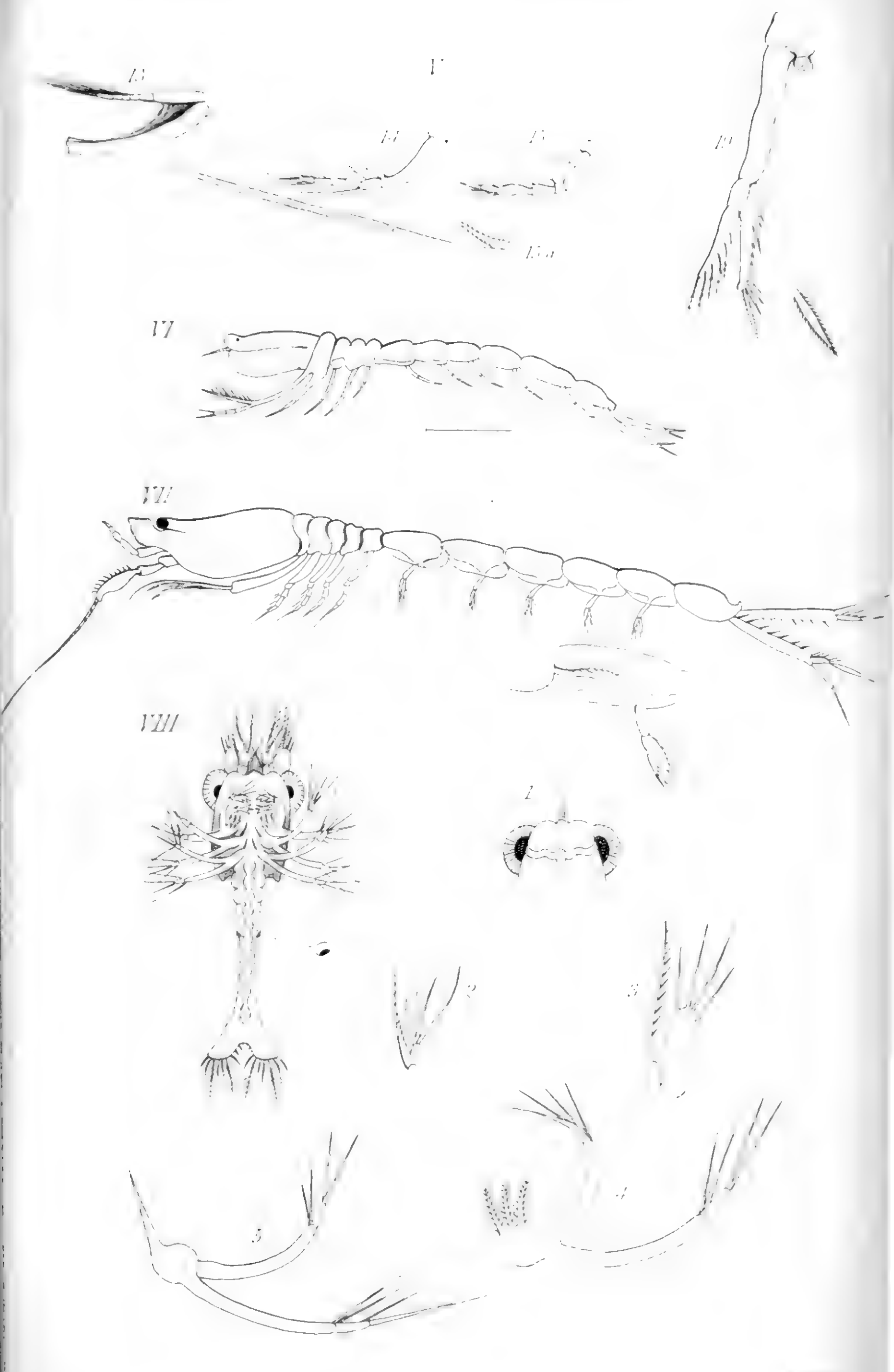
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