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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.')

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

"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. 73. JANUARY 1854.

I.—*On the Structure of the* Echinoderms. By Johannes Müller*.

[With a Plate.]

In addition to their radial form and division, the Echinoderms are essentially characterized by the calcification of their perisoma and of many internal parts, by their peculiar metamorphoses, and especially by their ambulacral organs, feet or suckers, which may be distended by means of a peculiar system of internally ciliated canals.

The larvæ of the Echinoderms are bilaterally symmetrical, and present no trace of a radial arrangement; when impelled by their cilia, it is always one end which is directed forwards. The radial arrangement is met with only in the adult Echinoderm forms, and even they always present more or less obvious traces of a bilateral symmetry. In those *Holothuriæ* which creep upon an 'ambulatory region' (Sohle) and in the irregular *Echinidæ*, the bilaterality is at once obvious. But all Echinoderms do not constantly creep on the same surface, or in other words, possess

* Read before the Royal Academy of Sciences of Berlin, May 26, 1853. Translated and communicated by Thomas Huxley, F.R.S.

an ambulatory region; many *Holothuriæ* having nothing of the kind. The ambulatory region, or the surface turned towards the ground, sometimes includes an equal portion of all the radii or ambulacra, so that the mouth, which is situated in the midst of them, occupies its centre, as in the regular *Echini* and in the *Asteridæ*, or the mouth is placed at the end, and the ambulatory region, as in those *Holothuriadæ* which possess one, is not constituted by all the radii, but is formed by only three out of the five ambulacra. The abdominal and dorsal surfaces therefore are not constant in relation to the radial form. The inquiry into the bilateral symmetry of a radial form becomes, partly from this reason and partly from the predominating radial symmetry of the regular forms, exceedingly complicated, and it is even necessary to avail ourselves of the instinct manifested by the Echinoderms in their movements.

All the forms provided with one, exhibit the most distinct instinctive impulse to direct the ambulatory region, however constituted, whether the mouth be placed in its centre or at one end, towards the ground, and if laid upon their backs they endeavour to turn round as an insect would do under like circumstances. Even the radiated rudiment of the Echinoderm, in the larva, behaves in this way as soon as the first ambulacral feet have made their appearance. The primitive rudiment of the *Echinus* or of the Starfish, dragging its larval framework about with it, opposes by the movement of its suckers every position in which they are not directed towards the containing glass, and thus endeavours to reinstate itself in its natural ambulatory posture.

It is undoubtedly no part of the instinctive tendencies of the animal to turn its ambulatory or abdominal side in accordance with gravitation: for insects run upon the under side of fixed surfaces when they are able to adhere to them, and the *Echinidæ* creep actively up perpendicular surfaces by the aid of their suckers; the instinct of these animals, it may rather be said, directs them to turn the ambulatory portion of their ambulacra to whatever firm supports present themselves.

The regular forms, whose ambulatory region includes equal portions of all the radii and whose mouth lies in its centre, as the regular *Echinidæ*, the *Asteridæ*, and *Ophiuridæ*, do not creep in any particular direction, with one radius constantly anterior, but it is sometimes one, sometimes the other radius or interradius which is directed forwards as the animal progresses. What Tiedemann says about the *Asteridæ* holds equally good of the *Ophiuridæ* and *Echinidæ*. These animals move exactly as if they were not aware of any difference between back and front, although they distinguish the ventral from the dorsal sides in the most marked manner. The very young *Holothuria* with five suckers round its mouth, but without any upon its body, does not creep upon its future ambulatory region, but acts exactly as if the oral suckers constituted that region; taking the position of an *Echinus* with its mouth directed downwards and its body upwards, it adheres by the oral suckers and stretches them about in various directions. When, however, the first ventral sucker emerges at the posterior extremity of the body, immediate use is made of it, as if it at once belonged to the ambulatory region and availing itself, sometimes of the oral, sometimes of the lateral sucker for adhesion, and as fixed points whence to stretch itself, the young animal forms a sort of transition towards a *Holothuria* with an ambulatory region. In this condition also we see that the young *Holothuria* does not creep in any particular direction; on the other hand, feeling about on the glass, it moves hither and thither indiscriminately. I have not yet seen the adult *Holothuriadæ* with ambulatory regions creeping head foremost; I have no doubt however that they do, as they are completely adapted for this mode of progression. The extant information upon this point is obscure; they have been seen creeping, but it is not stated in what direction. Johnston says of *Thyone papillosa* (Forbes's British Starfishes, p. 236), that it has a slow progressive motion, more gradual than that of the shadow on a sun-dial, effected by the suckers being elongated and fixed to some spot, and then contracting so as to drag the body forwards; the suckers, however, are said to be used more frequently as anchors than as feet, since these animals are sluggish and indolent in disposition. The *Synaptæ* do not move in any particular direction, but simply twist and wind about, unless they are upon a sandy bottom; thus placed however in vessels of water, Quatrefages has seen them bury themselves in the sand with their oral tentacles.

The elongated Sea-urchins occupy an important position in this inquiry. In the *Spatangidæ* the ambulatory region consists of segments of all the five ambulacra, but the mouth is situated nearer the one extremity of the ventral surface and the anus at the other, between two radii and opposite to the azygos radius, which has thence been called the anterior radius; in fact, as its suckers are more particularly made use of in locomotion, it would really seem to deserve this name. Accordingly it has been sought for also in the regular forms, in which the anus either lies in the centre of the dorsal surface (regular *Echinidæ* and most *Asteridæ*), or as in other *Asteridæ* is wholly absent. That the position of the madreporic plate does not determine the posterior extremity was rendered evident by the circumstance that in many elongated *Echinidæ* it is lateral, while in others it is an expansion of the right anterior genital plate towards the centre (Anat. Studien über die Echinodermen, Archiv 1850).

Among the regular *Echinidæ* the elongated forms of the *Echinometræ* are particularly interesting.

In *Echinometra acufera* the anus is approximated to one, the longest radius, so that the antero-posterior diameter is the longest. If the azygos middle radius of an *Echinometra* be placed in front, the madreporic plate will constantly be found to lie laterally and to be the left posterior genital plate. In this position the radii and inter-radii of *Echinometra* are perfectly symmetrical, and it is the only position in which they are so. In the genera *Heterocentrotus*, Br. (*Acrocladia*, Ag.), and *Colobocentrotus**, Br. (*Podophora*, Ag.), which have been separated from *Echinometra*, the body is only symmetrical when placed transversely, as was observed by Brandt in the first-named genus, and expressed by him in the phrase '*corpus transversum*', but overlooked by Agassiz, who regards their forms as oblique, in common with *Echinometra*. The proper position of these shells is—with the greatest diameter of the shell transversely, the smallest longitudinally, and the smallest radius anteriorly; thus placed, the madreporic plate in *Heterocentrus trigonarius*, *mammillatus*, and in *Colobocentrus atratus*, is the right anterior genital plate. Among twenty-four specimens of *Colobocentrus atratus*, twenty-three had the madreporic plate thus situated; one however had this plate in the left posterior inter-radius. Such variations depend upon whether the Echinus-disc with its madreporic canal is formed on the right or on the left side of the larval framework—deviations which, as my figures of Echinus-larvæ from Helgoland show, have already been observed.

In *Echinometra* the transverse symmetry occurs rarely as an anomaly; among a great number of *Echinometræ* (about eighty specimens, including all the known species) only four transversely symmetrical specimens were met with. Among fifteen examples of *Echinometra acufera*, Bl., from the same locality (Venezuela), there was one; among six of *E. oblonga*, Bl., one also was transversely symmetrical, *i. e.* one had the azygos radius shortest; in the others, the azygos radius was the longest of the five.

The division of the *Echinometræ* into genera rejected by Souleyet (Bonite) is hence shown to be natural.

In the *Spatangidæ* of the present epoch the madreporic plate is commonly situated at the posterior extremity of the apex, but even in this case its position is problematical; I have already

* It may be preferable to shorten these names into *Heterocentrus* and *Colobocentrus*.

remarked, that its perforated area (Porenfeld) in *Schizaster canaliferus* extends from the right genital plate and from the immediate neighbourhood of the right genital pore. A short time ago I had occasion to demonstrate this by internal dissection. The canal which passes from the madreporic plate to the circular canal of the ambulacral vessels, the analogue of the sand-canal of the *Asteriadæ,* is inserted in fact, in *Schizaster canaliferus,* into the circular canal between the right anterior and right posterior ambulacral canals, corresponding therefore with the right posterior inter-radius. In the Clypeasters the posterior extremity is also determined by the position of the anus; but in this division of the Sea-urchins the madreporic plate, on the other hand, lies exactly in the centre between the genital apertures, which are not carried by special plates. Singularly enough, however, in this case, the canal which passes from the madreporic plate to the circular canal, as well as the short thick heart which lies close to it, is so disposed, that its position corresponds, not with that of the anal inter-radius, but with that of the right posterior inter-radius. From all this it follows, that the anus as well as the madreporic plate may be inter-radial; that sometimes the one and sometimes the other may pass out of its inter-radial space into the centre; that the inter-radius of the madreporic plate may be distinct from that of the anus; that the madreporic plate, even when it lies between the genital pores or at the posterior extremity of the apex, may be reduced to a lateral genital plate; and that it is united, not with the posterior part of the circular canal, but with a lateral part of it by means of the 'sand-canal;' finally, that no one of the five inter-radii is invariably that of the madreporic plate, but that this may be seated in the most widely different inter-radii, sometimes on the right and sometimes on the left side.

We may now compare the azygos radius in those Echinoderms in which it is easily determinable, as in *Echini* and *Holothuriæ,* and it at once appears that an anterior radius corresponding with that of the *Spatangidæ* cannot universally exist in the Echinodermata. In the *Holothuriadæ* with an ambulatory disc, the anterior and posterior extremities and the bilateral symmetry also are indisputable. The azygos radius, however, is here directed, not from the mouth upwards and forwards, so as to lie in front of and above it, as in the *Spatangidæ,* but takes exactly the opposite direction—from the mouth backwards and downwards—and lies beneath and behind the mouth; the azygos radius is here the middle ventral radius and the ambulatory disc is formed by three radii, while on the dorsum there are only two.

Whether now is the true ventral surface, that of the *Spa-*

tangidæ or of the *Echinidæ*, or that of the *Holothuriadæ*? I imagine no one will be disposed to get rid of this difficulty by supposing that the *Holothuriadæ* are exceptions and creep upon their backs. Let us conceive the typical form (Mittelform) of the Echinoderms to be a sphere with radial areæ, the question is, whether this typical form passes from that of the *Spatangus* into that of the *Holothuria*, by the body being rotated in the plane of its middle longitudinal section, so that from resting upon the inferior inter-radius it comes to lie upon the opposite radius; or, whether this change is effected by the rotation of the typical form round the axis of the radii, so as to bring the globe from its position with an inter-radius inferior into that with a radius inferior. In the former case, the conju ate sides and the anal inter-radius remain constant, but the denominations of the conjugate sides as regards right and left become changed with the rotation in the longitudinal plane. In the latter case, the conjugate sides and the position of the anus would shift, but the anterior and posterior ends would remain constant, different radii and inter-radii becoming developed into the ambulatory disc, and the anal inter-radius undergoing a corresponding alteration.

If any such thing as a homology of the Echinoderms exists, it can only be sought for in the former of these hypotheses. By rotation round its axis the position of the *Spatangus* may indeed approximatively be converted into that of the *Holothuria*, but not wholly; for even then to correct this position, and at the same time to change a *Spatangus* into an *Echinus*, the rotation in the opposite direction round a transverse axis, or in the longitudinal plane between the conjugate sides, would still be required.

If, therefore, we seek an ideal middle term among the various actual forms of Echinoderms, this typical form will be found to possess no constant anterior and posterior extremities; it has the mouth in the one pole of the ambulacra, but in passing into the various forms of Echinoderms, it may turn sometimes one side of its radial body forwards, sometimes exactly the opposite. These anteriorly directed sides are, however, determinate in all cases; they are invariably cut by the same constant meridian of the radial form; *i. e.* the longitudinal plane of separation between the symmetrical halves of the ideal typical form is in all cases constant.

Those terms are best which are derived from the intrinsic peculiarities of a form and not from positions, which it may alter. On the former principle we may bring the ambulacra of the 5-partite Echinoderms under two classes, the one of which contains three, the other two ambulacra; we thus obtain a triradial and a biradial segment, a *trivium* and a *bivium*. In the Sea-urchins of the genus *Dysaster*, trivium and bivium are actually separated by a wide interspace; but in most quinquepartite Echinoderms they may be discovered and the position of the radii thence determined. Between the two radii of the bivium lies the anus, or it moves away from the mouth to the apical pole, and even beyond it, to the opposite azygos radius.

If the azygos radius be unknown, it may be determined by the meridian of the anus, which in *Cidaris* and *Echinus* is approximated to one of the five ambulacra. If the azygos radius be known, but the anus central, as in the *Holothuriadæ* with ambulatory regions, the meridian of the anus may be determined from the azygos radius of the elongated form.

We may lay down then, upon the ideal spherical Echinoderm, the oral and apical pole; a triradial segment and a biradial segment, with the anal area. If the ambulacral areæ of this Echinoderm are equally developed in all directions, it will become an *Echinus* with its mouth directed downwards. The sphere is as it were in equilibrium in this position; it is, however, traversed by an ideal plane which passes through the meridian of the azygos radius. If it be rotated, within this plane, out of its position of equilibrium, in such a manner that the bivium occupies more of the ventral surface than the trivium, we have the position of the *Spatangidæ*. If within the plane, the globe rotate in the opposite direction, so that the trivium alone occupies the ventral surface, the result is the position of the *Holothuriadæ*. In this ideal globular model of the quinquepartite Echinoderm we have then the following points fixed, and good for all possible cases, viz. the oral and apical poles and their axis; the contrasted trivium and bivium; the longitudinal plane passing through the meridian of both, and dividing the Echinoderm into two equal parts; and finally, the anal area. In the creeping Echinoderms the oral pole may be directed downwards or forwards, the apical pole upwards or backwards; the trivium, with its azygos radius, may sometimes be presented forwards, sometimes downwards; the bivium, with its azygos inter-radius, sometimes backwards, sometimes upwards; the anus downwards and backwards, upwards and backwards, or upwards.

The radial segments of the Echinoderm have an *oral pole*, and opposed to this an *apical pole*. The mouth, surrounded by the circular canal of the ambulacra, lies in general in the centre of the oral region, rarely on one side of it. The surface between the poles may be divided into *ambulacral* and *interambulacral* segments. By the extension of the former in breadth, the latter may entirely disappear, as in the *Holothuriæ sporadipodes*. In the *Holothuriæ* the ambulacra pass from the mouth to the opposite extremity; when they cease before attaining this extremity, there is formed, opposite to the ambulacral zone, an *antambulacral zone, e. g.* the *apex* of the Sea-urchins, which is continuous with the inter-ambulacral areæ.

If, like the *Asteridæ,* an Echinoderm has radial arms, the antambulacral area is continued, as well upon the antambulacral side of the arms, as between them into the inter-ambulacral areæ. It is not uncommon, as in many *Asteridæ,* for the inter-ambulacral part of the perisoma to be distinguished from the antambulacral areæ by the character of its plates—the inter-ambulacral plates. The boundary between the inter-ambulacral and antambulacral areæ is at times indicated by a peripheral margin, or even by special marginal plates, such as the marginal plates of the pentagonal *Astrogonium* and *Goniodiscus,* between the ventral and dorsal surfaces, which also lie between the ambulacral and antambulacral zones. In the *Asteridæ* and many Crinoids, the ambulacral or ventral and the antambulacral or dorsal, sides are about equally developed. *Arms* are free radii with an ambulacral and antambulacral side, and are either simple or divided. Divisions produced by processes or insections of the periphery of the Echinoderm are *lobes,* if they present no distinction of an ambulacral and antambulacral side, such as the lobes of a few flat Sea-urchins, *Runa, Rotula, Encope.* There exist ambulacral and inter-ambulacral lobes (*Runa*). Ambulacral lobes are ambulacral upon both sides and may be subdivided (*Rotula*). Segmentation of the margin and the formation of lobes, therefore, do not approximate the sea-urchin to the star-fish. If the antambulacral area of the Echinoderm grow up close to the mouth, arms for the ambulacra may still be developed in its neighbourhood, as in *Agelocrinus, Pseudocrinites,* and as in the oral arms of the calyx of *Echinoencrinus* and *Echinosphærites* discovered by Volborth. The existence of ambulacral pores upon the antambulacral area, on the opposite side of the arms, is self-contradictory; and it would appear that wherever arms are developed, whether at the circumference or at the oral part of the calyx, no ambulacral pores nor suckers can exist in the region which extends from the apical end to the arms.

The development of the ambulacra, as it is here set forth, renders it probable, therefore, that the pores in the plates of the calyx of *Caryocrinus, Hemicosmites* and *Echinosphærites* cannot possibly be ambulacral pores, inasmuch as they are situated in the antambulacral region and behind the arms, to which they have no relation whatsoever. *Pentacrinus* contributes analogically to this view, as it possesses similar pores in the interambulacral areæ, without suckers or any relation to the ambulacral grooves of the calyx, the suckers being situated in the ambulacral grooves of the calyx and of the arms.

I shall return to the antambulacral pores of the calyx of *Caryocrinus, Hemicosmites,* and *Echinosphærites,* in a particular section devoted to the ambulacra of the Crinoids in general, and especially the group of *Cystidea* of Von Buch.

In an Echinoderm which remains antambulacral close up to the mouth, and developes arms only from the oral part of the calyx, we have at its maximum that condition which in the *Echinidæ* is at its minimum. To borrow the phraseology of the 'Natur-philosophie,' we may say that the calyx of a *Pseudocrinites, Agelocrinites, Echinosphærites, Echinoencrinus,* is the apex of an *Echinus*; it is, however, an expansion of the apex large enough to enclose the whole intestines of the animal, while in the *Echinus* these are invested for the most part by the ambulacral zone of the perisoma.

The region of the ambulacra may be reduced to a circlet of suckers about the mouth, as in the *Synaptæ, Chiridotæ, Molpadiæ,* among the *Holothuriadæ*. In the last instance, the antambulacral area is only so large externally, Jäger having demonstrated that the ambulacral canals of the *Synaptæ* have as wide a distribution internally as those of the other *Holothuriæ*.

Although the ambulacra converge towards the oral pole, yet they are not in all cases provided with suckers up to the middle of the oral surface. In *Echinus,* for example, the ambulacra are interrupted around the oral area; and in many Crinoids, also, the oral area between the ambulacral sides of the arms, instead of presenting a continuation of the ambulacral grooves to the mouth, is covered uniformly with plates, as in *Actinocrinus*.

To the ambulacral system of canals, taken in its widest sense, belong, together with the suckers, the ambulacral canals of the radii, with their branches to the suckers and their ampullæ,—the circular canal which unites the five ambulacral canals around the mouth and a few appendages connected with it. The system of ambulacral canals exhibits ciliary motion over the whole extent of its internal walls and is everywhere closed, if we except the porous commencement of the sand-canal in the madreporic plate. This canal, extending from the madreporic plate to the circular canal, has now been observed in all forms of Echinoderms, with the exception of the Crinoids. Its porous commencement either opens externally as a madreporic plate in the *Asteridæ, Euryalæ, Echinidæ*; or is turned towards the abdominal cavity, as the porous calcareous sac of the *Holothuriadæ,* which possesses an external aperture only in the young state. In the *Ophiuridæ,* also, the calcareous sac is hidden in the cavity of the body.

These peculiarities have already been explained in the 'Anatomische Studien.' Besides the one or many sand-canals, there are two other descriptions of organs united with the circular canal of the Echinoderms,—the 'Polian vesicles' and the 'racemose appendages.' Both these organs occur contemporaneously in the *Asteridæ* (as is well known from Tiedemann's investigations) and reappear in the *Holothuriadæ*. In the latter the racemose appendages are recognizable as little vesicles, which are connected in pairs, by short stalks, with the circular canal of young *Holothuriæ*, and contain very peculiar double granules in constant tremulous motion, just like that of the otolithes of the Gasteropoda. In the adult *Holothuriæ* these organs are recognizable in the multitudinous small vesicles which beset the circular canal and open into its interior. The *Ophiuridæ* possess four simple vesicles and no racemes. In the *Spatangidæ* the appendages are absent upon the circular canal. In the regular Sea-urchins five stalked vesicles are connected with this canal; they have the same position as the Polian vesicles of the *Ophiuridæ*, but their walls are cellular, and therefore allied to the racemose appendages. In the *Clypeasteridæ* only, however, is the circular canal provided with many such appendages.

Analysis of the Ambulacra of the Sea-urchins.

After having expounded the anatomy of the central portion of the ambulacral canals in the 'Anatomische Studien über die Echinodermen' (Archiv 1850), I set before myself the task of analysing the ambulacra themselves.

The double pores of the ambulacra lie, in the Sea-urchins, either in the plates themselves or in their sutures; the latter occurring in the petaloid ambulacra of the *Clypeasteridæ*. In this case, either the ambulacral plates are similar, as in the petaloid ambulacra of *Scutella, Laganum, Echinarachnius, Lobophora, Mellita, Encope, Echinocyamus*; or alternately dissimilar, as in *Clypeaster* and *Arachnoides*; the smaller plates pass, in these, only from the external to the internal pore, the larger extend from the external pore to the internal suture. Upon this point Desmoulins has already made some good observations. At the lower extremity of the petaloid ambulacra, for the rest, the double pores readily pass from the sutures on to the plates themselves.

Desmoulins has thrown out the supposition, that originally there is a special ambulacral plate for every double pore of the Sea-urchins. In the *Clypeasteridæ*, a number of pores corresponding with locomotive feet occur on a single plate, and they multiply in proportion to the growth of the plate; but in all other Sea-urchins, this hypothesis would appear to hold good. The composition of the ambulacral plates in *Echinus* has hitherto remained unknown. In the shell of an *Echinus*, the so-called ambulacral plates are nothing but secondary ambulacral plates made up of the minute primary ambulacral plates. We may observe on the inner side of the shell the sutures between the primitive plates, which contribute to the formation of a secondary ambulacral plate. The primary plates correspond in number with the pairs of pores in one oblique transverse series of the ambulacrum. The sutures are also recognizable upon the exterior, and by careful examination we observe, that they divide even the tubercles situated upon them, as may be well observed in *E. sphæra*. Where there are four pairs of pores in a secondary ambulacral plate, the four pieces have very unequal horizontal diameters, the two median ones, in fact, being smaller transversely; all four pieces extend as far as the external suture, but only the first and the last attain the inner suture, applying themselves around the ends of the shorter pieces in such a manner, that the secondary ambulacral plate is divided internally by only one suture. The same suture exists when there are three pairs of pores. Here, again, it is the plate of the median pair of pores which does not reach the inner edge. In *E. albus*, 9–10 primary plates for 9–10 pairs of pores form in a similar way a secondary plate. The smaller plates are not subsequent to and intercalated between, the larger, but are found in the smallest specimens in which the plate is developed at all; so that a young Sea-urchin has just as many pairs of pores in an obliquely transverse series as afterwards, according to the species to which it belongs.

Agassiz has demonstrated, that in *Echinus* the addition of new ambulacral and inter-ambulacral plates takes place at the apical end of the corona, but denies the occurrence of such new formations in the *Clypeasteridæ*. The fact is, however, that it occurs here in exactly the same manner as in the regular Sea-urchins. The whole under surface of the *Clypeasteridæ* grows, retaining the original number of its plates, only by their individual increase; whilst the plates of the upper surface not only increase individually, but at the same time fresh, minute, ambulacral and interambulacral plates are added at the apex. This must be borne in mind in describing species, and the number of the plates should be reckoned from the end of the petaloid ambulacrum to the edge, and also from the edge to the mouth.

Philippi, again, who confirmed and extended the observation that new plates are formed at the apical end of the corona in *Echinus*, denies that the same new development takes place in the *Spatangidæ*; but it unquestionably occurs, from what I have observed, in *Schizaster canaliferus*, at different ages. I have compared specimens of 8‴, of 2″, and of 3″. The first has in each petaloid ambulacrum of the anterior pair only 28; the second 40; the third, 44 pairs of pores: in each ambulacrum of the posterior pair the first has only 14, the second 21, the third 25 pairs of pores on each side.

The *Clypeasteridæ* have, while the *Cidaridæ* have not, a permanent equatorial periphery. If an old and a young *Echinus* of the same species be compared, those plates which in the young specimen lay in the equator of the periphery, have in the older ones moved towards its ventral side; and the equator is occupied by a circlet of plates which in youth lay near the apex.

If the shell of the Sea-urchin terminate at some distance from the mouth and the oral feet are seated upon the oral integument, both the inter-ambulacral and the ambulacral plates terminate in pairs, as in *Echinus*. If, however, the shell is continuous up to the mouth and the oral feet are situated upon the shell itself, then the ambulacral plates terminate in pairs, while the inter-ambulacrals are single, as in the *Spatangidæ* and *Clypeasteridæ*. At the oral aperture in the *Clypeasteridæ* the corona becomes, it is true, considerably simplified, but not so much as is commonly supposed; in the end we have either a circlet of fifteen pieces, five of which are inter-ambulacral (*Clypeaster*, *Mellita*), or ten ambulacral pieces (*Arachnoides*). It is requisite to examine young specimens, though the sutures may always be recognized upon the inner surface. In *Clypeaster*, the first circlet around the mouth is composed of fifteen pieces, the second, on the other hand, only of ten,—the ambulacral plates becoming mutually applied, which is a generic character for all the species: in a few species the third circle also is completely formed by the ambulacral plates; further out, two alternating series of inter-ambulacral plates lie between them.

At the oral aperture of the shell of the *Clypeasteridæ* with branched clefts, there is a small process at the commencement of each ambulacrum, noticed, in fact, by Agassiz in his beautiful monograph upon the *Scutellidæ*, and regarded by him as a tube with one or many apertures for the reception of the gills. Upon this process, however, only two small tentaculiform processes with rounded ends like the feet are attached. These little tentacles are fixed to two shallow depressions of the process, from each of which a fine pore, similar to an ambulacral pore, leads obliquely into the interior of the shell. In *Arachnoides placenta* the process is absent, but the apertures exist at the edge of the shell, separated by the width of the groove. To these apertures the two anterior branches of the ambulacral vessel run, whence it is perfectly demonstrated that they are ambulacral and not branchial, and that they correspond with the oral feet of the regular Sea-urchins. The gills of *Echinus* are replaced in all the Sea-urchins with petaloid ambulacra, as well *Spatangidæ* as *Clypeasteridæ*, by the ambulacral gills of the petaloid ambulacra; however, the *Spatangidæ* have well-developed oral tentacles.

In the regular Sea-urchins of the genera *Echinus*, *Echinometra*, *Salmacis*, and others, all the feet, including those of the oral disc, have a similar structure, being suckers with a sucking disc; but this is not the case with every regular Sea-urchin; they are not all, to use Duvernoy's term, *homoiopodous*. Delle Chiaje, indeed, has already stated that the dorsal feet of *Echinus neapolitanus* (*Echinocidaris æquituberculata*) are pectinated, though his figure does not give a correct representation of them. The fact is, that all the *Echinocidarides* present this peculiarity. The lower feet have a sucking disc below, which is a circular calcareous ring. On the dorsal portion of the ambulacrum, the sucking disc and the calcareous ring suddenly vanish altogether, the feet becoming at the same time laterally flattened, pointed at their ends, and lobed on their flat sides. This arrangement, which would appear to be repeated in *Asteropyga* and *Diadema* (from dried specimens), evidently affords a transition to the gill-like dorsal feet of the *Spatangidæ*. In *Colobocentrus atratus*, likewise, the feet undergo a metamorphosis from the ventral to the dorsal sides; the suckers gradually disappear, and the feet take, upon the dorsal surface, a flat pointed form without lobes, very different from that in *Echinometra*. These feet contain two canals separated by a partition, but uniting with one another at the extremity, while at the base each is connected with one of the double pores. All previously mentioned sea-urchins have the ordinary cutaneous gills at the anterior edge of the corona, like *Echinus* (*Diadema* and *Asteropyga*, also, if we may judge by the insections of the shell). They are absent in *Cidaris*, the ventral feet here being cylindrical with terminal suckers, while on the dorsum they are conical and not lobed.

The oral feet of *Cidaris* form complete series upon the moveable buccal plates, which here, in a manner, repeat the corona, and may be divided into ambulacral buccal plates with double pores and inter-ambulacral buccal plates, the former of which remain double up to the mouth, while the latter become simple at the furthermost extremity.

The *Spatangidæ* present far more numerous differences in the characters of the ambulacral feet. Four general forms may be distinguished:—1. Simple locomotive feet, truncated or slightly rounded, without any special sucking disc. 2. Locomotive feet terminated by a sucker; this is either a large round disc notched at its edges and supported by radiating reticulated calcareous plates, or its edge is divided, star-like, into digitations, the calcareous plate dividing and sending a ray to each digitation. 3. Tactile feet, whose expanded end is penicillate, being closely covered with stalked knobs; the stalks contain a simple calcareous rod. 4. Gill-like feet, ambulacral gills; three-cornered laminæ pointed at their ends and having their edges pectinated by processes or insections. Two or even three kinds of feet are disposed on the same radius in those portions of the ambulacra which are bounded by the *semita*.

The import of the *semitæ* of Philippi, the *fascioles* of Agassiz—structures peculiar to the *Spatangidæ*—has been hitherto unknown. They are distinguished from other parts of the shell by bearing fine ciliated bristles instead of spines, the outer surface of which up to the soft, knobbed, outer extremity of the bristle exhibits a lively ciliary motion. The *semitæ* are therefore ciliated fringes upon determinate areæ of the shell. (Archiv 1853, p. 1.)

In the genus *Spatangus* we meet with three kinds of feet; tactile, locomotive, and branchial feet, with regard to which I may refer to Duvernoy's beautiful figures. In all the ambulacra, those feet which are nearest the mouth, the oral tentacles, are covered at their extremities with clavate cirri; the other ventral feet are locomotive without any cap of cirri. In the subanal area, on the other hand, that is, within the area circumscribed by the subanal semita, there are on each side three additional cirrated feet which Duvernoy has overlooked. Delle Chiaje, on the contrary, has improperly given cirri to all the ventral feet in his figure of *Brissus Scillæ*. The subanal cirrated feet belong to the two posterior ambulacra and in fact, to their inner halves, so that the subanal semita passes between the internal and the external halves of the ambulacrum. The dorsal feet of the four petaloid ambulacra are gill-like. The anterior radius has no ambulacral gills at all; but the locomotive feet, preserving the same form, extend to its upper extremity; this radius is therefore rightly distinguished by Duvernoy as *radius locomotorius*. The genus *Spatangus* possesses no semita upon the upper surface of its shell. In those genera which possess one, either circumscribing the dorsal part of all the ambulacra, as in *Brissopis*, *Schizaster*, &c., or that of the anterior ambulacrum alone, with the apex (*Amphidetus*, &c.), I find a peculiar kind of feet in the upper part of the anterior radius also, *i. e.* locomotive feet, with discoid or stellate digitated suctorial plates. The figure of *Brissus Scillæ* by Delle Chiaje, again, shows nothing of this difference; he even represents the cirrated oral feet extending along the anterior radius as far as the semita. It is improbable that *Brissus* should differ from *Brissopis*, and the figure would appear to be in fault.

In *Brissopis* and *Schizaster* the peripetalous semita divides the anterior radius transversely into two portions; the region below the semita contains simple locomotive feet; that above the semita, on the other hand, as far as the dorsal extremity, presents a sudden transition to feet provided with large suctorial discs, which are strengthened by radiating osseous plates. In the northern *Schizaster fragilis* these feet are disposed in simple series on each side of the ambulacrum; in *Schizaster canaliferus*, however, they constitute a dense series on each side. The lower portion of the anterior radius, from the oral tentacles as far as the semita, contains in *Schizaster* only a small number (three) of simple locomotive feet at considerable distances from one another upon each side.

In *Amphidetus* the peripetalous semita is absent; the four conjugate ambulacra possess branchial feet in their dorsal portion, as is commonly the case among the *Spatangidæ*. The internal dorsal semita which occurs in this genus divides the azygos radius into an anterior and a posterior part, and, enclosing the posterior part and the apex, it forms an area in which the azygos radius contains only large feet with stellate digitated extremities. On the contrary, the portion of the radius in front of the semita has simple locomotive feet without digitations. The digitations are supported by calcareous plates. The semita not only cuts off a portion of the anterior, but also a part of the four lateral ambulacra; the portions of the conjugate ambulacra lying within the semita contain no branchial feet, but exceedingly small and readily overlooked cylindrical feelers, simple and rounded off at their extremities. The penicillate cirrated feet around the mouth in the five ambulacra present similar relations in all the *Spatangidæ* which I have examined, and all likewise possess subanal cirri. *Brissopis* has upon each side a series of six feet with cirri. In *Schizaster* (*canaliferus*), where the subanal semita is absent, and a posterior semita branches off from the peripetalous semita and forms an arch under the anus, seven cirrated feet exist upon each side in a longitudinal series, at a considerable distance from the anus, in the posterior part of the ventral region of the shell; not between the posterior semita and the anus, but in front of the posterior semita. The stems of the different feet, besides, contain transverse notched calcareous bands in their walls, which are absent in the branchial feet.

The *Clypeasteridæ* present the greatest deviations in the formation of their ambulacra. The feet of the double pores of the petaloid ambulacra are gill-like; they are broad, depressed, lobulated, hollow projections between every pair of pores, and are distended by the large ampullæ of the ambulacra. The locomotive feet, on the other hand, are cylindrical and exceedingly delicate, so that in the *Clypeaster* they have a diameter of $\frac{1}{20}'''$, in *Mellita* only $\frac{1}{40}'''$. They are extremely numerous, much more so than in the regular Sea-urchins, where their number amounts usually to about 2000, or in the *Spatangidæ*, which possess only a few hundred; in the Clypeasters the number of locomotive feet may, without fear of exaggeration, be estimated at many myriads. They are provided with a sucker at their extremities, which is either supported by a notched calcareous ring, as in the Clypeasters and their allies, or contains at least a couple of calcareous bodies, as in *Mellita*, where at the base of the sucker we find in general two scale-beam-shaped (wägebalkenförmig) calcareous rods, with two long and one short process, lying opposite to one another. *Mellita hexapora*, Agassiz. The locomotive feet extend for a greater or a less distance from the ventral to the dorsal surface. Their distribution upon the abdominal surface varies greatly, whence the Clypeasters may be divided into two sections. In the first, the feet are not distributed over the whole of the ambulacral plates, but occupy separate branched passages in which the pores are aggregated, the *pore-fasciæ*. These fasciæ are at first simple, then divide dichotomously or trichotomously (*Echinarachnius*), and their principal branches ramify again for the most part into lateral branches. Agassiz has already observed that these branches also pass on to the inter-ambulacral plates. To this section belong the genera *Rotula, Mellita, Encope, Lobophora, Scutella, Echinarachnius*. In the other section of the *Clypeasteridæ*, including the genera *Clypeaster, Laganum, Arachnoides, Moulinia, Scutellina, Echinocyamus, Fibularia*, the pore-fasciæ are entirely absent. A few have, indeed, in the middle line of the ambulacra a simple groove, as *Arachnoides*, but it is known to be without pores. The distribution of the pores and feet in these genera has hitherto been unknown, but may be determined with certainty in the larger kinds. The pores and feet are scattered over the entire surface of the ambulacral plates; and in *Clypeaster*, but not in *Arachnoides*, they pass on to a considerable portion of the inter-ambulacral plates. These, therefore, are *Clypeasteridæ* with *pore-areæ*, in opposition to those with *pore-fasciæ*. The division into *Clypeasteridæ* with simple, and those with branched grooves, does not seize the real distinction. A few genera with *pore-areæ* have the middle of the *pore-area* not even depressed, as *Echinocyamus* and *Fibularia*. In *Laganum*, indeed, the depression is half lost.

Upon the dorsal side of the *Clypeasteridæ* we must distinguish, in the petaloid ambulacra, the external area between every two series of double pores and the internal area. The former is always provided with ambulacral gills appertaining to the large double pores; the latter in many genera, *Clypeaster, Arachnoides, Echinarachnius*, is covered with the very small locomotive feet (together with pedicellariæ and spines). When the petaloid ambulacra terminate, their internal pore-area extends peripherally as far as the edge. In *Clypeaster* it again occupies a portion of the inter-ambulacral plates, while in *Arachnoides* it is excluded from them. The pores of the locomotive feet are most readily observed upon the inner surface of the shell when this is naked; in the large *Clypeasteridæ* they may also be easily detected on the exterior with high magnifying powers, and still more readily in the pore-fasciæ of the other section, in which they are round and simple. In the Clypeasters, where the internal apertures of the locomotive pores are also simple, their external openings are elongated, usually figure-of-8-shaped, and not uncommonly divided into two distinct pores. In *Clypeaster rosaceus* these pores are $\frac{1}{30}'''$ to $\frac{1}{25}'''$ long, and $\frac{1}{60}'''$ broad.

Upon the internal area of the petaloid ambulacra, the locomotive pores are arranged in such a manner, that their longitudinal diameter is directed radially, a disposition which they retain until close to the peripheral edge; the lateral ones, however, in the peripheral portion of the shell have a somewhat oblique direction, and become more and more so the more external their position; the direction of the axes of the pores in fact is from the periphery upwards and outwards. Upon the ventral surface of *Clypeaster*, the similarly constructed elongated pores are all disposed obliquely, viz. instead of taking a direction from the oral centre towards the periphery, they diverge from the middl line of the ambulacrum; that is, if we produce the longitudinal axis of each single locomotive pore, it will cut obliquely the middle line of the ambulacrum, and form an acute angle open towards the periphery. It is only towards the edge that the middle portion of the series becomes straighter. The lines of direction of the axes of the locomotive pores on the back are the continuation of the same lines of direction on the ventral surface. What are here denominated lines of direction of the axes of the pores must not be confounded with the lines upon which the pores are arranged, for these in the Clypeasters are never disposed in series, but are scattered without order. On the other hand, in *Arachnoides*, the pores, as internally they are disposed in transverse series, so, externally, they are arranged in oblique parallel rows, whose parallelism is continued from the ventral to the dorsal side, and through the whole extent of the petaloid ambulacra.

In *Echinarachnius parma*, according to Agassiz, who has examined the living animal, the locomotive feet are replaced by tentacles, which, without being connected with the ambulacral vessels, open through their ampullæ into the abdominal cavity. The pores for these tubes are found in the petaloid ambulacra in regular rows internal to the great pores; through these tubes he supposes the water to have access to the interior of the shell (Comptes Rendus de l'Acad. des Sciences de Paris, t. xxv. 679). Hence we see that Agassiz was the first to observe these fine pores and their ampullæ, but that he confounded the proper locomotive feet which are supplied from the ambulacral vessels with respiratory tentacles. Neither in this nor in other Sea-urchins are there any tubules which penetrate the shell to open into the interior of the abdominal cavity. The ampullæ in question, in fact, are connected with the ambulacral vessels by their branches to the locomotive feet; and similar ampullæ exist also external to the petaloid ambulacra and upon the ventral surface, connected with the branches of the ambulacral vessels and corresponding with each locomotive pore.

Relations of this kind appear to be prevalent among the *Clypeasteridæ*, and obtain, not only in *Echinarachnius parma*, for specimens of which I am indebted to Prof. Eschricht, but in *Clypeaster* and *Arachnoides*, as results from the examination of the specimens of *Clypeaster placunarius* collected by Messrs. Ehrenberg and Hemprich, and in like manner in *Clypeaster Rangianus*, and in the specimens of *Arachnoides placenta* brought by Dr. Th. Philippi from Mergui.

We may first examine the internal area of the petaloid ambulacra. The whole area from one marginal double series of large pores to the opposite double series of the petal is covered with small cylindrical locomotive feet, which have the same size and structure as the feet of the peripheral dorsal pore-areæ, and as the feet of the ventral pore-areæ. The investigation of the internal surface of the shell throws further light upon the matter. The median ambulacral canal in *Clypeaster Rangianus*, *Cl. placunarius*, *Arachnoides placenta*, *Echinarachnius parma*, supplies the ambulacrum with as many parallel lateral branches as there are double pores for the ambulacral gills; each lateral branch in these is connected with the internal pore and with the large ampulla of the gill-like foot. But before reaching the internal pore, an additional series of small cæcal ampullæ, of exactly the same form as those of the peripheral dorsal and the ventral, locomotive feet, is attached to the lateral vessel. Each of these small ampullæ, of $\frac{3}{10}'''$ long and $\frac{1}{30}'''$ broad, corresponds with a very small aperture through which a twig of the transverse lateral vessel penetrates the shell and passes to the locomotive foot upon the external surface of the ambulacrum. In *Clypeaster Rangianus* there are twenty pores and ampullæ in one transverse row of half the ambulacrum in its broadest part, in *Clypeaster rosaceus* thirty, in *Clypeaster placunarius* ten, in *Arachnoides placenta* twenty, in *Echinarachnius parma* fifteen. In *Echinarachnius parma*, whose ambulacral plates are similar, these locomotive pores lie in the sutures: in *Clypeaster* and *Arachnoides*, where the ambulacral plates are alternately dissimilar, so that the internal area of the ambulacrum is formed by the broad plates, the locomotive pores are found in the plates themselves, so arranged, that either two transverse series of pores occur on one plate (*Clypeaster Rangianus* and *placunarius* and *Arachnoides placenta*), or, as in *Clypeaster rosaceus*, four series of pores exist upon one ambulacral plate. In the former, therefore, every great ampulla of the branchial feet receives the lateral vessel of one series of pores and small ampullæ; in the latter, two series of small pores correspond with every large pore. *Clypeaster rosaceus* has (judging by a hasty examination) about 4000 of these fine locomotive pores within each petaloid ambulacrum, *Cl. Rangianus* about 1200, *Cl. placunarius* about 600. In *Echinarachnius parma* their external apertures also lie in the sutures, and likewise in regular transverse series, which is rendered possible by the extreme minuteness of the tubercles upon the shell of this sea-urchin. In the Clypeasters with large tubercles, on the other hand, the latter disturb the serial arrangement of the pores upon the external surface of the shell, and the apertures may rather be said to be scattered irregularly between the tubercles.

In *Clypeaster placunarius* we meet with small calcareous spicula on the inner surface of each ambulacral plate between the series of pores: in *Cl. Rangianus* these spicula, which also abound over the rest of the internal surface of the shell, are arranged upon walls, into which the ambulacral plates are produced between every two series of pores. In *Clypeaster rosaceus* the spicula are absent; on the other hand, the walls of the ambulacral plates are raised up into septa, which are again united by a calcareous covering, in which the sutures of the ambulacral plates are repeated. The petaloid ambulacra, therefore, have double walls (like the dome of St. Peter's at Rome), the inner wall belonging only to the locomotive area, not to the area of the large or branchial pores, whose ampullæ are uncovered. Between the double walls in these Sea-urchins there are regular interseptal ambulacral chambers, each of which contains four rows of locomotive pores. All the transverse chambers are, however, intersected by a longitudinal passage, open towards them, for the median ambulacral vessel. In the covering there are three longitudinal series of apertures, by which the ambulacral galleries are connected with the abdominal cavity. The middle series answers to the median gallery, the lateral ones to the transverse chambers; the lateral apertures are intended for the passage of the ambulacral vessels to the large ampullæ of the ambulacral gills. Since every chamber opens in the neighbourhood of two double pores, the number of the lateral apertures in the galleries is exactly half that of the large double pores.

At the peripheral part of the dorsal ambulacra as far as their edge, and over the whole ventral part of the ambulacra, the ambulacral vessels in *Clypeaster*, *Arachnoides* and *Echinarachnius*, give off pennate branches to transverse series of pores, and are again provided with a corresponding number of ampullæ. In *Clypeaster Rangianus* about 100 transverse series of pores may be counted from the mouth to the peripheral edge; on the back, from the edge to the petaloid ambulacra, about 40; the number in a transverse series increases from the mouth to the edge and diminishes again, from the edge to the petaloid ambulacrum; towards the edge there are 80–90 pores in one transverse series of the half-ambulacrum.

The ambulacral vessels as they are distributed to the pores lie sometimes free, sometimes covered in ambulacral chambers. In *Clypeaster scutiformis* the series of pores are uncovered through the whole ambulacral area, but the ventral and dorsal portions of the shell are connected by numerous acicular pillars; in *Clypeaster Rangianus*, *placunarius*, and *Arachnoides placenta*, the series of pores lie for the most part free, but at the edge of the disc they are enclosed in chambers, which, however, are wholly or partially common to the abdominal and dorsal sides, inasmuch as the walls of separation connect the abdominal and dorsal parts of the shell. These parallel transverse chambers, of which there are six in the Clypeasters in question, many (about twelve) in *Arachnoides*, are traversed by a median longitudinal canal which extends from the abdominal to the dorsal side. In this lies the median ambulacral vessel, bending round from the abdominal part of the shell to the dorsal portion, and giving off, both in the ventral and in the dorsal part of its course, two transverse branches to each chamber, so that every marginal chamber has four vessels, two ventral and two dorsal, and as many series of pores. *Clypeaster rosaceus*, with a ventricose periphery, has no common dorso-ventral marginal chambers, but the entire ambulacra lie between double walls, and the pennate branches of the ambulacral vessels and their series of pores are everywhere contained in ambulacral chambers or ducts. Between the two transverse series of chambers there is also a covered way for the trunk of the ambulacral vessel. In this Dædalian maze there are usually four chambers on every ambulacral plate, and from the mouth to the petaloid ambulacrum, on each side about fifty chambers; at their outer extremities they open into the abdominal cavity. Every chamber contains four series of pores, the number of pores in which is about 80–90 in the broadest part of the ambulacrum. The 2 × 50 chambers of the two halves of an ambulacrum may, in the space from the mouth to the petaloid ambulacrum, contain about 16,000 pores for the ambulacral vessels of the locomotive feet; if we add to these the 4000 locomotive pores of the petaloid ambulacrum, we shall find that *Clypeaster rosaceus* has in an entire ambulacrum about 20,000, and in the five ambulacra together about 100,000 locomotive pores. About 15 are visible in an area of 1‴ in diameter on the external surface.

The interambulacral plates between the petaloid ambulacra are destitute of pores. The other interambulacral plates, on the other hand, both on the dorsal and on the ventral surface, are porous; the pores being so arranged that, on the back, they are more distributed upon the outer portion of the interambulacral plates, a poreless area remaining between the perforated areæ of any two ambulacra. This poreless area takes up so much space on the dorsum of *Clypeaster rosaceus*, that 6–10 tubercles arise from it transversely; on the ventral surface the perforated areæ approach so closely, that only 2–3 tubercles stand between them*.

To the division of *Clypeasteridæ* characterized by ambulacra with double walls and parallel ambulacral chambers from the mouth to the apex, belong, besides *Clypeaster rosaceus*, many fossil Clypeasters whose sections I have examined, as *Cl. altus* and *pyramidalis*†, and more particularly those high Clypeasters, whose peripheral part is not flattened. On the other hand, flattened fossil forms, like *Cl. scutellatus*, M. de S., and its allies, present nothing of this kind, but only marginal chambers, so that it would be justifiable to separate those forms with double-walled ambulacra, under the name of *Echinanthus* (Leske), from the other *Clypeasteridæ*.

* Klein's figure (tab. 29) of a section of *Clypeaster rosaceus* may for the present be sufficient to give an idea of the regular succession of chambers, and of the double walls of the ambulacra.

† There is a Clypeaster in the collection of the Gesellschaft Naturforsch. Freunde with a very high crown similar to the high varieties of *Cl. altus*, but differing totally from it by the breadth of the interambulacral areæ between the ambulacra petaloidea, as compared with the ambulacra themselves. The interambulacral area is for half its length, and as far as the upper half of the length of the petaloid ambulacra, about as wide as the internal area of the latter at the same height, and about four times as broad as the distance between two corresponding pores; beyond the upper half of the petaloid ambulacra the interambulacral area is broader than their internal area. In all varieties of *Cl. altus*, to which also the species distinguished by Philippi appear to belong, the interambulacral area between the ambulacral petals is very narrow. The peculiarity of *Cl. pyramidalis* may be as distinctly recognised in transverse sections by the high median and transverse ridges upon the internal coat of the petaloid ambulacra, the median ridges being united like buttresses with the ventral wall. The *Scutella pyramidalis*, badly figured by Risso, would appear to belong here.

Laganum Bonanni has only two marginal chambers common to the dorsal and ventral walls. The pore-areæ on the outer surface of the shell resemble those of the Clypeasters; only every ambulacral plate has its peculiar pore-area, narrow poreless bands intervening between them. On the internal surface of the shell every ambulacral plate presents an especial pore-area, whose pores are not disposed in many transverse series; in the marginal chambers we meet with many parallel series of pores. The dorsal surface of the shell also presents certain peculiarities; small pores are perceptible upon the internal surface of the petaloid ambulacra, which spread out upon the peripheral portion of the back; and the interambulacral areæ also, between these, contain similar fine pores upon those portions of the interambulacral plates which are contiguous to the large branchial double pores, where, in other cases, locomotive pores are never found: specimens preserved in spirit should be examined with regard to this point.

I now pass to the *Clypeasteridæ* with ventral pore-*fasciæ*. The internal area of the petaloid ambulacra presents the same relation in *Echinarachnius* as in the Clypeasters and *Arachnoides*, and it would therefore seem, at first, as if this character were universal in the entire family of *Clypeasteridæ*. However, in spirit specimens of *Mellita quinquepora* and *hexapora*, and *Lobophora bifissa*, for which I am indebted to MM. Krantz, Eschricht, and Steenstrup, I have been unable to find either the small ampullæ or feet on the lateral branches of the ambulacral vessel in the petaloid ambulacrum. The peripheral dorsal part of the ambulacra is always present. Not far distant from the edge, the ambulacral vessel of *Mellita quinquepora* forms a pennate ramification on the imperforate anterior radius. These curved parallel branches lie in canals of the shell, which are here and there connected with other sinuses of the shell. I have also persuaded myself of the presence of feet upon the peripheral part of the dorsal shell of *Mellita*.

In *Echinarachnius parma* the ambulacral galleries are absent, and we find only transversely perforated partitions and rafters between the dorsal and ventral walls at the periphery of the disc, constituting imperfect marginal chambers. On the ventral part of the ambulacrum of *Echinarachnius*, we observe from the mouth to the peripheral galleries, on the inner surface of the shell, many short pennate branches with appended ampullæ. It is from these therefore that the pores of the median pore-fasciæ must be supplied. In correspondence with the lateral branches of the fascia externally, there run internally long pennate branches of the ambulacral vessel provided with many ampullæ. The further ramifications take place in the peripheral galleries.

In the genera *Mellita, Lobophora* and *Encope*, the lateral twigs of the ambulacral vessel become immediately hidden in a superficial labyrinth of fine canals in the shell, which form ambulacral galleries, and are here and there connected with deeper sinuses open towards the abdominal cavity.

In these genera the pore-fasciæ, at a short distance from the mouth, divaricate in consequence of their dichotomous divisions from the middle of the ambulacrum, in which the trunk of the ambulacral vessel lies. No branches of the ambulacral vessel follow the course of the two principal branches of the pore-fasciæ, but the pores of these two large pore-fasciæ are supplied by vascular twigs, which are directed transversely to them, and partly arise directly from the median ambulacral trunk, partly have a pennate origin from branches of the latter. But all these twigs of the ambulacral vessels run in narrow ambulacral galleries, which occasionally anastomose and give off transverse offsets in close succession which meet the lateral ambulacral fasciæ, and then penetrate in part transversely, in part obliquely, to their pores. From this source then the pores receive their twigs. In *Mellita quinquepora* I could follow out the branches of the ambulacral vessels from the trunk into the galleries, to their very ultimate ramuscules. In this manner also the many secondary branches of the pore-fasciæ are supplied. But, I repeat, the ramifications of the pore-fasciæ and those of the branches of the ambulacral vessels are totally different.

The ambulacral galleries of *Mellita, Lobophora* and *Encope* occupy a thin superficial layer of the shell and are distinguished, by the narrowness of the canals, from the other deeper sinuses of the shell common in this genus.

I am unable to confirm the statement that cæcal processes of the intestine lie in these sinuses in *Mellita quinquepora* and other *Clypeasteridæ*. In the former species, as well as in *Mellita hexapora*, in *Lobophora, Clypeaster*, and, in fact, in all the genera which I have examined, the intestine has no cæca, and passes by the sinuses and apertures of the ambulacral chambers without giving off any processes whatever, accompanied at its outer edge by a great vessel, as in the regular Sea-urchins, and fastened by a mesentery. In *Mellita* and *Lobophora* a portion of the lobules of the sexual organs passes into the sinuses of the shell.

The innumerable muscular organs, subject to voluntary control, on the back of the shell of a Sea-urchin, such as the suckers, pedicellariæ, and the muscles of the spines, receive their nerves from the ambulacral nervous trunk lying in the interior of the shell, whose branches accompany the branches of the ambulacral vessel. The nervous trunks of the five ambulacra, united around the mouth by a nervous ring, form the larger portion of the nervous system, and inasmuch as they become more slender towards both ends of the ambulacrum and far surpass the nervous ring of the oral aperture in diameter, these ambulacral nervous trunks might be regarded as ambulacral cerebra, whose unity of action is provided for by the nervous ring. It is this ring which is cut through in the *Synaptæ*, when we divide the head longitudinally upon one side, and so deprive them of the power of breaking themselves up.

[To be continued.]

II.—*On a new species of* Tanager *in the British Museum.* By Philip Lutley Sclater, M.A.

Through the kindness of Mr. G. R. Gray I have had an opportunity of examining an apparently new species of Tanager lately acquired by the British Museum. It is nearly allied to the *Saltator rubicus* of Vieillot, which is the type of the genus *Phœnicothraupis,* Cabanis. But I agree with Dr. Cabanis that the proper place of this bird is nearer *Pyranga* and *Tachyphonus* than *Saltator,* with which it is often classed, and I think we may with propriety adopt the new generic name Dr. Cabanis has coined for it, and station it intermediately to the two former genera. My new bird will be the third of the genus, if we admit the claims of the Mexican variety named *rubicoides* by De la Fresnaye to be a true species. A specimen of this latter bird from Guatimala in my collection differs little in size from the southern race, although varying slightly in the conformation of the bill and rosy tint of the under plumage, as that accurate naturalist has remarked.

I possess a second local variety of this species from the island of Trinidad. It is smaller, and has the throat, belly and crissum of a rosy tint like the *rubicoides*; but I should be unwilling to separate it specifically without seeing more specimens.

The three species of the genus *Phœnicothraupis* will therefore stand as follows:—

Sp. 1. Phœnicothraupis rubica (V.).

Saltator rubicus, Vieill. Nov. Dict. xiv. 107.
Tanagra flammiceps, Temm. Pl. Col. 177.
——— *porphyrio,* Licht. Verz. d. Doubl. p. 31.
Pyranga rubica, D'Orb. Voy. p. 265.
Phœnicothraupis rubica, Cab. M. H. p. 24.

Hab. in Brazilia (Max.), Bolivia (D'Orb.), Paraguaya (Azara).

Sp. 2. Phœnicothraupis rubicoides (Lafr.).

Saltator rubicoides, Lafr. Rev. Zool. 1844, p. 41.
Phœnicothraupis rubicoides, Cab. M. H. p. 24.

Hab. in Mexico (Lafr.), Guatimala.

Sp. 3. Phœnicothraupis gutturalis, Sclater.

P. niger: vertice cristato cum gutture medio coccineis: rostro pedibusque nigris.
Long. tota 7·25; alæ 3·8; caudæ 3·2 (poll. angl.).

Hab. in Nova Grenada (?).

The plumage is of a nearly uniform brown-black; bill and feet deep black; an elongated vertical crest and the middle of the throat crimson: the nape of the neck and upper breast are slightly tinged with the crimson colour. The extreme tips of some of the crest feathers are black; the chin and sides of the throat are black.

49 Pall Mall, Nov. 24, 1853.

III.—*Descriptions of new or little-known species of Reptiles collected in Ceylon.* By E. F. Kelaart, M.D., F.L.S. &c.

Order SAURIA.

Tribe *Geissosaura.*

Fam. Acontiadæ.

Genus Nessia, Gray.

Nessia Burtoni (?), Gray.

Dark rufous brown above, and spotted longitudinally with darker brown spots; dark gray beneath, clouded and indistinctly spotted. Tail cylindrical, rounded at the end, and coloured and spotted like the body. Limbs four, very small, each with three subequal toes, clawed.

Length $5\frac{1}{2}$ inches.

Hab. Allagalla, 3000 ft., and Kaduganava, 2500 ft.

If our identification is correct, it would appear probable that the only specimen in Europe, found in the Army Medical Officers' Museum at Fort Pitt, was sent from Ceylon. The specimen was named after Staff Surgeon Burton, who was the Curator of the Museum when Dr. Gray visited that establishment.

Genus Acontias, Cuvier.

Acontias Layardi, n. s., nobis.

Light olive, and spotted longitudinally with brown spots, paler beneath.

Length of young 4 inches.

Hab. Soil of the Cinnamon gardens of Colombo.

The form of this reptile is distinguished from that of *Nessia*, above described, by the absence of limbs; in other respects it is very like the outline characters of *Nessia*. Mr. Layard procured us the specimens (apparently young) of this curious lizard.

Mr. Blyth writes, that he has described an allied genus from Rangoon by the name of *Ophiseps*.

Fam. Uropeltidæ.

Rough-tails. Dapat-naya, Sing.

This curiously formed family of reptiles is known in the island as *Dapat-nayas*, or Double-headed Snakes. The natives consider them poisonous, but our experience of their habits leads us to believe that they are perfectly harmless, and that they are timid creatures, seldom making their appearance above ground, living chiefly in ant-hills or dung-hills, sometimes also several feet deep in rich loamy soil. They feed on ants, small earthworms, and larvæ of insects.

It appears from Dr. Gray's Catalogue, that in the museums of Europe there are only three species, and of these three only one is from Ceylon, viz. *Siluboura Ceylonicus*, many specimens of which we have found in the Kandyan Hills since our work on the Fauna of Ceylon was published. We have also, since the publication of that work, collected three other species, making in all five distinct, undescribed or new species of Rough-tails (*Uropeltidæ*) in the island of Ceylon, which we shall now describe in a connected form.

Dr. Gray subdivides the family into three groups, and we have added a fourth, to admit of two species, one of which only we have described in the 'Prodromus.'

Genus Rhinophis, Hempr.

Rhinophis Blythii, n. s., nobis.

Dark yellowish brown above, with darker brown spots on the anterior third of scales; paler beneath. Rostrum yellow. Sides of nape and neck waved with angular marks of a yellowish hue; yellow spots on each side of vent. Tail thick, slightly truncated, conical; upper part near termination has a small subtriangular nearly smooth shield, lower surface covered with broad scales. Vent-shields 1–2.

Length 16 inches; circumference of the middle of body $1\frac{3}{10}$ inch; tail and neck rather thicker.

Hab. Mountains of Ceylon. Three specimens, found 3 or 4 feet below the surface soil of coffee plantations.

Genus Uropeltis (part), Cuvier.

Tail obliquely truncated, flattish, and covered with a flat roundish radiating granular shield, lower edge rounded, the under side of tail with six series of small scales. Gray.

Uropeltis Saffragamus, n. s., nobis.

Head dark olive-brown, the rest of the upper surface of a blackish brown colour, with bluish bronze reflections; beneath white; a pale white spot on each side of neck near the head. Tail deeply truncated and nearly covered with a large flat circular blackish granular shield, white and rounded beneath, and lower part covered with five series of small scales, the central series broader than the lateral ones. Vent-shields 1–2. The neck and fore part of the body much thicker.

Length 9 inches.

Hab. District of Saffragam, near Adam's Peak.

The only specimen of this species which we have as yet seen is one sent to us by Mr. Barnes De Zilva from Ratnapoora.

Uropeltis grandis, n. s., nobis.

Above dark brown with a bluish metallic lustre, anterior part of each scale with a blackish spot; beneath of a pale yellow colour, spotted brown on the anterior part of scale. Head of a light olive-brown colour. Tail short, abruptly truncated, the truncated surface entirely covered with a large circular granular shield. Vent-scales 1–2.

Total length superiorly, 1 foot 7 inches; inferiorly, 1 foot 8 inches. Tail-shield nearly the size of a shilling-piece. Head 8–10 inches in length. Greatest circumference $2\frac{3}{4}$ inches near the neck.

Hab. Southern Province.

The only specimen we have seen of this very large Rough-tail is one procured by Mr. Balkhuysen of the Colonial Medical Service, from Kerinday near Matura.

Uropeltis pardalis, n. s., nobis.

Head small, dark olive; upper parts black with beautiful bluish bronze reflections, irregularly spotted white; beneath yellowish white, marked with small and larger black spots of various shapes; some palee-yed. These black spots occupy more than one scale, generally two or three contiguous scales, and they are placed without order in various directions. Chin and throat unimaculate. Tail very short, obliquely truncated and covered with a large flat orbicular granular shield.

Length $6\frac{1}{4}$ inches; circumference $\frac{3}{4}$ inch.

Hab. Matura, Southern Province.

Genus Dapatnaya, n. g.

Tail obliquely truncated, upper part and tip covered with a large semi-conical granular shield. Vent-shields 1–2.

Dapatnaya Lankadivana, n. s., nobis.

Above dark brown, beneath paler. Scales with pale margins. Head yellowish in some. Rostrum yellow. Shield of tail sloping down to the lower surface. Vent-scales yellow; in some the spot extends beyond the vent.

Length from 1 to 2 feet. Thickness nearly the same throughout, about 1 inch.

Hab. Common at Trincomalie and in the Kandyan Province. Found 2 or 3 feet under ground, and in ant-hills. The young is of a dark olive-brown colour.

Dapatnaya Trevelyanii, n. s., nobis.

Black above, margin of scales pale; white beneath, with longitudinal series of black spots, formed of central spots on each scale; a line of triangular white spots, with their apices directed upwards, along each side. Vent white. A white line rising from this spot runs over the tail, and another whitish line extends forwards from the vent for about $\frac{3}{4}$ inch. Tail short, and nearly covered with a white semi-conical granular shield; tip ridged, a little produced.

Length from 12 to 18 inches; nearly of the same thickness throughout, about 1 inch.

Hab. Kandyan Hills, 3 or 4 feet under ground, and in the soil near the roots of coffee trees and cane.

Some of the young are of a bluish colour, others are spotted on the back.

Tribe *Nyctisaura*.

Fam. Geckotidæ.

Genus Boltalia.

Boltalia sublævis, Gray.

Above dark rufous brown; beneath sulphureous yellow, sometimes clouded with black. Back granular, with two or more longitudinal lines of larger granules on each side. Scales of chin large. Tail armed with adpressed spines in rings. Femoral pores in male only, from sixteen to twenty.

Length $5\frac{1}{2}$ inches.

Hab. The Central and Southern Provinces.

This Gecko we obtained in great abundance in Galle; we have also seen a few at Kaduganava after the publication of the 'Prodromus.' It is rarely seen on the walls of houses, generally on trees and on the roofs of houses. The rufous brown colour changes at times into a dark gray mottled with black. When immersed in spirits the rufous brown colour is entirely lost.

This Gecko has been mistaken for *Hemidactylus Leschenaultii*, and also for a large variety of *H. frenatus*, but the clawless compressed last joint of the thumb will distinguish this lizard from others.

From *Peripia Peronii* it is sufficiently removed by its granular back and armed tail. This lizard cannot be confounded with *Hemidactylus Coctæi*; it has very little resemblance to it, and the thumb of *H. Coctæi* is clawed. (Vide Prodromus Faunæ Zeylanicæ.)

Genus Hemidactylus, Cuvier.

Hemidactylus Pieresii, n. s., nobis.

This new species of Gecko, described in 'Prod. Faunæ Zeylanicæ,' p. 159, is found in the Kandia Hills, and also in the southern parts of the island. It is recognised by Mr. Blyth as a distinct species from *H. trihedrus*.

Genus Gymnodactylus, Gray.

Gymnodactylus Kandianus, n. s., nobis.

(Prod. F. Zeylanicæ, fol. 186.)

This diurnal Gecko is considered by Mr. Blyth to be identical with Gray's *Goniodactylus Timorensis*; but we are still of opinion that it is a distinct species, more particularly as *Goniodactylus Timorensis* is not described as bearing spines on the tail or back. There are also, in the male of our species, a small curved translucent elevation on each thigh with two or three glandular bodies or pores. Dr. Gray has now with him specimens from Ceylon, which we have sent him by Mr. E. Layard.

Order BATRACHIA.

Suborder 1. *Salientia.*

Fam. RANIDÆ. Frogs.

Genus RANA, Linn.

Rana Kandiana, n. s., nobis.

Beautiful grass-green above; beneath orange-red, inside of limbs slightly vermiculated with yellow. Skin of upper parts rough, coriaceous; a white granular ridge on each side of the back.

Length $3\frac{1}{2}$ inches.

Hab. Kaduganava, Kandyan Province.

We have only seen two specimens of this rare frog.

Fam. HYLIDÆ. Tree Frogs.

Genus LIMNODYTES, Dum. et Bib.

Limnodytes mutabilis, n. s., nobis.

Upper parts very changeable; generally of a bright green above and yellow beneath, a red line on the outer edge of limbs; sometimes of a dark chestnut on the upper parts, and variegated with yellow and green on the sides and limbs; of a more slender form than the common tree frogs, *Polypedates cruciger* and *P. leucomystax*. About 2 inches long.

Hab. Cinnamon gardens, Cotta, near Colombo.

If not mistaken, we have also seen this elegant frog at Newera Ellia. In spirits the colours fade into a pale leaden hue; the red streak on the limbs disappears last.

Limnodytes maculata, n. s., nobis.

Brown, spotted and streaked with black or dark brown; paler beneath, seldom spotted. About $1\frac{1}{4}$ inch long.

Hab. Galle, Southern Province.

We believe this species to be generally distributed, but have before mistaken it for the young of *Polypedates leucomystax*.

Genus EUGYSTOMA, Gray.

Eugystoma cinnamomea, n. s., nobis.

Cinnamon-red, spotted black. Limbs also spotted. Belly whitish.

Length (young) $1\frac{1}{4}$ inch.

Hab. Colombo, Western Province.

Order PSEUDOPHIDIA.

Fam. Cæciliidæ.

Genus Ichthyophis.

Ichthyophis glutinosus, Gray.

Since the publication of 'Prod. Faunæ Zeylanicæ,' we have collected several large and small specimens near rivulets on the hills of Kaduganava, Kandyan Province. They are generally seen crawling on mud after rain. They feed on small earth-worms. We have not yet succeeded in securing a "tadpole" of this reptile. The pale lines seen in specimens preserved in spirits are of a pale *yellow* colour in fresh specimens, very distinctly marked even in young animals.

IV.—*Note on* Spadix purpurea, *Gosse*. By Professor Edward Forbes, F.R.S. &c.

I take some blame to myself for not having two months ago called attention to the fact that this most curious and interesting creature, or one very near it, had already received a generic and specific denomination from the illustrious Sars. Before Mr. Gosse published his account of it, that excellent naturalist kindly sent me a specimen, which accidentally arrived in a bad state for examination. I recognised, however, its probable identity with a curious zoophyte found by Mr. Cocks and Mr. Alder, and of which I had a good outline drawing in my possession, sent me by Mr. Alder in 1847. Unfortunately its discoverers delayed publishing any account of it.

In a valuable paper by Sars, entitled "Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken," published I believe originally in the 'Christiania Journal' (though, having only a separate copy, I cannot speak to the exact date), is the following generic description, among his list of Polypes of the group of *Anthozoa* (p. 14):—

"*Myriothela arctica*, S., nov. genus et sp. (a μυρίος, innumerabilis, et θηλή, papilla). Character generis: Animal solitarium, nudum, cylindraceum, affixum, superne tentaculis numerosis brevibus sparsis apice globoso, ore terminali; inferne gemmis globosis breviter pedicellatis, racematim coacervatis."

Then follows a brief remark in Norwegian on its distinctions from *Coryne* and *Syncoryna*; and the statement that it was found at Tromsö in a depth of from 20 to 30 fathoms, attached to a stone with *Sertulariæ*.

It is enumerated in his list between *Hydractinea carnea* and *Syncoryna ramosa*.

I need not say that I was unacquainted with this passage when I received the communication from Mr. Gosse, to whom, I believe, in my reply I mentioned the likelihood of his animal being identical with that discovered by Mr. Cocks and Mr. Alder.

In the paper referred to are many notices of new marine animals, including several zoophytes, to which the attention of the explorers of our seas might well be directed.

The fact of the occurrence of the *Bryarea Scolopendra* in the British seas was first made known by myself, in a communication to the Wernerian Society in 1840; and at the Meeting of the British Association in 1849, when Dr. Ball gave an account of its discovery in Ireland, much information was communicated by several naturalists present respecting this very beautiful and still anomalous animal.

V.—*Description and Illustrations of new species of* Verrucaria *and* Sagedia *found about Torquay, Devonshire.* By Richard Deakin, M.D.

[With Four Plates.]

Verrucaria, Pers.

Apothecia globose, enclosed within or protruded above the thallus. *Nucleus* gelatinous, enveloped in a tunic, and entirely or partly covered with a black or brownish *perithecium* (not contracted into a neck), perforated with a minute or dilated pore, and often papillated at the apex. *Sporidia* in asci. *Thallus* horizontal, crustaceous.

V. neglecta. (Plate I. fig. 1.)

Thallus crustaceous, a dark dull olive-green, warty and uneven, unequally cracked, upon a black substratum, indeterminate; apothecia numerous, crowded, black, immersed, conico-hemispherical, with a naked subpapillated apex and large open pore; perithecium dimidiate; nucleus brown, in a black tunic; sporidia small, oblong, single-celled.

Thallus in large, spreading, indeterminate patches, of a dark dull olive-green, uneven, warty, and more or less granulated, irregularly cracked, becoming greener and continuous when moistened, here and there showing the black substratum which forms a thin layer beneath the whole, and often forms a margin beyond the edge of the outer coat. When the plant is grown in shady places and not exposed to the sun, it has a much more powdery appearance, is continuous, not cracked, and in this state closely resembles the *V. trachona*, Tayl. *Apothecia* numerous, crowded, black, at first entirely covered by the thallus and hemispherical, becoming more conical and naked at the apex, often with a minute papillated elevation; but as the pore becomes larger and open, this seems to disappear; frequently in exposed parts of the stone, the outer coat of the thallus falls away, leaving the apothecia much more prominent and rough, and attached only to the black substratum. *Perithecium* dimidiate, slightly incurved at the base. *Nucleus* brown, almost black when dry, in a thin black tunic. *Sporidia* in asci eight, small, pale, single-celled, ovate-oblong.

Hab. Limestone rocks, Babbicombe near Torquay, Devonshire.

The *Verrucaria trachona* described by Taylor in 'Flora Hibernica,' part 2. p. 93, is not, as is shown by Leighton (British Angiocarpous Lichens, p. 50), the *V. trachona* (Engl. Bot. Suppl.), but an undescribed species; and the *V. trachona* (Engl. Bot. Suppl.), which he supposes to be Acharius's, and like *V. lithina*, Tayl., is a *Pyrenothea*, and named by him *P. lithina*. Both these species are very different from the above, which is at once distinguished by the black substratum to the thallus; and the sporidia are ovate, single-celled, and not of a fusiform shape and four-celled, as is shown in the *V. trachona*, Tayl., by Leighton. From *Pyrenothea lithina* they are readily distinguished by the difference in their generic character.

V. parva. (Plate I. fig. 2.)

Thallus crustaceous, thin, ashy-gray, continuous, indeterminate, the surface minutely granulated; apothecia minute, globose, black, prominent; pore small, at length widely umbilicated; perithecium entire; nucleus brown, in a pale tunic; sporidia elliptical, two-celled, colourless.

Thallus thin, crustaceous, of a dull ashy-gray colour, becoming of a greenish-brown hue when moistened, spreading in continuous indeterminate patches; the surface, when seen with a magnifying power, rough with minute granular-looking points giving it a powdery appearance; the internal substance white, with green granules thickly scattered amongst it. *Apothecia* very small, numerous, scattered, full, black, globose, half immersed; pore scarcely visible, at length it is widely open and umbilicated, looking like a minute cup. *Perithecium* entire. *Nucleus* brown, in a pale tunic. *Sporidia* in asci eight, elliptical, two-celled, colourless.

Hab. Limestone rocks near Torquay, Devonshire.

This little Verrucaria may have been overlooked as a variety of *V. rupestris*, but its entire perithecium and two-celled sporidia distinguish it from that species; and its smaller globose apothecia, together with its two-celled sporidia, separate it from *V. murina*, Leight., which has much larger apothecia, and the sporidia are single-celled.

V. Leightonii. (Plate I. fig. 3.)

Thallus crustaceous, very thin, continuous, indeterminate, dark brownish-gray, somewhat powdery-looking on the surface; apothecia very small, black, hemispherical; pore minute, at length widely umbilicated; perithecium dimidiate, neither spreading nor incurved at the base; nucleus pale yellow, in a thin black tunic; sporidia ovate, two-celled, contracted at the septa, yellowish-brown.

Thallus very thin, continuous, indeterminate or limited, with a pale margin; the surface is even, but when seen through a magnifying power is minutely powdery-looking, with dark points; when dry it is a dull dark gray or mouse-colour, becoming darker and of an olive hue when moistened; beneath the outer coat and generally through the white substratum are scattered green granular bodies. *Apothecia* at first very small, prominent, hemispherical, without any distinct pore; at length the top becomes flattened, sunk, and has then, from the margins being elevated, the appearance of a Lecidea; when moistened it becomes more elevated from the swelling of the nucleus, and is roughish with slightly elevated points. *Perithecium* dimidiate, thin, covering half the nucleus, neither spreading nor incurved at the base. *Nucleus* pale yellowish-brown, hyaline when moist, in a thick black tunic. *Sporidia* in asci eight, ovate-oblong, more or less pointed or obtuse at the extremities, two-celled, and generally slightly contracted at the septa, dark yellowish-brown, the margin and septa darker.

Hab. Limestone rocks near the sea, Torquay, Devonshire.

This little plant appears to have been overlooked, or may have been mistaken for a species of *Lecidea*, which the apothecia in an old state resemble; but it will be seen from the description and illustration that its structure is that of a true *Verrucaria*; and it is named in compliment to the Rev. W. A. Leighton, the author of the 'British Angiocarpous Lichens,' in which he has pointed out the way to a more accurate knowledge and satisfactory investigation of the structure of Lichens and their distinctive specific characters.

V. ovata. (Plate II. fig. 4.)

Thallus crustaceous, dark dull olive-green, thin, terminated by a narrow black line cracked into angular areolæ; apothecia black, small, scattered, immersed, hemispherical, the apex becoming naked, depressed; pore minute; perithecium dimidiate, thick, incurved at the base; nucleus black, in a thin black tunic; sporidia ovate, single-celled, pale yellow, granulated.

Thallus thin, in irregular-shaped patches, terminated when growing with other species, which is generally the case, in a narrow, black, often indistinct margin; the surface a dull dark brownish-olive, even and smooth, more or less cracked into angular areolæ, which are not visible when the plant is moistened; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* immersed in the thallus, which swells about its base; the apex at length becomes naked, and more or less prominent, sometimes conical, but afterwards depressed or flattened; pore minute. *Perithecium* thick, clumsy-looking, and often so swollen and spreading at the base as to appear to entirely envelope the nucleus, but upon careful examination it is found wanting at the base, and the nucleus only separated from the stone by a thin black tunic. *Nucleus* black, becoming white and hyaline when moistened. *Sporidia* in asci eight, ovate, single-celled, pale yellow, granulated or clouded from the contained sporules.

Hab. Calcareous rocks near the sea, Torquay, Devonshire.

V. fugax. (Plate II. fig. 5.)

Thallus crustaceous, very thin, continuous or scattered, minutely scaly, fugacious, greenish-olive; apothecia minute, scattered, hemispherical, glossy black; pore minute, becoming umbilicated, large and open; perithecium dimidiate, incurved at the base; nucleus pale brown, in a pale tunic; sporidia ovate, single-celled, pale yellow.

Thallus crustaceous, very thin, spreading in indeterminate patches, continuous, or sometimes here and there cracked into minute areolæ, apparently soon falling away, leaving a few scattered scales especially about the apothecia, and then pulverulent; it is of a dull brownish-gray when dry, olive-green when moist; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* numerous, scattered, minute, hemispherical, prominent, glossy black, the base only immersed in the thallus; pore minute, becoming umbilicated, at length open, the top falling away, leaving the remains, a minute ring. *Perithecium* dimidiate, incurved at the base, and enveloping the nucleus except a small space at the bottom. *Nucleus* pale brown, white and hyaline when moist; tunic pale. *Sporidia* in asci eight, ovate, pale yellow, single-celled, often clouded from the contained sporules.

Hab. Calcareous rocks, Torquay, Devonshire.

V. perminuta. (Plate II. fig. 6.)

Thallus dark olive-green, thin, indeterminate, continuous, uneven, rugose and warty; apothecia scattered or crowded, minute, prominent, brownish-black, globoso-hemispherical; pore minute; perithecium dimidiate, incurved at the base; nucleus white, in a thin black tunic; sporidia fusiform, six-celled, pale yellow.

Thallus thin, in unequal-sized indeterminate patches of a dark olive-green, unchanged by moisture, sometimes of a brownish hue, uneven and somewhat warty, but smooth, not polished; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* scattered, sometimes several are crowded together, very small, scarcely visible to the naked eye, prominent, globose or hemispherical, black with a brownish hue, sometimes glossy. *Perithecium* dimidiate, incurved at the base, the pore very minute, often not visible, but in an old state it becomes large and open. *Nucleus* white, in a very thin black tunic. *Sporidia* in asci eight, fusiform, tapering at each end, pale yellow, six-celled, with five septa.

Hab. Rocks near the sea, Torquay, Devonshire.

Notwithstanding the close affinity in the general appearance and the structure of the thallus and apothecia with *V. trachona*, Tayl., the sporidia are very distinctly different; they are more tapering at the extremities, and have six cells and five septa, while in *V. trachona*, Tayl., they are obtusely pointed at the extremities, have four cells and three septa.

V. viridis. (Plate III. fig. 7.)

Thallus crustaceous, very thin, grayish-green, cracked into angular areolæ, indeterminate; apothecia small, scattered, black, at length depressed and umbilicated; perithecium prominent, dimidiate, neither incurved nor spreading at the base; nucleus white, in a pale tunic; sporidia elliptical, two-celled, yellow, granulated.

Thallus crustaceous, very thin, spreading in indeterminate patches of a dull grayish-green, becoming yellowish-green when moist and somewhat gelatinous, cracked when dry into angular areolæ, the internal substance scattered throughout with green granules. *Apothecia* minute, black, prominent, scattered, hemispherical, becoming depressed, and the minute pore widely umbilicated. *Perithecium* dimidiate, short, neither incurved nor spreading at the base. *Nucleus* white, and hyaline when moist. *Sporidia* in asci eight, elliptical, two-celled, yellow, and granulated with the ultimate sporules.

Hab. Red Sandstone rocks, Torquay, Devonshire.

The three following species, though not new, have not been, I think, fully illustrated.

V. plumbea, Ach. (Plate III. fig. 8.)

Thallus crustaceous, lead colour, terminated by a black margin cracked into small angular areolæ; apothecia small, black, subhemispherical, immersed, becoming half-protruded, depressed at the top; pore minute, rarely umbilicated; perithecium entire; nucleus pale brown or white; sporidia elliptical, single-celled, pale yellow.

Verrucaria plumbea, Ach. Lich. Univ. 285. Syn. 93; Fries, Lich. Europ. p. 438; Hook. Brit. Fl. ii. 153; Tayl. Fl. Hib. pt. 2. p. 91; Bohl. Lich. Brit. pl. 81.
Verrucaria cærulea, DeCand. Fl. Franc. ii. 318; Schær. Lich. Enum. 216. Exs. 102.
Lichen plumbosus, Sm. Eng. Bot. 2540.

Thallus crustaceous, rather thin, in irregular-shaped patches, terminated by a somewhat thickened black margin, the surface even or slightly rugged, of a bluish lead-colour, becoming in an old state darker and often brownish, cracked into small angular areolæ; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* numerous, scattered, one, sometimes two, in an areola, small, black, immersed in the thallus, becoming half-protruded, hemispherical, at length depressed, and a section shows them to be almost square; pore minute, occasionally becoming open and umbilicated. *Perithecium* entire. *Nucleus* white or pale brown, hyaline when moist. *Sporidia* in asci eight, elliptic ovate, single-celled, pale yellow, sometimes granulated.

Hab. Limestone rocks in various parts of Europe.

V. Gagei? Borr. (Plate III. fig. 10.)

Thallus crustaceous, thin, indeterminate, a dull gray or brownish-white, uneven, cracked into angular areolæ; apothecia minute, black, half-immersed, globose, becoming much larger, open and patelliform; perithecium entire; nucleus pale brown; sporidia oblong-ovate, four-celled, colourless.

Lichen Gagei, Sm. Eng. Bot. 2580.
Verrucaria Gagei, Borr. Hook. Eng. Fl. ii. 153.

Thallus thin, spreading in irregular-shaped indeterminate patches, whitish-gray, and generally with a brownish hue, cracked into small angular areolæ, the surface more or less uneven, not powdery; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* numerous, scattered, very minute, scarcely visible to the naked eye, black and polished, half-protruded, with an indistinct pore, globose or oblong. *Perithecium* thin, entire. *Nucleus* black when dry, but pale brown and hyaline when moist. *Sporidia* in asci eight, oblong-ovate, four-celled, with the septa colourless.

Hab. Sandstone rocks near Florence, Italy.

Such is the normal state of the apothecia, but by age they become much larger, the pore gradually expanding into the appearance of a small disc and minutely granulated, the margin of the perithecium forming an elevated border; but in this state I have not been able to find any sporidia in the asci, nor is the nucleus changed by moisture, as it is in the young state, but remains black; in some of the asci, in those apothecia which are not so fully expanded, I have found sporidia, and they are of a darker colour with the margin and septa brownish.

It is probable that the old state of the apothecia, as above described, was the reason why Sir J. Smith considered his plant an *Urceolaria*, and allied it to *U. Acharii*, to which they have a great resemblance; and it may have been also the reason why Fries was so doubtful respecting it (see Lich. Europ. p. 193). I have ventured to keep the name of *V. Gagei* for the above reasons; but in Leighton's Brit. Angio. Lich. p. 63, he says that "the specimens of *V. Gagei*, Borr., and *V. Harrimanni*, Ach., in *herb. Borr.*, showed only on section a black, flat perithecium, with a roundish-yellow spot underneath, no trace of asci or sporidia being discernible."

The sporidia resemble those of *V. prenophora*, Ach. (see Leight. Brit. Angio. Lich. p. 54. tab. 23), but the apothecia are very much smaller and of a different shape, and the perithecium is entire and not dimidiate as in that species.

V. Harrimanni, Ach. (Plate III. fig. 9.)

Thallus crustaceous, thin, mouse-coloured, continuous, terminated by a narrow black margin, the surface minutely dotted and powdery-looking; apothecia minute, black, immersed, the apex prominent; pore at length widely umbilicated; perithecium dimidiate, very short; nucleus pale brown, in a pale tunic; sporidia ovate, single-celled, colourless.

Verrucaria Harrimanni, Ach. Univ. 284. Syn. 93; Hook. Brit. Fl. ii. 153; Leight. Brit. Angio. Lich. 63; Schær. Lich. Enum. 216.

Verrucaria rupestris, *b*, Fries, Lich. Europ. 437.

Thallus crustaceous, thin, spreading in irregular-shaped small patches, terminating with a narrow black margin; the surface gray with a reddish hue, minutely dotted and powdery-looking when seen through a magnifying power; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* minute, scarcely visible to the naked eye, scattered, immersed; the apex black, slightly protruded, hemispherical or flattish; pore at first very minute, becoming open and umbilicated. *Perithecium* dimidiate, slightly immersed at the base. *Nucleus* pale yellowish-brown, hyaline when moistened, in a pale indistinct tunic. *Sporidia* in asci eight, ovate, very minute, single-celled, colourless.

Hab. Limestone rocks near Torquay, Devonshire.

SAGEDIA, Ach. (in part), Fries.

Apothecia enclosed within the thallus, globose or obovate. *Nucleus* gelatinous, deliquescing. *Perithecium* membranaceous, at length becoming black. *Pore* distinct, attenuated into a slender neck, dilated at the apex, perforated. *Thallus* horizontal, subcrustaceous or crustaceous.

S. ampullacea. (Plate IV. fig. 11.)

Thallus crustaceous, thin, indeterminate, greenish-gray, cracked into angular areolæ, slightly powdery on the surface, pale green when moist; apothecia numerous, scattered, immersed, black, ampullaform, the apex hemispherical, slightly protruded; perithecium entire; nucleus white; sporidia irregularly ovate or elliptical, large, granulated, single-celled, pale yellow.

Thallus spreading in large indeterminate patches of a greenish-gray, cracked into unequal-sized, variable-shaped, angular areolæ, the surface when magnified having a powdery or minutely warty appearance; when moistened it becomes of a bright yellowish-green, and somewhat gelatinous-looking; beneath the outer coat is a green granular layer upon a white substratum. *Apothecia* numerous, scattered, immersed in the thallus, and forming a cavity in the mortar beneath it, of a medium size and ampullaform shape; the apex small, hemispherical, slightly protruded, black, with a depressed central pore slightly thickened at the top of the constricted neck. *Perithecium* thickish, entire, tough, black. *Nucleus* white, hyaline when moist, in a pale thin tunic, scarcely visible. *Sporidia* in asci eight, large, ovate, oblong, obovate or elliptical, single-celled, pale yellow, granulated.

Hab. Growing on the plaster of an old gate-post near Ilsham, Torquay, Devonshire.

S. calcarea. (Plate IV. fig. 12.)

Thallus crustaceous, thin, hard, continuous, indeterminate, pinkish-gray, dusty-looking on the surface; apothecia small, entirely immersed, the apex naked, globose, contracted into a narrow neck; perithecium entire; pore slightly umbilicated; nucleus dark brown; sporidia brownish-yellow, large, oblong, two-celled, granulated, contracted in the middle.

Thallus spreading in large indeterminate patches, hard and stone-like, continuous; the surface smooth, even, and when seen through a magnifying glass appearing dusty, of a pale pinkish-gray, sometimes quite pink, becoming of a brownish hue when moistened; beneath the outer coat is a green layer of minute granules upon a hard white substratum. *Apothecia* scattered, entirely sunk in the thallus, of a globose shape, contracted at the top into a narrow neck; the apex small, naked, but not elevated above the thallus, obtuse, with a small, more or less umbilicated pore. *Perithecium* entire, thickish, tough, black. *Nucleus* black, becoming blackish-brown when moistened, and with black granules mixed amongst it. *Sporidia* in asci eight, large, oblong obtuse, two-celled, slightly contracted at the septa, granulated, of a pale brownish-yellow colour.

Hab. Limestone rocks, Torquay, Devonshire.

S. marina. (Plate IV. fig. 13.)

Thallus crustaceous, subgelatinous when moist, smooth, continuous, dark greenish-black, terminated by a narrow black margin; apothecia very small, numerous, scattered, immersed, the apex slightly elevated; pore minutely papillated; perithecium entire, black, submembranaceous; nucleus black, yellowish and hyaline when moist; sporidia minute, ovate-oblong, single-celled, colourless.

Thallus spreading in large, continuous, smooth, even, irregular-shaped patches of a dark greenish-black, becoming of an olive hue when moistened; the surface is somewhat polished, occasionally slightly pitted, at other times with minute elevated points; generally it is perfectly continuous, but in those specimens grown upon rocks less frequently covered by the sea it is cracked; the internal substance when dry is similar in appearance to the outer, but when moistened it is a yellowish-green, darker towards the surface, semitransparent, and of a subgelatinous texture. *Apothecia* very minute, not visible to the naked eye, immersed in the thallus, of an obovate or oblong shape; the apex slightly elevated above the surface of the thallus, depressed in the middle, having a central minutely papillated pore. *Perithecium* entire, thin, submembranaceous, black; when dry almost colourless, when moist more or less contracted towards the top into a neck. *Nucleus* when dry almost black, pale yellowish-brown and hyaline when moist. *Sporidia* minute, ovate-oblong, single-celled, colourless, containing one, two, or three granules.

Hab. Rocks submerged by the sea at high-water, Meadfoot, &c., near Torquay, Devonshire.

EXPLANATION OF PLATES I. II. III. AND IV.

Fig. 1. *Verrucaria neglecta*, Deak.:—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia magnified; *e*, apothecium with its papillated apex; *f*, the same with the apex fallen away; *g*, vertical section of the same; *h*, sporidia greatly magnified.

Fig. 2. *Verrucaria parva*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, apothecium magnified; *f*, vertical section of the same; *g*, sporidia greatly magnified.

Fig. 3. *Verrucaria Leightonii*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, vertical section of apothecium magnified; *f*, sporidia greatly magnified.

Fig. 4. *Verrucaria ovata*, Deak. :—*a*, in a dry state; *b*, slightly magnified; *c*, vertical section of thallus and apothecia; *d*, vertical section of apothecium magnified; *e*, sporidia greatly magnified.

Fig. 5. *Verrucaria fugax*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, vertical section of apothecium magnified; *f*, sporidia greatly magnified.

Fig. 6. *Verrucaria perminuta*, Deak. :—*a*, in a dry state; *b*, slightly magnified; *c*, vertical section of thallus and apothecia; *d*, vertical section of apothecium magnified; *e*, sporidia greatly magnified.

Fig. 7. *Verrucaria viridis*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, vertical section of apothecium magnified; *f*, sporidia greatly magnified.

Fig. 8. *Verrucaria plumbea*, Ach. :—*a*, in a dry state; *b*, slightly magnified; *c*, vertical section of thallus and apothecia; *d*, vertical section of apothecium magnified; *e*, sporidia greatly magnified.

Fig. 9. *Verrucaria Harrimanni*, Ach. :—*a*, in a dry state; *b*, slightly magnified; *c*, vertical section of thallus and apothecia; *d*, sporidia greatly magnified.

Fig. 10. *Verrucaria Gagei*? Borr. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, vertical section of apothecium magnified; *f*, vertical section of an old apothecium; *g*, apothecium in a perfect state; *h*, apothecium in an old state; *i*, sporidia greatly magnified.

Fig. 11. *Sagedia ampullacea*, Deak. :—*a*, in a dry state; *b*, slightly magnified; *c*, in a moist state; *d*, vertical section of thallus and apothecium; *e*, vertical section of apothecium; *f*, sporidia in ascus; *g*, sporidia greatly magnified.

Fig. 12. *Sagedia calcarea*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, slightly magnified; *d*, vertical section of thallus and apothecia; *e*, vertical section of apothecium; *f*, sporidia greatly magnified.

Fig. 13. *Sagedia marina*, Deak. :—*a*, in a dry state; *b*, in a moist state; *c*, vertical section of thallus and apothecia; *d*, *e*, vertical sections of apothecia in a moist state; *f*, vertical section of apothecium in a dried state; *g*, sporidia highly magnified.

VI.—*Account of a MS. of Laurence Theodore Gronov lately purchased for the British Museum, with a Collection of Dry Fish which it describes.* By John Edward Gray, Ph.D., F.R.S., V.P.Z.S.

A box of dry skins of fish arranged between sheets of cartridge paper like a collection of dry plants, said to be accompanied by a MS. description, was offered for public sale in a collection of objects of *vertu* in Bond Street.

At the time of the sale and while on view the MS. could not be found; however, as a slight examination of the specimens showed they were a partially named collection of about the time of Gronov (better known by his Latinized name of Gronovius), who was, without doubt, one of the best ichthyologists of the latter part of the last century, and by a person who used the names which he had introduced, and I found there were sundry Dutch names on the specimens, and the paper of Dutch manufacture, I considered the collection even without the MS. would be an advantageous purchase.

The day after the sale the MS. was found and delivered, and I was much pleased to find it consisted of 120 separate sheets of gilt-edged quarto letter paper, containing the generic and specific characters and detailed descriptions of the new species in the collection, with a reference to their synonyma, illustrated with 84 similar sheets, consisting of original drawings of the more important species, some engravings extracted from Gronovius's 'Museum Ichthyologicum,' and some of the original drawings from whence other figures in that work and the 'Gazophylacium' of the same author had been engraved.

A careful examination of the MS. convinced me that it must have been written by that author, and was a revision and extension of his other works on Ichthyology, and must have been prepared between 1774 and his death in 1777. I am led to this conclusion from the following reasons:—

1. In referring to the works of other authors the name precedes the reference, but in referring to the 'Museum Ichthyologicum' and the 'Gazophylacium' (which is referred to throughout the whole MS.) the name is always omitted, and only the title of the work cited.

2. Under the genus "*Teuthis Linnæa*" the author refers as a synonym to "*Hepatus nobis*," and this genus was established by Gronovius in the 'Zoophylacium,' *n*. 352.

3. The style of the work exactly agrees with that of his preceding works, and the author uses the technical terms peculiar to him, and explained in the 'Museum Ichthyologicum.'

4. The new species are fully described; but when the species is described at length in the 'Zoophylacium,' he only refers to the page where it is to be found.

But all doubt of the authorship was set at rest by observing that in several instances the author states at the end of the species, "Descripsi in Zoophylaceo, p. 113. n. 362," and once, "Descriptionem exhibui in Zooph. p. 24."

If there had remained any doubt I might have added, the paper has the same water-mark as the paper used in the printed work above referred to, the possession of the original drawings engraved in those works, and other particulars.

I fixed the date above given, because several of the drawings are marked "De la Targue genaannd van Nieuwland ad vivum del. 1774," so that it could not have been prepared before that year, and one is marked "J. J. Byland 1768." Gronovius died in 1777.

Since the above account was prepared, I have discovered the following paragraph in the preface to Meuschen's 'Museum Gronovianum,' according to which the collection of M. Laurence Theodore Gronov was sold by public sale on Wednesday the 7th of October and subsequent day, 1778.

I do not find the MS. and collection referred to in the sale, so that it was probably kept by the family, and from the appearance of the box and the padlock on it which contained the collection, it appears doubtful if it has been more than cursorily examined since that period. The key appears to have been lost, as the box has evidently been forced open.

Speaking of the former possessor of the collection, he observes— "Ingens studium per omnem fere vitam præcipue nuper Defunctus hujus Thesauri Possessor collocavit in excolenda *Ichthyologia*, suique indefessi laboris specimina abunde præbuit in *Musæo Ichthyologico* ante viginti annos edito, et in primo sui *Zoophylacii* fasciculo a 1763, in lucem emisso; unde præ ceteris hæc Musæi Gronoviani pars Naturæ Curiosorum alliciet attentionem: *tanto magis, quum in eadem Parte Regni Animalis perficienda ad mortem suam usque incredibili diligentia perrexerit; quemadmodum docuit novum Systema Ichthyologicum MS. ab Eo relictum, inque scriniis Ejus inventum, in quo multorum Piscium imagines à præstantissimis artificibus depictæ exstant, neque pauci exsiccati Pisces novo huic operi sunt inserti, quos, licet in Musæo et Zoophylacio Gronoviano sint descripti, frustra ideo in hoc Elencho quærent Historiæ Naturalis cultores.*"

The MS. contains the following genera which are not in the 'Zoophylacium'; the numbers are those in the MS.:—

5.	Pastinaca	= Myliobates, *Dum.*
6.	Torpedo	= Temera, *Gray*, and Narke, *Kaup.*
7.	Squalina	= Squatina, *Dum.*
12.	Holocanthus	= Ostracion § 3. *Zooph.* = Diodon, *Linn.*
19.	Callionymus.	
22.	Cestrus	= Sciæna, *Cuv.*
24*.	Boops.	
27.	Sargus	= Ephippus, *Cuv.*
29.	Gonopterus	= Chelmon, *Cuv.*

35. Adonis	=	Blennius, *Cuv.*
42. Gonocephalus	=	Dactylopterus, *Lacep., Cuv.*
46. Scorpæna	=	Scorpæna, *Cuv.*
47. Sarda	=	Caranxomores, *Lacep., Cuv.*
48. Thynnus	=	Centronotus, *Cuv.*
49. Trachurus	=	Caranx, *Cuv.*
52. Merlucius	=	Merlucius, *Cuv.*
71. Chromis	=	Sciæna?
79. Cephalinus	=	Agriopus, *Cuv.*
81. Trichopterus	=	Cirrhites, *Comm., Cuv.*
82. Cordylus	=	Scomber, *Cuv.*
84. Orthagoriscus	=	Orthagoriscus, *Schn.*
85. Lepturus	=	Macrourus, *Bloch, Cuv.*
87. Elops	?	
89. Pteracles	=	Pteraclis, *Cuv.*
91. Dascilus	?	
93. Holocentrus	=	? Holocentrum, *Cuv.*
94. Amia	=	Apogon, *Lacep., Cuv.*
95. Stethochætus	=	Trichopus.
97. Cæpola	=	Cæpola.
102. Acronurus	=	Acanthurus, *Lacep., Cuv.*

All these genera are fully characterized.

Lacépède commenced his work on Fish in 1798, and finished the last volume in 1803. *Bloch* published his large work on Fish between 1785 and 1796, and *Schneider* his Synopsis of Bloch in 1801; so that all these authors published their works after the death of *Gronov* in 1777. And all these genera would have had priority, if the publication of the MS. had not been prevented by his death.

It is to be feared that the MS., and perhaps the collection, is not quite complete, as left by the author, though some part of the imperfection in the MS. may have been occasioned by its not having been completed at his death, as is proved by the absence of any description to the genus *Mystus*, and the unfinished state of the description of *Dascilus* and some others.

The imperfections are supposed, because some person, evidently not the author, or one well conversant with the subject, has marked the genera in the MS., which had never been sewed together, with a consecutive number, and the number of illustrations which accompany each genus; the same number is also marked on the cover; and on most of the separate papers containing the specimens the generic numbers are often also marked with a page, as if referring to the pages of the MS., but they are not paged, and do not agree with the pages which now exist.

It is evident that these numbers are an addition after the MS.

had left the hands of the author, for they are written in quite a different hand. The generic names are in one or two instances incorrectly written, and the numbers on the specimen pages are often very carelessly placed on the wrong end of the paper, so that the fish are seen on their back when the numbers are read; and they are frequently equally carelessly placed over the name of the specimen written by the hand of the author in pencil on each of the papers. Unfortunately these names, as well as being so written over in a few instances, have been obliterated by the dust and rubbing of the papers against the sides of the box; but the illustrations generally enable one to determine the specimens where the name has been so destroyed.

The specimens are prepared after the manner described by the uncle of the author, John Frederic Gronov, in a paper published in the 42nd volume of the 'Philosophical Transactions.' They are in a very good condition, showing that the plan is one well adapted for the purpose of a collection of the smaller species of fish.

VII.—*A Catalogue of the Species of Ants found in Southern India.* By T. C. Jerdon, Esq., Assistant Surgeon, Madras Medical Establishment *.

I have been induced to pen the following brief account of the Ants I have met with in Southern India, more with the view of stimulating others to record their observations on any species they may meet with, than under a sense of the value or completeness of the remarks contained herein. But no one, as yet, having taken the initiative, I trust that any errors in the accompanying paper will be pardoned by the scientific entomologist at home, and that the meagre details I have given will be improved and rendered more faithful and complete by observers in this country.

To assist any observers in this country, who may be able and willing to aid science on this subject, I shall here present them with a view of the classification of these interesting insects by modern entomologists, so that they may be able, in describing one which is deemed a novelty, to refer it to its place in the system, even if its real genus be not satisfactorily made out, which I fear will be too often the case, as I have experienced in my attempts at naming those described in the following pages.

Latreille, in the 'Règne Animal' of Cuvier, places Ants as part

* Extracted from the 'Madras Journal of Literature and Science' for 1851, by Frederic Moore, Assistant, Museum, East India House.

of the family of the Heterogynes, of the section *Aculeata* of the order Hymenoptera, and divides them as follows:—

1st. *Formica*, without sting, the antennæ inserted near the forehead, and with triangular jaws; abdominal pedicle of only one knot or scale.

2nd. *Polyergus*, also without a sting, but with the antennæ inserted near the mouth, and the jaws narrow, arched or bent; abdominal pedicle also of one knot.

3rd. *Ponera*, neuters and females with a sting; abdominal pedicle of one knot; antennæ thicker towards the end; jaws triangular; head somewhat triangular.

4th. *Odontomachus*, differs from the last in the one abdominal pedicle ending superiorly in a spine; antennæ very slender and filiform in the neuters; head oblong, much notched posteriorly; jaws long, narrow, parallel, three-toothed.

5th. *Myrmica*, with sting; abdominal pedicle with two knots; jaws triangular; maxillary palpi long.

6th. *Atta*, differs from the last only in its short palpi; head of neuters usually very large.

7th. *Cryptocerus*, also with a sting; two knots in the abdominal pedicle; head very large and flattened, with a cleft on each side to lodge part of the antennæ. (Peculiar to South America.)

St. Fargeau, in the 1st volume on the Hymenoptera in the 'Suites à Buffon,' divides the Ants thus:—

1st Tribe. *Les Myrmicites*, females with a sting; 1st segment of abdomen of two knots. This includes the following genera: 1st, *Cryptocerus*; 2nd, *Atta*; 3rd, *Ocodoma*; differing from *Atta* in its larger head, and the presence of spines. 4th, *Myrmica*.

2nd Tribe. *Les Ponerites*, females with sting; 1st segment of abdomen of one knot only. It includes the genera *Odontomachus* and *Ponera*.

3rd Tribe. *Les Formicites*, females without a sting; 1st segment of the abdomen of one knot only. It contains the genera *Polyergus* and *Formica*.

It will be shortly seen that many of our ants cannot be well referred to any of these genera; but as it is probable that some new genera have been formed by recent writers, I shall in general content myself with referring most of my species to one or other of those here characterized.

Following the arrangement of St. Fargeau, we have first the tribe of *Myrmicites*, and the first genus mentioned by him, *Cryptocerus*, being American exclusively, we come to the genus *Atta* of Latreille, from which St. Fargeau has separated *Ocodoma*, the chief distinction being the spines which exist either on the head or thorax of the latter, which, moreover, is said to have the head of variable size, whilst in *Atta* it is said to be usually not of a large size. We have in India species belonging apparently to both groups, which I shall now endeavour to describe.

1st Tribe. Myrmicites.

Genus Atta.

I possess six species of Ants, all of small size, which appear to belong to this genus, having a sting, two knots in the first segment of the abdomen, antennæ not concealed in a cleft, thorax without spines, and short palpi.

1. *Atta minuta*, Jerdon (p. 105).

Worker barely $\frac{1}{12}$th of an inch long; head oblong; eyes minute, advanced; thorax narrow; abdominal pedicles long, narrow, the first much more raised than the second; antennæ gradually thickening, of a rufous colour, with the abdomen somewhat darker or fuscous. Female about $\frac{1}{3}$rd of an inch long, similar in form to the worker; abdomen larger proportionally, and head smaller.

This minute species makes a temporary nest in various situations—in an empty box; between the back of a book and its leaves; even among the loose pages of a book; in an empty shell, &c. Nothing is used in its construction, a shelter from the light merely being sought for. It is perhaps not very numerous in individuals; one wingless female is generally found in the nest. It is very common in the Carnatic and most of India, but I have not seen it in Malabar. It appears to prefer dead animal matter to saccharine or vegetable products.

2. *Atta destructor*, Jerdon (p. 105).

Worker about $\frac{5}{48}$ths of an inch long; head oblong, not so long in proportion as in the last; eyes small, more medial than in the last; antennæ short; thorax narrow, slightly grooved; abdominal pedicles long, narrow, first higher than the second; abdomen oval; colour rufous; abdomen glossy brown. I have not seen the female.

They live in holes in the ground or in walls, &c., and are very numerous in individuals. They prefer animal to vegetable substances, destroying dead insects, bird skins, &c., but also feed greedily on sugar. They are very common in all parts of India, and often prove very troublesome and destructive to the naturalist.

3. *Atta domicola*, Jerdon (p. 106).

Worker about $\frac{1}{6}$th of an inch long; head oblong; eyes moderate size, medial; antennæ rather long; jaws strongly 4-toothed;

thorax very slightly notched; abdominal pedicles narrow, first much raised, second slightly so; abdomen ovate; legs longish; head, thorax and legs deep red-brown; abdomen blackish.

This species of Ant does not seem to be common. I have only hitherto procured it at Nellore in a hole in a house, and I only saw one kind of individual.

4. *Atta rufa*, Jerdon (p. 106).

Worker $\frac{1}{6}$th to $\frac{1}{8}$th of an inch long; head short, oblong; eyes rather small, medial; antennæ rather short, with the two last joints much enlarged; jaws linear, oblong, strongly toothed; thorax slightly grooved; first abdominal pedicle lengthened, narrow in front, wide behind and much raised; second broader, not so high, of a uniform glossy rufous colour, with the end of the abdomen somewhat darker.

Warrior variable, about $\frac{1}{4}$th of an inch long; head large, very square, slightly notched behind, smooth; eyes advanced, lateral; jaws oblong, quite entire, blunt; antennæ short, otherwise as in the ordinary worker. Female about $\frac{7}{24}$ths of an inch long; head small, diamond-shaped; eyes very large, three large ocelli on the top of the head; antennæ *not* geniculate, short, all the joints nearly equal; thorax thick in front, depressed behind; abdomen long, oval; wings reach beyond the abdomen.

This ant is the only one of the true *Atta* that has two kinds of neuter individuals, and in its form and general habits it approaches much to the next genus, *Ocodoma*; but as it wants the spines on the thorax, I have referred it to *Atta*. It is very common in Malabar, but is also found in the Carnatic; it is found in holes under ground, about gravel walks, mud walls, and often appears in houses, coming through a crevice in the floor or wall. There is a colony of them in my bathing-room, and every now and then vast numbers of the winged females (and males) issue forth just before sunset, attended as far as the window by swarms of the neuters of both kinds. Its favourite food is dead insects and other matter, but it also carries off seeds like the *Ocodoma*, as I know to my cost, chaff, &c. It stings very severely, leaving a burning pain that lasts for several minutes.

5. *Atta dissimilis*, Jerdon (p. 107).

About $\frac{1}{10}$th of an inch long; head oblong, rounded; eyes moderate; antennæ suddenly thickening at the last joint; thorax very slightly grooved; abdominal pedicles narrow above, both equally raised, first rather more conic than the second; abdomen long, oval, colour blackish throughout. I have only found this ant in small numbers on trees in Malabar.

6. *Atta floricola*, Jerdon (p. 107).

Worker not $\frac{1}{17}$th of an inch long; head oblong, square; eyes small, advanced; jaws linear, pointed; antennæ very short, last joint suddenly enlarged; thorax very slightly grooved; abdominal pedicles about equal, narrow, raised; abdomen long, oval; thorax and legs dark rufous; head and abdomen glossy dark brown.

I have obtained this very small ant, of which I have only seen one kind of individual, in small numbers on flowers and leaves at Tellicherry, and it appears to feed solely on vegetable secretions.

Genus Ocodoma.

We now come to a set of Ants extremely numerous over all India, and comprising several species very nearly alike, and probably confounded together by those who have not examined them thoroughly. Almost all the species that I have seen have two kinds of neuters, one of them of very large size compared with the ordinary workers, and which are usually called warriors. Some points in the history of the œconomy of these Ants have caused much interest among naturalists at home with regard to the food of these little creatures. The chief distinction of *Ocodoma* from *Atta* consists in the former having some small spines on the thorax.

7. *Ocodoma malabarica*, Jerdon (p. 107).

Worker $\frac{1}{8}$th of an inch long; head oval; eyes moderate; jaws rounded, triangular, pointed and finely serrated; antennæ long and slender; thorax doubly notched and with some small tubercles, especially two in the usual situation of the thoracic spines; first abdominal pedicle small and conic, second large, rounded; head, thorax and legs rufous; abdomen blackish; legs long.

Warrior $\frac{1}{4}$th of an inch long; head enormous, rugose, striated, deeply notched behind; eyes minute, advanced, lateral; jaws triangular, bluntly toothed, and with an appendage at the base; thorax very rough, tubercled, with two minute rudimentary spines; first abdominal pedicle small, narrow, barely raised; second large, broad, raised, rounded; antennæ short; antennæ, legs and abdominal pedicles rufous, the rest of the body blackish.

This species of Ant appears to form a link between the two genera *Atta* and *Ocodoma*, as shown by the rudimentary state of the thoracic spines. I have found it chiefly about houses; it runs rapidly, lives both on insects and other animal matter, and on sugar, bread, &c. At first sight I mistook it for a small species of *Formica*, mentioned hereafter, *F. vagans*.

8. *Ocodoma providens* (Sykes ?), Jerdon (p. 108).

Worker about $\frac{1}{7}$th of an inch long; head somewhat ovate, bulging slightly at the sides and narrowed behind, notched posteriorly and with two points, rough and granular; eyes moderate, central; thorax slightly grooved, with two small spines on its posterior angles; first abdominal pedicle pointed, second longer, broader and rounded. Warrior with jaws pointed and finely toothed; thorax very rough. Length $\frac{1}{4}$th of an inch; head large, otherwise similar.

I am by no means certain if this be Sykes's species or not, and indeed, without actual comparison, it would be very difficult to determine, so similar are the general features of these small ants, of which I possess four very closely allied species from Southern India, and have only collected these from two or three localities; so that many other allied species may still exist.

The habits and manners of all are very similar. They live under ground, making for their size a large series of excavations. Their common food I suspect to be animal matter, dead insects, &c., which at all events they take readily, but they also carry off large quantities of seeds of various kinds, especially the small grass seeds, and, as every gardener knows to his cost, more especially garden seeds. They will take off cabbage, celery, radish, carrot and tomato seeds, but are particularly partial to the light lettuce seeds; and in some gardens, unless the pots in which they are sown be suspended or otherwise protected, the whole of the seeds sown will be removed in one night. I have also had many packets of seeds (especially lettuce) in my room completely emptied before I was aware that the ants had discovered them. I do not know, however, if they eat them or feed their larvæ on them, though for what other purpose they carry them off I cannot divine. I have often observed them bring the seeds outside their holes, as recorded by Colonel Sykes, and this, I think, generally at the close of the rainy season; but in some cases I had reason to believe that it was merely the husks, of which I have seen quite heaps, and that the ants did not take them back to their nests. If any of the forementioned seeds be sown at once in a bed, most likely in the morning you will find the surface of the whole spot covered over with little ridges, the work of these creatures, and the few seeds that perhaps remain, dug all round, and being carried off, sometimes above ground, at other times under ground. Their galleries and subterranean passages are often very extensive, and it is no easy matter to dig down to their nest to see what becomes of the seeds. I have not procured the male or female of this species.

9. *Ocodoma diffusa*, Jerdon (p. 109).

Worker about $\frac{1}{8}$th of an inch long; head somewhat oval, nearly smooth, with a few scattered granules, slightly emarginate behind; eyes moderate size; thorax deeply grooved, with two small spines posteriorly; first abdominal pedicle very pointed, conic, second rounded, of equal height; head, thorax and legs rufous; abdomen brown.

Warrior $\frac{1}{4}$th of an inch long; jaw strongly toothed; head large, much striated, deeply notched behind; thorax more deeply grooved and tubercled; otherwise as in the worker. This species appears to be spread over most of India, and has similar habits to the last.

10. *Ocodoma diversa*, Jerdon (p. 109).

Worker about $\frac{7}{28}$ths of an inch long; head oblong, nearly smooth, emarginate behind; eyes small; jaws triangular, toothed; thorax but slightly grooved and with two longish spines posteriorly; first abdominal pedicle broadly conic, second rounded; head, thorax and legs dark maroon; abdomen blackish.

Warrior nearly $\frac{1}{2}$ an inch long; head very large, nearly smooth, slightly striated; jaws lancet-shaped, entire; eyes small, somewhat advanced; antennæ short; otherwise as in the worker. I procured this ant in the Wynaad, where it is not uncommon. The difference between the worker and the warrior is greater than in any other Indian species.

11. *Ocodoma affinis*, Jerdon (p. 110).

Worker $\frac{1}{8}$th of an inch long; head nearly square, almost smooth, with only a few striæ; eyes nearly medial, smallish; jaws triangular, with two strong teeth at the external angle of the jaw, and two smaller at the internal angle; thorax very slightly grooved, with two curved spines posteriorly; first abdominal pedicle very narrow, long, conic posteriorly, not much raised; second rounded, of equal height, broader; head, legs and thorax rufous; abdomen dusky.

Warrior nearly $\frac{7}{16}$ths of an inch long; head and jaws striated; eyes very minute; head notched anteriorly; antennæ inserted in a deep groove; metathorax elevated; no palpi apparently.

This ant is very common in Malabar; is nearly allied to, but differs from, *O. diversa* in the toothed jaws of the warrior, &c.

12. *Ocodoma minor*, Jerdon (p. 110).

Worker about $\frac{5}{48}$ths of an inch long, entirely rufous; head oblong, smooth; eyes small; jaws long, somewhat triangular, toothed, last tooth prolonged; thorax slightly grooved, with two small spines in its posterior extremity; abdominal pedicles slightly raised, first long, conic, second rounded, both narrow above.

Female $\frac{5}{8}$ths of an inch long; head nearly square, slightly notched behind, three ocelli on top of head; eyes large, medial; head striated, with a hollow for the base of the antennæ; jaws triangular, bluntly toothed at the two angles; antennæ short; thorax much raised anteriorly, and with two small posterior spines; abdomen long, oval, large.

I, on one occasion only, found a single individual, which I presume to be the female (which had lost her wings), under a stone in my garden at Tellicherry, surrounded by numerous workers who were busy tending her, and removing some eggs or larvæ. It is the only female I have seen of this genus, and is well characterized by its large eyes and ocelli.

13. *Ocodoma quadrispinosa,* Jerdon (p. 111).

Worker nearly $\frac{1}{8}$th of an inch long; head smooth; eyes small; thorax with two small spines anteriorly, and two large curved spines posteriorly; first abdominal pedicle long, raised, rounded behind; second also rounded, blunter, of equal height; head, legs and thorax dark rufous; abdomen blackish brown.

I have not seen the warrior (if any) of this race, which I found during the monsoon forming a small temporary mud abode round the head of flowers of a species of *Leucas* abundant in Malabar. It appeared to be feeding on the vegetable secretions surrounding the seeds.

Of these seven species of *Ocodoma* the first and last are very distinct from all the others, the first by having only rudimentary spines, and the last by having four spines instead of two. *Ocodoma minor* is easily recognized by its smaller size; and the other four are most readily distinguished by the jaws of the warriors, which in *diversa* is entire, in *affinis* with two teeth at each angle, in *diffusa* with moderately strong teeth throughout its extent, and in *providens* with the jaw very finely toothed.

Genus Eciton.

The characters of this genus are thus given by St. Fargeau: "Antennæ entirely free, head elongated, and the thorax without spines; maxillary palpi long, of six joints; jaws linear; wings unknown." I have got four species of ants which perhaps may be ranged under this genus, of which only one species is described, and that from South America; but it is more than probable that they will form a new genus, to which however I will not attempt to impose a name. My species have a long slender body, oblong head, large eyes, short antennæ, inserted very near the mouth, linear or oblong jaws, and sting very severely.

14. *Eciton? rufonigrum*, Jerdon (p. 111).

Worker, length about $\frac{11}{24}$ths of an inch; head square; antennæ short, first joint thickened; very long palpi; eyes large, lateral, posterior; jaws somewhat linear, oblong, with two strong teeth at the external angle, and bluntly toothed in the rest of its extent; thorax slightly grooved; abdominal pedicles very little elevated, first very long; abdomen long, ovoid; thorax, legs, abdominal pedicles and antennæ rufous; head and abdomen black. This ant is very common in the Carnatic, less so in Malabar. It makes its nests in holes of trees, old palings, bamboo rafters, and such like; it does not care for sweets, is never seen on flowers, but devours dead animal matter. I have not seen the female. It stings very severely.

15. *Eciton nigrum*, Jerdon (p. 112).

Worker, length $\frac{9}{24}$ths of an inch; head long; eyes large, medial; antennæ short, the first joint not being so long as the head; jaws somewhat square, bluntly toothed; thorax low, barely grooved; both abdominal pedicles rounded, low; abdomen long, oval; sting very large. Colour uniform black. Female, length $\frac{11}{24}$ths of an inch; differs from the worker only in having wings. This ant, like the last, is rare in Malabar, but tolerably common in parts of the Carnatic; it has the same habits as the last, living in holes of trees, &c., and feeds on the same matter. I have found, on cutting open a dead branch on which they had formed their nest, many winged females, and larvæ and pupæ in different states of development.

16. *Eciton rufipes*, Jerdon (p. 112).

Worker, length $\frac{11}{48}$ths of an inch; head oblong; eyes very large, slightly advanced; thorax considerably grooved; abdominal pedicles long, low; abdomen long, ovate, black, with rufous legs.

I have only found this species on one occasion under a stone in the Salem district, and know not if it has the dendrophilous habits of the two last.

17. *Eciton minutum*, Jerdon (p. 112).

Worker about $\frac{1}{6}$th of an inch long, black throughout, very slender; legs rather thick; palpi much exposed. I regret that I have not at present a specimen of this little ant to describe from more fully. Its general structure, however, is exceedingly similar to that of its congeners, from which its small size sufficiently distinguishes it. I have found it both in the Carnatic and in Malabar, almost always on trees, but do not know if it has its nest in holes of the wood or otherwise. Though scarce in individuals, it is by no means rare, and I hope to be able to describe it more fully hereafter.

Genus Myrmica.

Gen. Char. Antennæ sufficiently exposed; head triangular, without spines; maxillary palpi long, of six joints; jaws triangular; three cubital cells in the upper wings, the third incomplete, &c. Such are the characters assigned to this genus by modern authors. Whether the following species all belong to this genus or not, I cannot decide, but judging from their differences, I imagine that they form at least three groups.

In the first group I shall place two or three nearly allied species, one of which has already been described by Col. Sykes as a *Myrmica*, so that it may be considered the typical group. Of this I have what I imagine to be three species, but all very closely allied to each other.

18. *Myrmica diffusa*, Jerdon (p. 113).

Worker rather more than $\frac{1}{9}$th of an inch long; head wider than thorax, oblong, triangular, striated; antennæ rather short, basal joint barely longer than the head, inserted near the mouth; eyes large; thorax notched, with two small spines on the posterior angles, curving backwards; first abdominal pedicle longish, somewhat heart-shaped, excavated, second obovate, both very slightly raised; abdomen triangular; head and body rufous; abdomen dark glossy brown.

Female, head not wider than the thorax, which is not spined; length $\frac{5}{12}$ths of an inch; wings not so long as abdomen.

Male, head very small; eyes large; antennæ with the first joint not elongated; no spines on thorax, which is much raised; wings reach beyond abdomen; length $\frac{1}{7}$th of an inch.

This is a well-known and widely diffused species, being found throughout India. It makes its nest in holes in branches of trees, runs with its abdomen turned upwards almost over its head, especially when excited, and feeds on honey and other vegetable secretions. Occasionally they appear to join their nest among the roots of moss, orchideæ, and various epiphytic plants; at least this is the case in Malabar, and I cannot detect any marked difference of species, although it is possible that the two races may be distinct. It is very pugnacious, and bites very severely, not appearing to use its sting much.

19. *Myrmica rufa*, Jerdon (p. 114).

Worker, length $\frac{9}{48}$ths of an inch, head shorter proportionally, and eyes larger; thoracic spines longer, straighter; first abdominal pedicle longer and less raised than in the last; entirely of a rufous colour.

This is a very closely allied species and is found in the same localities as the last. Had I found it in a different tract of country, I should have perhaps considered it as a climatal variety, but its large size and the few points enumerated above lead me to view it as distinct. Its habits are similar.

20. *Myrmica Kirbii* ? (Sykes*), Jerdon (p. 114).

Is very closely allied to the two last; has its thorax larger, rough, and much ridged; its thoracic spines larger; first abdominal pedicle somewhat diamond-shaped, second heart-shaped; the abdomen strongly ridged longitudinally; head, thorax and legs dark maroon; abdomen dark brown. Length $\frac{7}{48}$ths of an inch.

I have found this species chiefly in the elevated forests of the Wynaad; I cannot say that I have met it below the Ghauts. It forms a considerable nest of some papyraceous materials, usually of an oval form, and placed round a small branch which supports it. It is very numerous in individuals, countless swarms issuing from it on being disturbed, and boldly attacking the assailant both with teeth and sting. It feeds on honey of flowers and other vegetable secretions.

21. *Myrmica fodiens*, Jerdon (p. 115).

Worker, length $\frac{4}{12}$ths of an inch; head rounded, triangular striated; eyes large, posterior; jaws somewhat linear, four-toothed; thorax raised in front, depressed posteriorly, with two small spines on each side in front, and two tubercles above these, and two large nearly horizontal spines at the posterior extremity of thorax; first abdominal pedicle long, narrow, raised behind, second raised, rounded; abdomen somewhat triangular; head, thorax, legs and abdominal pedicles maroon colour; abdomen shining brown.

Female, head rather smaller proportionally, finely striated; eyes larger; three ocelli; jaws blunt, without teeth; antennæ scarcely longer than the head; thoracic spines less developed; abdomen larger.

This is one of the most common and abundant ants in Malabar; I do not remember to have seen it in the Carnatic. It seldom enters houses, but otherwise appears to take the place of *Formica indefessa*, which is not found in Malabar. It feeds chiefly on honey and other vegetable secretions, but also will

* Trans. Ent. Soc. i. p. 99. Col. Sykes's specimens of *M. Kirbii* are in the Museum at the East India House.—F. M.

take dead animal matter. It is also occasionally found in the train of caterpillars feeding on leaves. It makes large excavations underground, generally having the entrance round the trunk of a tree, and it forms considerable heaps of fine earth round the mouth of the nest. It runs, unlike the last species, with its abdomen turned downwards under the abdominal pedicles. It appears to form the type of a very distinct group from the last.

22. *Myrmica? tarda*, Jerdon (p. 115).

Worker, length $\frac{1}{6}$th of an inch; head somewhat triangular, square behind, of same width as thorax; eyes rather small, quite lateral, somewhat posterior; antennæ short, thick, inserted near the mouth; thorax short, square, ending in two spines on each side, it and the head rough and shagreened; abdominal pedicles much raised, long, narrow; abdomen triangular, also shagreened; head, thorax, legs and abdominal pedicles brick-red; abdomen dusky, dark blue. This is a very curious-looking ant. It lives in holes in the ground in small societies, and feeds on vegetable secretions. It moves very slowly. It is found both in the Carnatic and Malabar.

23. *Myrmica? cæca*, Jerdon (p. 116).

Worker, length $\frac{1}{5}$th of an inch; head somewhat oval, rather small; no eyes; antennæ short, thick, inserted near the mouth; an oblique groove on each side of forehead for the insertion of the antennæ; jaws triangular, hooked at the tip, and finely serrated; thorax narrow, of uniform width, granulose, with an elevation posteriorly ending in two small spines; abdominal pedicles raised, rounded, pointed backwards, the first the highest; abdomen long, oval; head, thorax and legs reddish brown; abdomen glossy brown.

I found this curious ant only once, under a stone in the Wynaad.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

The Palm Trees of the Amazon and their Uses. By A. R. Wallace. With 48 Plates. London: Van Voorst, 1853.

We beg most strongly to recommend this book, as one that will not interest the botanist alone, but give pleasure to unbotanical readers.

It must be looked upon as a highly valuable companion to the great work on Palms by Martius, supplying to us a very clear idea of the general appearance of the palm-trees. Being the work of a professed and excellent naturalist, it is quite trustworthy even in the smallest details. The book contains full-length portraits of forty-three species, accompanied in several cases with an enlarged figure of some of their parts. These portraits are especially interesting to Europeans, from our having no native trees of this graceful group; the only palm of our quarter of the world being the *Chamærops humilis*, which inhabits Sicily.

In the introduction Mr. Wallace has given a most curious account of the almost endless uses to which palms are applied by the inhabitants of tropical countries. It is probable that very few of his readers will have had any approach to an adequate conception of their value, not only to those who live amongst the palm-trees themselves, but also to us and other nations of the temperate regions of the earth.

We should like to transfer some part of this introduction to our pages, but find that it must be the whole or none. We choose the latter alternative, in the confident hope that very many of our readers will see it in the book itself.

The Botanist's Word-Book: an Etymological and Explanatory Vocabulary of the Terms employed in the Science of Botany. By G. Macdonald and J. Allan. London: Reeve & Co., 1853.

We are sorry that it is not in our power to recommend this little book, for there are internal proofs of its having been compiled by persons unacquainted with botany. It is full of blunders, and even if correct, it would have been found to be far too meagre to be of use to botanical students. For instance: "Acina. The small granules which make up a bramble or mulberry." Of course we need scarcely add that it means neither, and that they are not of similar structure. "Adnate. Applied to stipulæ growing close to the stem." To take another part of the book: "Nodose. Knotty. A term applied to a particular form of pubescence." "Pappus. A particular kind of seed." But we have said enough, and are sorry that Messrs. Reeve should have been persuaded to publish such a book.

A Narrative of Travels on the Amazon and Rio Negro, with an Account of the Native Tribes and Observations on the Climate, Geology, and Natural History of the Amazon Valley. By A. R. Wallace. Pp. 541. 8vo. London, 1853. Reeve & Co.

This book has interested us greatly, and we advise our readers to peruse it. The travels of a good naturalist in such a region as that of the Amazon could scarcely be related without forming a most agreeable work. That is pre-eminently the case in the instance before us, in which the author has so happily blended the account of his journey with the scientific observations, as to produce a narrative, which no reader, even only slightly or not at all acquainted with natural science, will read without pleasure.

During a residence of four years in the valley of the Amazon, Mr. Wallace visited most of the interesting places upon the banks of the lower half of that great river, and also throughout nearly the whole extent of the Rio Negro. Perhaps the most interesting part of the book is that containing an account of his two visits to the Rio Uaupés, which is inhabited solely by tribes of Indians in their natural state, not at all altered and deteriorated by contact with the unprincipled white residents on the banks of the neighbouring rivers. Mr. Wallace collected quite a museum of the productions of the Indian tribes, but, most unfortunately, lost them all, together with the specimens of natural history obtained during the latter two years of his stay in that country, his journals for that period and numerous sketches, by the burning of the ship on his homeward voyage. The results which we have before us cause us the more to lament this misfortune. We hope that when he fulfils the desire expressed in his preface, of "again visiting the wild and luxuriant scenery and the sparkling life of the tropics," he may be again successful, but escape the concluding misfortune of his former journey. The author proposed to pay the expenses of his journey by making collections in natural history, and was enabled to do so, notwithstanding the deplorable loss which we have mentioned.

At the conclusion of the narrative there are four chapters on the natural history of the country and on the Indian tribes, which, had he saved all his materials, were intended to form part of a separate work on the Physical History of the Amazon. They well deserve careful perusal, and lead us to hope that, should Mr. Wallace fulfil his desire of revisiting the country, we may at a future time have such a work from his pen.

At the end of the volume are some valuable remarks by Dr. R. G. Latham on the vocabularies of Amazonian languages collected in the course of this journey.

Preparing for Publication.

The Aquarium: a Biography of Marine Animals. With coloured Plates.

Mr. P. H. Gosse is preparing for the press a work under the above title, which will contain many interesting particulars of the instincts and manners of various marine animals (hitherto little known) as observed in captivity. These will be preceded by a brief sketch of the history of the Marine Aquarium, and instructions for its use.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 22, 1851.—John Edward Gray, Esq., F.R.S. &c., Vice-President, in the Chair.

Description of a new form of Lamprey from Australia, with a Synopsis of the Family. By J. E. Gray, Esq., F.R.S., V.P.Z.S. etc.

The Lamprey which I have now to present to the attention of the Society differs in so remarkable a degree from any other known species, that, premising that I propose for it the name of *Geotria Austra-*

lis, I think it best to connect with the description a revision of the whole Family to which it belongs.

Petromyzonidæ.

Nasal aperture closed, and the palate entirely covered with skin.

Lampredia, Rafin. Anal. Nat. 94, 1818.—*Petromyzonidæ* (*Petromyzonini*), Bonap. Syst. Ichth. 1838; De Kay, Nat. Hist. of New York, 379.—(*Fam.*) *Hyperoartia*, Müll. Abhandl. Akad. Berlin, 1836, 77; Mag. Zool. & Bot. i. 406.—*Petromyzidæ*, Gray, Syn. B.M. 1842, 148, 150.

Müller (*Abhandl. Akad. Berlin*) divided the genera thus:—

1. *Petromyzon*, with visible teeth.
2. *Ammocœtes*, without visible teeth.

Synopsis of Genera.

A. Petromyzonina. *Teeth distinct; eyes visible.*

1. Petromyzon. Upper inner teeth two, conical, close together; lower single, crescent-shaped; labial teeth numerous, conical; lingual teeth two, pinnate.

2. Lampetra. Upper and lower teeth transverse, crescent-shaped; labial teeth in two submarginal rows; inner lateral teeth larger, two- or three-lobed, lingual teeth pectinate.

3. Geotria. Upper and lower teeth transverse, crescent-shaped; upper lobed; labial teeth numerous, distant, acute, innermost largest; lingual teeth elongate, conical, arched.

4. Velasia. Upper and lower teeth transverse, crescent-shaped; upper two-lobed; labial teeth numerous, crowded, truncate; innermost largest; lingual teeth elongate, arched.

5. Caragola. Upper internal teeth two, far apart, three-lobed; lower crescent-shaped, nine-lobed; labial teeth transverse, band-like, four tubercles; lingual teeth flattened.

6. Mordacia. Upper inner teeth two; lateral three-lobed; lower nine, conical, in an arched series; labial teeth conical, in a single submarginal series; lingual teeth elongate, conical, arched.

B. Ammocœtina. *Teeth none; eyes hidden.*

7. Ammocœtes.

A. Petromyzonina. *Teeth distinct.*

1. PETROMYZON.

Upper inner teeth two, triangular, close together. Lower inner tooth single, large, crescent-shaped, many-toothed. Labial teeth conical, acute, numerous, in diverging, arched series; the inner one largest, and gradually becoming smaller near the edge. Tongue with two compressed, pectinated teeth above, and a broad, lunate, dentated tooth beneath, which is strongly bent up between the upper teeth in the centre.

Yarr. Brit. Fish. fig. p. 603; De Kay, Zool. New York, t. 56, 216 (bad).—*Petromyzon, sp.*, Linn. Syst. Nat.; Rafin. Anal. Nat.; Müll. Abhandl. Akad. Berlin, 1834, 77 (1836).—*Petromyzon*, Gray, Proc. Zool. Soc. 1851.

1. Petromyzon marinus. The Lamprey.

Petromyzon marinus, Linn. Bloch, iii. pl. 77; Linn. (édit. de Gmelin) Faun. Suec. 292; Artedi, Ichth. gen. 64. syn. 90; Neue Schrift. der Berl. Naturf. 7. 466; Schneid. Bloch, i. 530, 1801; Penn. Brit. Zool. iii. 102. pl. 10, 1776–78; Shaw, Gen. Zool. v. 251. pt. 2. pl. 133, 1804; Don. Brit. Fish. pl. 81, 1820–21; Flem. Brit. An. 163. sp. 1, 1827; Cuv. Règ. An. ii. 404, 1829; Müll. Mém. de l'Acad. Berlin, 1834, 78. t. 4. f. 1, 5; Osteol. t. 9, 65, 67, 68. f. 9; Yarr. Brit. Fish. 2 ed. ii. 598, 1841.—*Lamproie marbrée*, Daub. Encycl. Méth.; Bonn. Planches d'Hist. Nat. de l'Enc. Méth.—*Petromyzon maculosus*, Artedi, Ichth. gen. 64. syn. 90.—*Petromyzon lamproie*, Bloch, Hist. Nat. Poiss. 31, 77. pt. 13.—*Petromyzon maximus*, Cuv. Règ. An. ii. 118, 1817.—*Petromyzon*, Klein, Misc. Pisc. iii. f. 30. n. 3.—*Mustela sive Lampetra*, Belon, Aquat. 76; Salv. Aquat. f. 62 *b*.—*Lampetra major*, Schwenck. Theriotr. Siles. f. 451; Charlet, Onom. f. 153. n. 3; Aldrov. 539. liv. 4. c. 13; Jonston, liv. 2. tit. 2. c. 3. pl. 24. f. 5.—*Lamproie*, Coms. Hist. Nat. v. 284; Fermin, Surin. 85; Rond. 310. pt. 1. liv. 13; Valmont de Bomare, Dict. Hist. Nat.—*Lampetra Rondeletii, Lamprey or Lamprey-Eel*, Will. Ichth. 105. pl. 2. f. 2, 1685; Ray, Syn. f. 35. n. 3.—*Ioatzma unagi*, Kæmpfer, Voy. au Japan, i. pl. 12. f. 2. —*Il mustilla*, Forsk. Desc. Anim. f. 18.—*Plota fluta*, Authors.—*Lampetra, Lampreda kentmanni, lampreda, marina, mustela*, Gesn. (germ.) 180 *b*. et paralip. 22.—*Le Pétromyzon Lamproie*, Lacépède, Hist. Nat. Poiss. i. 2, 3. pl. 1, 1798.—*La Grande Lamproye*, Cuv. Règ. An. ii. 404, 1819.

Hab. European Seas.

2. Petromyzon Juræ. MacCulloch's Lamprey.

Petromyzon Juræ, MacCull. West. Isles, ii. 186, 187. t. 29. f. 1; Jen. B. V. A. 522.—*Petromyzon fluviatilis, var.*, Flem. Brit. An. 162.

Hab. Coast of Scotland, east shore; island of Jura.

Probably a variety of *P. marinus*: the drawing of the teeth shows it has no relation to *P. fluviatilis*.

3. ?Petromyzon americanus. American Sea Lamprey.

Petromyzon marinus, Schæpff. Beobachtungen, &c. viii. 184; Mitch. Trans. Lit. & Phil. Soc. i. 461.—*Petromyzon americanus*, Lesueur, Amer. Phil. Soc. (N. S.) i. 382; Hist. N. A. Fish. ined. plate; Storer, Rep. on the Fishes of Massachusetts; De Kay, Nat. Hist. of New York, 379. pl. 66. f. 216. pt. 1; Zool. 1842.

Hab. N. America.

4. Petromyzon nigricans. Bluish Sea Lamprey.

Petromyzon nigricans, Lesueur, Amer. Phil. Soc. (N. S.) i. 385;

Storer, Rep. on the Fishes of Massachusetts; De Kay, Nat. Hist. of New York, 381. pl. 79. f. 247 (teeth indistinct), pt. 1; Zool. 1842.
Hab. N. America.

5. Petromyzon argenteus. Silvery Lamprey.

Petromyzon argenteus, Kirtland, Boston Journ. iii. 342. pl. 4. f. 3; De Kay, Nat. Hist. of New York, 382. pt. 1; Zool. 1842.
Hab. N. America, river Ohio.

2. LAMPETRA.

Upper inner tooth single, transverse, lunate, entire, with a conical prominence at each end. Lower inner tooth single, transverse, lunate, many-toothed, outer lobe largest. Labial teeth unequal, the outer numerous, small, subequal, conical, in a single, submarginal series, the inner larger, unequal; of the upper part small, in series; of the sides in a single series, larger, with two or three conical tubercles. Tongue with two compressed, pectinated teeth above, and a large, crescent-shaped, transverse tooth below, crenated on the edge, and with a larger, conical projection in the centre.

Yarr. Brit. Fish. fig. p. 604; De Kay, Nat. Hist. of New York, t. 79, 249 (bad).—*Petromyzon, sp.*, Linn., Cuv., Müll.—*Lampetra, sp.*, Ray.—*Lampetra*, Gray, Proc. Zool. Soc. 1851.

* *Dorsal fins separate.*

1. Lampetra fluviatilis. Lampern or River Lamprey.

Petromyzon fluviatilis, Linn. Bloch, pt. 3. pl. 78. f. 1; Linn. (edit. de Gmel.); Müll. Prod. 37. n. 307; Aldrov. 587; Penn. Brit. Zool. v. pt. 106. pl. 10, 1776–78; Schneid. Bloch, 530, 2, 1801; Shaw, Gen. Zool. 257. pt. 2, 1804; Don. Brit. Fish. pl. 80, 1820–28; Flem. Brit. An. 404, 1827; Cuv. Règ. An. ii. 404, 1829; Mém. de l'Acad. Berlin, 78, 1834; Jen. Man. Brit. Vert. 521. sp. 210, 1835; Yarr. Brit. Fish. 2 ed. ii. 598, 1841; Parnell; Rich. Faun. Bor. 294, 1836. —*Petromyzon fluviatilis*, Cuv. Règ. An. ii. 118, 1817.—*Lamproie prycka*, Daub. Encycl. Méth.—*Nein-oga natting*, Faun. Suec. 106. —*Petromyzon, &c.*, Artedi, gen. 64. syn. 89. sp. 99.—*La petite Lamproie*, Bloch, 34. pt. 3. pl. 78. f. 1.—*La Lamproie branchiale*, Bonn. Planches de l'Encycl. Méth.—*Petromyzon, Prick* (*negen-oog*), Gronov. Mus. i. 64. n. 114; Zooph. 38.—*Mustela*, Pliny, liv. 9. c. 17. —*Mustela fluviatilis*, Belon, Aquat. 75.—*Lampetra subcinerea, maculis carens*, Salv. Aquat. 62.—*Lampetra, alterum genus*, Gesn. Aquat. 597.—*Lampreda*, Icon. Anim. 326.—*Lampetra, medium genus*, Will. Ichth. 106. tab. g. 2, 3. f. 1, 2; Ray, Syn. Pisc. 25. n. 1. —*Lampetra fluviatilis*, Aldrov. 587; Jonston, 104. pl. 28. f. 11; Schone, 41; Charlet, 159. n. 7; Marseli, Dan. Pann. iv. 2. t. 1, 1726. —*Lampetra fluviatilis, media*, Schwenck. Theriotr. Siles. 532.—*Jaatz me unagi*, Kæmpfer, Voy. dans le Japan, i. 156. pl. 12. f. 2.—*Minog*, Rzæzynski, 134.—*Lamproie*, Fermin, Hist. Nat. de Surinam, 85.—*Petromyzon*, Kramer, Elenchus, 38. n. 1; Klein, Misc. Pisc. iii. 29. n. 1. t. 1. f. 3.—*Le Petromyzon pricka*, Lacépède, Hist. Nat. des Poiss. i. 18, 1798.
Hab. Europe.

2. Lampetra planeri. Fringed-lipped Lampern.

Petromyzon planeri, Linn. Bloch, viii. pl. 78. f. 3; Linn. (édit. de Gmelin); Schneid. Bloch, 531, 532, 4, 1801; Shaw, Gen. Zool. v. pt. 2. p. 259, 1804; Jen. Man. Brit. Vert. 522. sp. 211, 1835; Müll. Mém. de l'Acad. Berlin, 78, 1834; Cuv. Règ. An. ii. 404, 1829; Yarr. Brit. Fish. 2 ed. ii. 607, 1841.—*Lamproiea planer,* Bonn. Planches de l'Encycl. Méth.—*Le Pétromyzon planer,* Lacépède, Hist. Nat. des Poiss. i. 30. pl. 3, 1798.

Hab. Europe.

** *Dorsal fin in contact with the second.*

3. Lampetra sanguisuga. Leech Lampern.

Petromyzon Sanguisuga, Lacépède, Hist. Nat. des Poiss. ii. 99. pl. 1; Supp. to Petromyzon; Shaw, Gen. Zool. v. pt. 2. p. 261, 1804. —*Petromyzon planeri, var.,* Cuv. Règ. An. ii. 118.

Hab. Europe, Seine.

A very doubtful species; Cuvier says it is the same as the former.

4. Lampetra Lamottenii. American Lampern.

Petromyzon Lamottenii, Lesueur, Hist. N. A.; De Kay, Nat. Hist. of New York, 382. pl. 79. f. 249 (mouth), pt. 1; Zool. 1842.

Hab. N. America, New York.

3. GEOTRIA, n. g.

Upper internal tooth large, transverse, crescent-like, divided into four lobes; the two inner lobes small, acute; outer truncated. The lower internal tooth transverse, narrow, slightly sinuous. The labial teeth numerous, far apart, conical, acute, in arched series, diverging from the throat; the innermost one larger, rest small; the innermost one of the lower part on each side small, elongate, transverse, with two small, rudimentary tubercles. Tongue with two elongate, conical, arched teeth, with a triangular plate on the lower side of the base. Throat with a very large dilatable pouch. Dorsal fins two, far apart. Mouth very large, surrounded with rather large, transverse, torn leaves.

This genus chiefly differs from *Velasia* in the rudimentary state of the lower internal tooth, in the form of the labial teeth, in the large size of the oral disk, and the extraordinary development of the throat-pouch, which is found in a rudimentary state in the *Petromyzon marinus.* This development of the pouch is perhaps to adapt the animal to the long drought of the Australian rivers.

1. Geotria australis. Pouched Lamprey.

Hab. South Australia. Fresh water.

4. VELASIA.

Upper internal teeth large, transverse, crescent-like, divided into four flat, elongated lobes; the outer lobes largest. The lower internal teeth large, transverse, crescent-like, convex, denticulated on the edge. The labial teeth very numerous, truncated, in crowded, arched series, diverging from the throat; the inner ones large, and gradually diminishing in size to the edge. Tongue with two very large, long, curved teeth, with a triangular plate beneath at their base. Dorsal fins two, far apart. Mouth moderate, edged with transverse foliations.

1. Velasia chilensis. Chilian Lampern.

Hab. Chili. In fresh water.

5. CARAGOLA.

Upper inner teeth two, large, separate, lateral, submarginal, each with three acute tubercles. Lower inner teeth large, crescent-shaped, nine-lobed; the central and two lateral lobes on each side larger. The labial teeth in a subcircular, submarginal series, large, transverse, band-like, with three or four tubercles. Tongue with two flattened teeth, and a triangular, transverse plate below, with an acute process between the teeth on the upper edge. Dorsal fins two, far apart.

1. Caragola lapicida. Caragol.

Hab. West Coast of America.

6. MORDACIA.

Upper inner teeth two, separate, lateral, subtrigonal, each with three tubercles. The lower nine conical, acute, in an arched series; the five central smaller. Labial teeth small, conical, in a single, circular, submarginal series, with a single, additional, odd tooth in the centre above. Tongue with two conical, arched teeth. (Rich. Voy. Erebus & Terror, t. 38.)

Petromyzon, sp., Rich. Voy. Erebus & Terror, t. 38, 1845.

1. Mordacia mordax. Australian Lampern.

Petromyzon mordax, Rich. Voy. Erebus & Terror, t. 38, 1845.—*Mordacia mordax*, Gray, Proc. Zool. Soc. 1851.

Hab. Tasmania.

Species of Doubtful Situation in the Family.

1. Petromyzon appendix. Small Lamprey.

Petromyzon appendix, De Kay, Nat. Hist. of New York, 381. pl. 64. f. 211. pt. 1; Zool. 1842.

Hab. N. America, Hudson River.

"A ring of irregular-shaped corneous processes within the oral orifice, and a large isolated double tooth of the same texture on the inferior portion of the mouth."—*De Kay.*

2. Petromyzon tridentatus. Tridentate Lamprey.

Petromyzon tridentatus, Gairdener, Rich. Faun. Bor. Amer. 293, 1836; De Kay, Nat. Hist. of New York, 381. pt. 1; Zool. 1842.

Hab. N. America, Falls of the Walamet.

3. Petromyzon argenteus. Silvery Lamprey.

Petromyzon argenteus, Bloch, t. 415. f. 2; Schneid. Bloch, 532. t. 102. f. 1, 1801; Shaw, Gen. Zool. v. pt. 2. p. 262, 1841.
Hab. Indian Seas.

4. Petromyzon bicolor. Brilliant Lamprey.

Petromyzon bicolor, Shaw, Gen. Zool. v. pt. 2. p. 263, 1804.—*Petromyzon niger*, Lacépède, iv. 667.
Hab. Europe, Seine.

5. Petromyzon plumbeus. Leaden Lamprey.

Petromyzon plumbeus, Shaw, Gen. Zool. v. pt. 2. p. 263, 1804.—*Petromyzon Septœil*, Lacépède, iv. 667.
Hab. Europe, Seine.

B. Ammocœtina. *Teeth none; eyes none.*

7. AMMOCŒTES.

Teeth none.

Ammocœtes, Dum. Zool. Anal.; Cuv. Règ. An. ii. 118, 1817; Müll. Abhandl. Akad. Berlin, 1834, 78 (1836).—?*Lampreda*, Rafin. Anal. Nat. 94, 1815.

1. Ammocœtes branchialis. Pride or Sandpiper.

Ammocœtes branchialis, Dum.; Flem. Brit. An. 164. sp. 3, 1828; Cuv. Règ. An. 406, 1829; Müll. Mém. de l'Acad. Berlin, 1834; Jen. Man. Brit. Vert. 522. sp. 212, 1835; Yarr. Brit. Fish. 2 ed. ii. 609, 1841.—*Petromyzon branchialis*, Linn. (édit. de Gmelin) 1815; Bloch, pt. 3. pl. 78? f. 2; Linn. Faun. Suec. 292; Wulff. Ichth. Borus. 15. n. 20; Müll. Prod. Zool. Dan. 37. n. 307 *b*; Kramer, Elench. 483; Penn. Brit. Zool. iii. 107. pl. 10, 1776–78; Shaw, Gen. Zool. 260, 1804.—*Petromyzon corpore annuloso, &c.*, Artedi, gen. 42. syn. 90.—*Lamproie branchiale*, Bonn. Planches de l'Encycl.; Daub. Encycl. Méth.—*Petromyzon*, Gronov. Zooph. 38. n. 160; Klein, Misc. Pisc. iii. 30. n. 4.—*Petromyzon cæcus*, Couch, Mag. Nat. Hist. v. 23. f. 60.—*Mustela fluviatilis*, Gesner, Aquat. 589; Icon. Anim. 286; Thierb. 159 *b*.—*Lampetra minima*, Aldrov. 539.—*Lampern, or Pride of the Isis*, Will. Ichth. 104.—*Pride*, Plot, Hist. of Oxford, 182. t. 10.—*Lampetra cæca*, Will. Ichth. tab. g. 3. f. 1; Ray, Syn. Pisc. 35. n. 2, 4; Couch, Loudon's Mag. Nat. Hist. v. 23. f. 9, 10.—*Lampreta neunange*, Jonston, t. 28. f. 10.—*Lamproyon et Lamprillon*, Rond. Hist. Poiss. ii. 202.—*Querder, Schlamquerder*, Schwenckf. Theriotr. Siles. 423.—*Der Kieferwurn*, Müll. l. c. iii. 234.—*Lampreyon*, Valmont de Bomare, Dict. Hist. Nat.—*Le Petromyzon lampreyon*, Lacépède, Hist. Nat. des Poiss. i. 26. pl. 2. f. 1, 1798.
Hab. Europe, rivers.

2. Ammocœtes ruber. Red Lamprey.

Ammocœtes ruber, Cuv. Règ. An. 406, 1829; Müll. Mém. de l'Acad. Berl. 78, 1834.—*Petromyzon ruber*, Lacépède, Hist. Nat.

des Poiss. ii. 99. pl. 1; Supp. to Petromyzon; Shaw, Gen. Zool. v. pt. 2. p. 261, 1804.—*Ammocœtes branchialis, var.*, Cuv. Règ. An. ii. 118, 1817.

Hab. Europe, Seine.

3. Ammocœtes concolor. Mud Eel or Blind Eel.

Ammocœtes concolor, Kirtland, Boston Journ. iii. 473. pl. 27. f. 1 *a*, *b*, 1841.

Hab. N. America, Mahoning and Scioto rivers.

4. Ammocœtes bicolor. Coloured Mud Lamprey.

Ammocœtes bicolor, Lesueur, Amer. Phil. Soc. (N. S.) i. 386.—*Ammocœtes bicolor*, Storer, Fishes of Massachusetts, 198; De Kay, Nat. Hist. of New York, 383, 679. f. 248. pt. 1; Zool. 1842.

Hab. N. America, Connecticut river.

5. Ammocœtes unicolor. Plain Mud Lamprey.

Ammocœtes unicolor, De Kay, Nat. Hist. of New York, 383. pl. 79. f. 250. pt. 1; Zool. 1842.

Hab. N. America, Lake Champlain.

Nov. 11, 1851.—W. J. Broderip, Esq., Vice-President, in the Chair.

The following paper was read:—

Descriptions of sixteen new species of Rissoina. By Arthur Adams, Surgeon R.N., F.L.S. etc.

Rissoina, D'Orbigny.

About eighteen species of this genus, as restricted by M. d'Orbigny, have been already described, inhabiting various countries. Those here named are a portion of the discoveries made by Mr. Cuming among the islands of the Philippine Archipelago, and are many of them of considerable size; and it is in these that the peculiarity of operculum is best seen.

The process of the semiovate, horny, subspiral operculum, first pointed out by D'Orbigny, is sometimes very long and slender, and very much resembles in appearance the analogous appendage of the operculum of *Nerita* and *Neritina*. The genus *Jeffreysia* of Alder, or *Rissoella* of Gray, has a similar appendage, but the position of the eyes, and the peculiar structure of the fore part of the head, place the latter genus in a different family, viz. *Pyramidellidæ*. The *Rissoinæ* may also readily be known from the neighbouring genus *Rissoa*, by the aperture being somewhat channeled anteriorly, whereas in *Rissoa* it is continuous and entire. The nature of the animal resembles *Rissoa*, according to D'Orbigny, who places the genus among the *Melaniadæ*.

1. Rissoina plicata, A. Adams. *R. testâ turrito-subulatâ, subpyramidali, albâ, sordidâ, anfractibus octo, planis, longitudinaliter valdè plicatâ, transversim striatâ, plicis elevatis, posticè subangulatis, interstitiis transversim striatis; aperturâ*

semiovatâ, anticè subcanaliculatâ; labro anticè subdilatato, margine incrassato.

Hab. Isle of Masbate. Mus. Cuming.

2. Rissoina fasciata, A. Adams. *R. testâ subulato-turritâ, solidâ, sordidè albâ, rufo-fusco fasciatâ, anfractibus octo, convexiusculis, transversim tenuissimè (sub lente) striatâ, longitudinaliter plicatâ, plicis obliquis, æqualibus, subdistantibus; aperturâ semiovatâ, anticè subcanaliculatâ; labro subdilatato.*

Hab. Sydney, under stones, low water (*Mr. Strange*). Mus. Cuming.

3. Rissoina scalariana, A. Adams. *R. testâ subulato-turritâ, albâ, solidâ, anfractibus octo, convexiusculis, transversim tenuissimè striatâ, longitudinaliter costatâ, costis elevatis, æqualibus, subdistantibus, anfractu ultimo anticè callo circumdato; aperturâ semiovali, anticè subcanaliculatâ; labio anticè callo desinente; labro flexuoso, anticè subproducto.*

Hab. Isle of Burias, Philippines. Mus. Cuming.

4. Rissoina pyramidalis, A. Adams. *R. testâ turrito-pyramidali, sordidè albâ, solidâ, anfractibus octo, planiusculis, transversim tenuiter striatâ, longitudinaliter plicatâ, plicis obliquis, confertis, subelevatis, interstitiis transversim striatis; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè callo desinente; labro subdilatato, incrassato.*

Hab. Isle of Baclayon. Mus. Cuming.

5. Rissoina d'Orbignyi, A. Adams. *R. testâ subulato-turritâ, albidâ, subpellucidâ; anfractibus decem, convexiusculis, supremis costellatis, lineolis elevatis, transversis, et longitudinalibus, decussatâ; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè subcalloso; labro dilatato, subreflexo, margine flexuoso, subacuto.*

Hab. Isle of Luzon. Mus. Cuming.

6. Rissoina clathrata, A. Adams. *R. testâ subulato-turritâ, albâ, solidâ, anfractibus convexiusculis, lineis elevatis, longitudinalibus et transversis decussatis, valde clathratâ, anfractu ultimo anticè sulco transverso instructo; aperturâ semiovatâ, anticè subcanaliculatâ; labro flexuoso, anticè producto, margine extus varicoso.*

Hab. Isle of Bohol. Mus. Cuming.

7. Rissoina micans, A. Adams. *R. testâ turrito-subulatâ, albâ, solidâ, nitidâ, anfractibus convexis, novem, longitudinaliter plicatâ, plicis elevatis, subdistantibus, æqualibus, interstitiis transversim striatis, anfractu ultimo anticè valde sulcato; aperturâ semiovatâ, anticè subcanaliculatâ; labro flexuoso, anticè subproducto, extus varicoso.*

Hab. Island of Mindanao. Mus. Cuming.

8. Rissoina nivea, A. Adams. *R. testâ parvâ, subulato-turritâ, subpellucidâ, niveâ, subnitidâ, anfractibus convexiusculis,*

longitudinaliter plicatâ, plicis obliquis, anticè subobsoletis; aperturâ semiovatâ, anticè subcanaliculatâ; labro subdilatato, extus incrassato.

Hab. Port Lincoln, Australia. Mus. Cuming.

9. Rissoina monilis, A. Adams. *R. testâ turrito-subulatâ, solidâ, fulvâ, anfractibus septem, planis, granulis moniliformibus ad suturas, longitudinaliter plicatâ, plicis confertis, angustis, æqualibus, interstitiis punctato-clathratis; aperturâ semiovatâ, anticè subcanaliculatâ; labio subincrassato; labro extus valde varicoso, margine transversim striato.*

Hab. Philippine islands. Mus. Cuming.

10. Rissoina bellula, A. Adams. *R. testâ subulato-turritâ, albâ, semipellucidâ; anfractibus octo, convexiusculis, cingillis transversis, elevatis, granulosis, interstitiis longitudinaliter concinnè clathratis, ornatâ; anfractu ultimo sulco profundo instructo; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè callo terminato; labro flexuoso, margine extus valde varicoso.*

Hab. Isle of Calapan. Mus. Cuming.

11. Rissoina striolata, A. Adams. *R. testâ subulato-turritâ, albâ, tenui, pellucidâ; anfractibus undecim, supremis longitudinaliter plicatis, planulatis, prope suturas subangulatis; transversim striatâ, striolis confertis concentricis; aperturâ semiovatâ, anticè subcanaliculatâ; labio posticè incrassato, anticè callo desinente; labro dilatato, margine incrassato, subreflexo.*

Hab. Baclayon island, Philippines. Mus. Cuming.

12. Rissoina costata, A. Adams. *R. testâ subulato-turritâ, albâ, opacâ, solidâ, anfractibus septem, convexiusculis, longitudinaliter costatâ, costis crassis, elevatis, posticè subangulatis, anfractu ultimo anticè sulco transverso valido instructo; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè tuberculo terminato; labro subdilatato, margine varicoso, flexuoso.*

Hab. Cobiga, Peru. Mus. Cuming.

13. Rissoina nitida, A. Adams. *R. testâ turrito-subulatâ, albâ, solidâ, nitidâ, anfractibus novem, convexiusculis, longitudinaliter costatâ, transversim liratâ, liris ad costas nodulosis; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè callo desinente; labro extus incrassato, margine subacuto, anticè diaphano producto.*

Hab. Isle of Camaguing. Mus. Cuming.

14. Rissoina concinna, A. Adams. *R. testâ subulato-turritâ, albâ, solidâ, nitidâ, anfractibus septem, planiusculis, longitudinaliter plicatâ, plicis anticè evanidis, transversim striatâ, striis creberrimis, confertis; aperturâ semiovatâ, anticè subcanaliculatâ; labio calloso; labro margine valde incrassato et rotundato.*

Hab. Cagayan, Philippines. Mus. Cuming.

15. Rissoina nodicincta, A. Adams. *R. testâ subulato-turritâ, albâ, solidâ, anfractibus* 10–12, *convexis, longitudinaliter plicatâ, plicis angustis, distantibus, transversim tenuissimè striatâ, in medio anfractuum cingulâ elevatâ ad plicas nodosâ, ornatâ, suturâ nodulis moniliformibus cinctâ; aperturâ semiovatâ, anticè subcanaliculatâ; labio anticè callo terminato; labro dilatato, extus incrassato, margine flexuoso.*

Hab. Isle of Capul, Philippines. Mus. Cuming.

16. Rissoina cælata, A. Adams. *R. testâ subulato-turritâ, albidâ, solidâ; anfractibus octo, convexiusculis, supremis clathratis, ultimo cingulis elevatis, æqualibus, subdistantibus, transversis, interstitiis lineis elevatis, longitudinalibus et transversis, decussatim ornato; aperturâ semiellipticâ, anticè subcanaliculatâ; labio calloso; labro anticè dilatato, margine incrassato, subreflexo.*

Hab. Siquijor. Mus. Cuming.

The two following species are true *Rissoæ*, characterized by the simple aperture, which is not channeled in front, and by the absence of the calcareous appendage to the operculum. Many species of small shells have been inaccurately referred to *Rissoa*, some of which belong, however, to entirely different families.

Rissoa bella, A. Adams. *R. testâ turrito-subulatâ, albâ, solidâ; anfractibus quinque, planiusculis; spirâ apice obtuso, lineis transversis, elevatis, concentricis, confertis, ornatâ; aperturâ ovali, anticè integrâ; labio subcalloso; labro subdilatato, extus marginato, margine flexuoso.*

Hab. Philippine islands. Mus. Cuming.

Rissoa elegans, A. Adams. *R. testâ subulato-turritâ, albâ, semipellucidâ; anfractibus 7, convexiusculis; suturâ canaliculatâ, lineis elevatis transversis concentricis et longitudinalibus concinnè decussatâ; aperturâ ovali, subproductâ, anticè integrâ; labio calloso; labro anticè dilatato, extus varicoso, margine acuto, subreflexo.*

Hab. Philippines. Mus. Cuming.

BOTANICAL SOCIETY OF EDINBURGH.

The Society opened their Eighteenth Session on Thursday, November 10th,—

Professor Balfour, President, in the Chair.

Dr. Balfour, in taking the Chair, alluded to the value of the Society as a means of keeping up a friendly intercourse among those who were prosecuting the science of botany. He noticed the recent researches in regard to the class of plants called Diatomaceæ, and stated that a large microscopical collection had been made at the Botanic Garden, and that the specimens would be exhibited during the Session.

A new part (concluding volume iv.) of the Society's 'Transactions' was placed on the table, containing papers by Professor Balfour, Mr. Babington, Professor M'Cosh, Dr. Greville, Major Madden, Dr. Wilson, Dr. Macadam, and Dr. Macgowan. The Secretary stated that the price of the Part had been fixed at 4*s*.

Many donations to the Society's library and herbarium were announced.

Dr. Balfour read a note from Professor Gregory, in which he stated that he had continued the examination of the Mull deposit of Diatomaceous loricæ, which he described last winter as containing 60 species of Diatoms, and that he had now found in it upwards of 140 species, which beats all the richest deposits known. Even at 60 it was far the richest. Besides the new species doubtfully indicated in his former paper, which Smith had named *Eunotia incisa*, he had found another and a very beautiful species, new not only to him, but to all those who had yet seen it or a figure of it. It is a *Pinnularia*, which, provisionally, he had named *P. hebridensis*. It is scarce in the deposit, a large and populous slide rarely yielding more than one specimen, and often none at all; and as yet he has not been able to find a trace of it in any other deposit within his reach, nor is there anything like it in any work he had seen. As to *Eunotia incisa* it occurs in a deposit from Lapland, in that from Luneberg, and in one from the banks of the Spey, and it seems remarkable that it has been so long overlooked. *P. hebridensis* is small, its length from ·00125 to ·0026 inch, and it has, like *P. lata*. *P. alpina*, and *P. distans*, only nine or ten costæ in ·001 inch. But all these are three or four times larger, and all on the side view are widest in the middle, whereas *P. hebridensis* is slightly contracted there. But it has the general characters of these three species from the fewness and thickness of the costæ.

The following papers were read:—

1. "Account of a Botanical Trip to the Grampian Mountains in August 1853," by Professor Balfour.

He gave a general account of the Clova and Glen Isla district which was visited, and noticed the rare alpine plants gathered. He offered some observations on the remarkably limited distribution of the *Oxytropis campestris* and *Lychnis alpina*, which were confined, the former to a single rocky projection in Glen Fiadh, and the latter to a small mountain summit called Little Gilrannoch. These plants only spread to a small extent from a centre. Besides the usual alpine plants, the party gathered a profusion of *Polypodium alpestre* in various states. In Glen Fiadh the plant was small, and very little of it was in fructification. In this state it is difficult to distinguish it at first sight from *Athyrium Filix-fœmina*. In Glen Dole the plant was also seen abundantly, but in most parts sparingly in fructification. At the upper part of the glen, near the falls of the White Water, and at the station where *Mulgedium alpinum* was originally found by Don, there were fine specimens of the *Polypodium*, 2 or more feet high, abundantly covered with sori. The same thing occurred a little above the track called Jock's Road. In these localities the fern was associated with fine specimens of *Athyrium filix-fœmina*. The party looked in vain for specimens of *Carex Grahami* in the old station in Glen Fiadh, and they failed in seeing *Potentilla tridentata* on the rocks near Loch Brandy, which is the station given for it by Don. Dr. Balfour noticed the heights at which the alpine species occurred, and exhibited a plan of the alpine district of Scotland, with specimens of the plants arranged upon it at their different altitudes.

Dr. Balfour stated that, through the kind permission of Colonel Ogilvie, the party had the use of the large hall at Clova, and that Lord Castlereagh offered every facility for visiting Caënlochan Glen.

2. "Notes of a Tour on the Hartz Mountains, Part II.," by W. Lauder Lindsay, M.D.

3. "Note on a Vegetable Substance formed in a water-pipe at Hafton, Argyleshire," by James Hunter, Esq. of Hafton. Communicated by Henry Paul, Esq.

About twelve months ago, having occasion to bring in an additional supply of water for the use of Hafton House, I had formed a small reservoir or fountain-head, as it is called, from which to lead the water to the then only existing fountain-head, so as to increase the supply in the latter. The connexion between the two was by means of a burnt clay-pipe, 2 inches in diameter, and in lengths of 36 inches, securely fastened at the joinings with Roman cement or mastic, the total length of the piping being 320 yards, secured at each end by zinc roses 4 inches in diameter in order to prevent any impurities passing through the pipe. When the work was finished the supply of water was very good, and it continued so until a fortnight ago, when the running of the water through the tile piping gradually diminished, and at last almost entirely ceased, a mere driblet, indeed, finding its way into the old fountain-head. Upon examination as to the cause of this change, by raising a considerable portion of the piping, there was found about halfway between the two fountain-heads the vegetable substance herewith sent. It was firmly lodged in one length of the piping and projected an inch or so into another.

It is very curious to observe that the colour of the water pressed out of this substance when first taken out of the pipe, and saturated as it was, was deep brown, whereas the water itself flowing through the pipe to the very last was as pure as crystal.

Several new Members were proposed, and the Society then adjourned till the second Thursday of December.

December 8, 1853.—Professor Balfour, President, in the Chair.

The following office-bearers were elected for the ensuing year:—

President.—Professor Balfour.

Secretary.—Dr. Greville.

Treasurer.—W. W. Evans, Esq.

Curator of Museum.—Dr. Anderson.

Assistant Secretary and Curator.—Mr. G. Lawson.

The following papers were read:—

1. "Notice of a Botanical Trip to Helvellyn, with pupils, in July 1853," by Professor Balfour.

2. "Notes of a Tour on the Hartz Mountains, Part III.," by Dr. Lindsay.

3. "On the Physiological and Therapeutical actions of *Cannabis indica*," by Dr. James B. Balfour, Kilsyth.

4. "Notice of Plants found in the neighbourhood of Dollar in the autumn of 1853," by Dr. Balfour.

ROYAL SOCIETY OF EDINBURGH.

Tuesday, December 6, 1853.—Sir Thomas Brisbane, President, in the Chair.

Notice of the Blind Animals which inhabit the Mammoth Cave of Kentucky. By James Wilson, Esq.

The cave in question was described as of great extent, and remarkable in several respects. Although described as a "cave," it consists of innumerable extensive underground galleries, the sides and tops of which consist of limestone. The temperature of the cave is uniformly 59° Fahrenheit throughout the whole year, and a remarkable phænomenon is shown by the variation of temperature outside. When the temperature outside is higher than that of the cave, then an outward current of air is observed, its violence being proportionate to the difference of temperature. On the other hand, when the outer air falls below 59°, then a reverse current sets in. In some cases these currents are so strong as to extinguish the lamps carried by explorers. No change of temperature has, however, been on any occasion observed in the cave, a proof of its vast extent. It is completely dark, but inhabited by some animals. These inhabitants are, in most cases that have been observed, completely blind, some indeed having the rudiments of eyes, and others the eyes to *appearance* pretty well developed, but useless for the purposes of vision. Specimens of the animals were handed round, and the author of the paper detailed their characteristics and habits, as well as of all other remarkable animals in other parts of the world that are known to be without the power of vision. As blind inhabitants of the Kentucky cave, he noticed two bats, two fishes, several beetles, two rats,—one found at a distance of seven miles from daylight, some spiders, moles, crustacea, and other animals, including the minute infusoria, which last not being furnished with eyes in those species that live in light, were not to be expected to possess them in those that live in darkness. He alluded to the blind mole of the Cape, and also to the blind mole of Greece, which is the common mole there, and the mole of Aristotle. Aristotle was therefore correct in describing *the mole* as blind, and his correctors and commentators wrong who found eyes in the British mole, which is a different animal, possessed of the faculty of vision. He also noticed a blind reptile. The inquiry as to the origin of those remarkable beings that inhabit the Kentucky cave is full of interest. Whether their origin is coæval with the cave itself we cannot tell; it may be that they were created for the remarkable conditions which it affords. But it is also possible that they may represent unfortunate animals that had ages ago wandered into the dark recesses of the cave, and in the total absence of light, and consequent disuse of their visual organs, these organs may have become obliterated, or where their forms remain, they may have become incapable of performing their functions. In such an inquiry, the author remarked, that, like the animals themselves, we grope in the dark.

MISCELLANEOUS.

On the Anatomy of Terebratula australis. By M. P. Gratiolet.

1. *The muscles which move the shell.*—The Brachiopoda are destitute of the sort of spring which opens the shells of the Lamellibranchiate Mollusca. Cuvier in his work on *Lingula* supposed that they separated the valves by means of their arms. This explanation has been adopted by Owen, Blainville, and Siebold. D'Orbigny has put forward the opinion within the last few years, that the movement which separates the valves might be explained by the action of the corneous cilia with which the edges of the mantle are furnished.

The author's examination of some specimens of *Terebratula australis* leads him to support the views announced by Quenstedt as early as 1835, that the shell of these animals is opened by the action of certain special muscles, which he calls *diductors*. These muscles are attached to the cardinal process (*talon*) of the imperforate valve behind the point of articulation of the valves ; they raise this cardinal process, and consequently depress the other extremity of the lever. Thus there are muscles to close the shell and others to open it. This is peculiar to the Brachiopoda, and occurs in all the genera of which the anatomy is known.

[The true action of these muscles, called by Professor Owen *Adductores breves*, and by Mr. Davidson *Cardinal muscles*, is well known in this country, having been pointed out by Mr. Woodward in 1851. The question of the real nature of those processes of the mantle which M. Gratiolet calls 'branchial papillæ,' but which are assuredly not branchial, will be found fully discussed by Dr. Carpenter, "On the intimate structure of the Shells of the Brachiopoda," Palæontographical Society, 1853.]

Besides these muscles there are four symmetrical and very fleshy muscles which pass from the valves to the peduncle. These muscles cause the various movements of the shell upon its stalk.

2. *The mantle.*—The structure of the mantle is remarkable. Its edges are furnished with a crown of corneous cilia, finely annulated, and originating in follicules, like true hairs. A circular muscle and small radiating fibres move these ciliated margins.

The internal lamina of the mantle is smooth and scarcely vascular, which is the reverse of what takes place in the *Lingulæ* and *Orbiculæ* ; on the other hand, the outer lamina is rich in vessels and covered with branchial papillæ which are inserted in the innumerable perforations with which the shell is pierced. These facts establish a characteristic difference between the *Terebratulæ* and the Lamellibranchiate Mollusca, and justify the denomination of *Palliobranchiata* which has been bestowed upon the *Brachiopoda*.

3. *The arms.*—The large stiff canal which serves as their base is in communication with the cavity of the body, but it has no connexion with the capillary tubes of the fringes. These tubes are connected with delicate canals which run beneath the base of the fringes, and by means of which the erection of the tubular threads is produced. The organization of these arms does not justify our attributing to them very extended movements, which, moreover, agrees with the direct observations of Quoy and Gaimard. The author found no traces in this animal of the retractor muscle of the arm so apparent in the *Orbiculæ* and *Lingulæ*.

4. *Digestive apparatus.*—The mouth is a small opening bordered on one side by the fringe of the arms, and on the other by a small lip which is not ciliated, and which is continued on each side through the whole length of the fringe as far as the extremity of the median arm. The anus does not open upon the side of the animal, as has been stated, but on the middle near the bottom of the perforated valve.

5. *Vascular system.*—The large venous sinuses of the body send off long processes (four to each lobe of the mantle). These processes furnish no vessels of any kind to the inner surface of the mantle; they ramify exclusively in its margin. From this marginal plexus the vascular ramifications which form the branchial network of the outer lamina originate. The branchial veins which collect the blood from this network carry it to the auricle of the two hearts; this auricle does not open into the sinuses of the cavity of the body, as has been stated; it is exclusively branchial, as is the case in all Mollusca.

6. *Nervous system.*—The centre of the nervous system of *Terebratula australis* consists of a quadrilateral collar which surrounds the œsophagus. The side of the collar which is beneath the fringed lip is the thickest. From the angles arise long nerves which ramify in the pallial lobes, and especially in the margin. The author could not perceive the nerves of the arms. The same structure is found in *Lingula*.

7. *Generative apparatus.*—The male and female organs are not mingled with the granulations of the liver, as has been stated from analogy with what exists in *Orbicula* and *Lingula*. They consist of small cæca attached in great numbers to a sort of mesentery, and float in the interior of the pallial venous sinuses. The author supposes that the ova of the females and the seminal fluid of the males escape by canals opened on the inner surface of the mantle.—*Comptes Rendus*, July 11, 1853, p. 45.

ON THE TEETH OF PERONIA AND OTINA.

In the 'Annals' for November 1853, I described the teeth of the genus *Peronia* as exactly similar to those of *Testacellus*; they were described from a slide mounted by Mr. Wilton, shown to me by

Mr. S. P. Woodward. Having since had an opportunity of examining the teeth of *Peronia mauritiana,* I find them similar to those of *Oncidium, Helicidæ,* &c. I am convinced that the slide so named must have been taken from a *Testacellus,* which Mr. Woodward now considers probable: the number attached to the specimens from which it was taken may have been misplaced, and there were both *Peronia* and *Testacellus* in the lot of animals examined by Mr. Wilton. The family *Peroniadæ* must therefore be abolished. This observation is interesting, as it gets rid of the apparent anomaly of the teeth of two allied genera being different.

Mr. Alder has most kindly sent me a series of drawings of the teeth of British Mollusca to examine; among other interesting specimens is that of *Otina otis,* which he describes as having "about ten rows of sixty teeth in each row." From the similarity of these teeth to those of other Pulmonata, I have little doubt that this mollusk, which has been placed in various parts of the system and in different families, will prove to be a marine species of *Auriculidæ,* like *Voluta alba* and *V. biplicata.*—J. E. Gray.

HABITS OF BIRDS.

In all works on Natural History, we constantly find details of the marvellous adaptation of animals to their food, their habits, and the localities in which they are found. But naturalists are now beginning to look beyond this, and to see that there must be some other principle regulating the infinitely varied forms of animal life. It must strike every one, that the numbers of birds and insects of different groups, having scarcely any resemblance to each other, which yet feed on the same food and inhabit the same localities, cannot have been so differently constructed and adorned for that purpose alone. Thus the goatsuckers, the swallows, the tyrant flycatchers, and the jacamars, all use the same kind of food, and procure it in the same manner: they all capture insects on the wing, yet how entirely different is the structure and the whole appearance of these birds! The swallows, with their powerful wings, are almost entirely inhabitants of the air; the goatsuckers, nearly allied to them, but of a much weaker structure, and with largely-developed eyes, are semi-nocturnal birds, sometimes flying in the evening in company with the swallows, but most frequently settling on the ground, seizing their prey by short flights from it, and then returning to the same spot. The flycatchers are strong-legged, but short-winged birds, which can perch, but cannot fly with the ease of the swallows: they generally seat themselves on a bare tree, and from it watch for any insects which may come within reach of a short swoop, and which their broad bills and wide gape enable them to seize. But with the jacamars this is not the case: their bills are long and pointed—in fact, a weak kingfisher's bill—yet they have similar habits to the preceding; they sit on branches in open parts of the forest, from thence flying after insects, which they catch on the wing, and then return to their former station to devour them. Then there are the trogons, with a strong serrated bill, which have similar habits: and the little humming-birds, though they generally procure insects from the flowers, often take them on the wing, like any other fissirostral bird.

What birds can have their bills more peculiarly formed than the ibis, the spoonbill, and the heron? Yet they may be seen side by side, picking up the same food from the shallow water on the beach; and on opening their stomachs, we find the same little crustacea and shell-fish in them all. Then among the fruit-eating birds, there are pigeons, parrots, toucans and chatterers,—families as distinct and widely separated as possible,—which yet may be often seen feeding all together on the same tree; for in the forests of South America, certain fruits are favourites with almost every kind of fruit-eating bird. It has been assumed by some writers on natural history, that every wild fruit is the food of some bird or animal, and that the varied forms and structure of their mouths may be necessitated by the peculiar character of the fruits they are to feed on; but there is more of imagination than fact in this statement: the number of wild fruits furnishing food for birds is very limited, and birds of the most varied structure and of every size will be found visiting the same tree.—*Wallace's Travels on the Amazon and Rio Negro.*

On a species of African Ant. By Dr. L. Imhoff.

In describing a species of Ant brought from Acropong on the Gold coast by M. Widmann, a Missionary, Dr. Imhoff gives the following account of one of its habits. The ant belongs to the genus *Anomma*, Shuck.

"Amongst the various ants which occur at the Missionary station at Acropong, there is one in particular of which both M. Widmann and his wife have a very vivid recollection. One New Year's night, during their many years' residence in that place, an army of ants, several inches broad, entered their bedroom; the ants scattered themselves in every direction, and spread over all the furniture and other objects in the room; whatever fell in their way was immediately laid hold of; the bed-cover was soon covered with them, until he and his wife could no longer endure the bites of the creatures and were compelled to leave the house. The ants continued to stream through the dwelling in an uninterrupted line for half an hour. This visit was quite unexpected by the inhabitants of the house; they had indeed seen ants in the house before, but only one at a time."

"This statement agrees remarkably with that made by Reugger in his 'Reise nach Paraguay.' The *tajy-ne* of Paraguay, an ant, apparently belonging to the genus *Odontomachus*, is, says he, a species which builds its nest in the earth, and only appears occasionally in houses, but then comes in crowds and quite unexpectedly, breaking through a crack in the wall or between the tiles of the floor. He describes it also as being exceedingly voracious and fond of biting. These ants attack every kind of animal, not excepting man. Crickets, spiders, mantides, which are also to be met with in the rooms, are immediately torn to pieces by them."

Dr. Imhoff originally proposed the name of *Sphegomyrmex* for this insect, believing it to form the type of a genus previously unknown; he afterwards, however, recognised it as belonging to the genus *Anomma*, Shuck., described in 1840. He seems to think, however, that the latter name comes so near that of *Anommatus*, which was appropriated in 1836 by Wesmael for a genus of Coleoptera, that it ought to be suppressed, in which case his name would be substituted for that given by Shuckard to this genus.—*Bericht über die Verh. der Naturf. Gesellsch. zu Basel*, x. 1852, p. 175.

On a new Muscle-element in the Thoracic Muscles of Insects. By Dr. Burnett.

Aubert* states that he has found an entirely new form of muscle-element in the *Libellulidæ*; this consists of flat, primitive, muscular bands occurring only in the thorax, and which by means of a pitcher-shaped (*becherförmigen*) apparatus move the wings.

The following are his conclusions on this subject:—

"1. The comparatively very large muscles of those insects which fly with a buzzing sound, separate, when fresh, into fine, transversely striated fibres.

"2. The fibres are the primitive muscular fibrillæ.

"3. Between the fibrillæ there is a granular mass, the use of which is unknown.

"4. All other muscles when fresh present no appearances of this kind.

"5. The *Libellulidæ* have in the thorax primitive muscular bands.

"6. The elements of the muscles are little cakes or cylinders which are applied together, forming the fibrillæ.

"7. During contraction the fibrillæ thicken, and the striæ are approximated."

These results have been confirmed by my own experience, for the thoracic muscles of insects have long been to me beautiful objects for the study of the histological elements of muscular tissues. It is a form of this tissue particularly to be recommended for the study of the intimate sarcous elements. The fibrillæ readily separate into the discs of which they are composed, and the whole field is then filled with these last floating freely about. But it is a question if these primitive fibrillæ, which are here so distinct, are not the products of definite cleavages of primitive muscular fibres. In studying them carefully with a power of 800 to 1000, we have been able to detect no remains of their early formative conditions. Furthermore, we know that the muscular fibre is the primitive embryological element of this tissue. It therefore appears to us probable that this peculiarity of the thoracic muscles of insects is due simply to readiness for cleavage, and which may be subservient to their rapid and delicate action.

Another point which we have noticed, and which Aubert also has alluded to, is the singular spiral aspect which these fibrillæ sometimes assume from an apparently irregular movement in their con-

* "Ueber die eigenthümliche Structur der Thoraxmuskeln der Insekten," in Siebold and Kölliker's Zeitsch. für Zool. iv. 1853, p. 388, taf. 15.

traction. This is particularly worthy of note now, since, recently, Martin Barry (Müller's Arch. 1850, p. 529) has advanced the doctrine of the spiral structure of muscular fibrillæ. We have not critically examined the ground on which Barry has based his views, but from our knowledge of this tissue, the phases of its formation from the earliest to the perfect state, and the various appearances it presents in different parts of the animal kingdom, we are led to venture the conjecture that its alleged spiral structure may be due to irregularities and anomalies of contraction.—*Silliman's Journal*, Sept. 1853.

DESMARESTIA PINNATINERVIA, MONT.

Some specimens of Alga, apparently new to our Flora, found floating in Lough Foyle in August 1853, were transmitted by Mr. W. Sawers of Londonderry to the late Meeting of the British Association, which were pronounced by the authorities there present to be a state of some common *Laminaria*. There were, however, peculiarities in the nervation and structure of the specimens which made this very improbable, and in the absence of Dr. Harvey, some of the specimens fell into my hands. After a minute examination and consideration of the probable affinities of the production, I applied to Dr. Montagne for his opinion, and he at once referred it to his *Desmarestia pinnatinervia*, figured from a specimen gathered on the coast of Spain, in the October number of the 'Annales des Sciences Naturelles' for 1842. The Irish specimens are indeed rather narrower, but differ in no essential character.

The species of Dr. Montagne is considered by J. Agardh as most probably a state of the broad form of *Desmarestia ligulata*, and this view is confirmed by Messrs. Crouan, who refer it as a variety to *D. Dresnaji*, Lamouroux, which is regarded as a form of *D. ligulata* by J. Agardh.

There is however a peculiarity of structure, as noticed both by myself and Mr. Sawers, which no one seems to have recorded, namely that the dark specks with which the specimens are sprinkled, and which exist equally in Dr. Montagne's plant, consist of red creeping anastomosing beaded cells, just like those of a young *Callithamnion*. It is possible, however, that these may be extraneous. It would be very desirable to compare very young specimens of the narrow form of *D. ligulata* with Mr. Sawers's plant, and till this is done, some doubt must still exist as to the real nature of the production. The youngest individuals that I have seen, sent to me by Mrs. Griffith, though retaining their disc, are already repeatedly divided.—M. J. B.

On Oligoneuria rhenana. By Dr. L. Imhoff.

Every year, usually in August, many thousands of an Ephemera make their appearance for several days together in this town (Basle). During a considerable series of years they appeared at the end of this month; in the year 1834 they were observed at its commencement; in 1851 they delayed their appearance until early in September. They are produced in the Rhine. A few hours before sunset, but not earlier, a few of these insects may be seen fluttering along close to the surface of the water, whilst others rise to a greater height in the air and even fly over the bridge. These are all males; their numbers gradually increase as evening approaches, when they force themselves upon the notice even of the least observant. They appear then in multitudes, and when at the approach of night the females mix with them the crowds become still more dense, and the animals settle by dozens on the clothes of the passengers on the bridge, and the air appears as though snowflakes were whirling about in it in every direction. At a later hour innumerable multitudes of these Ephemeræ may be seen dashing in circles round the lamps. What takes place later in the night I know not, but in the morning we often find the dead bodies of the animals lying heaped together in prodigious quantities at the bottom of different houses situated close to the Rhine.

I have ascertained that these insects, which are rather nocturnal than diurnal, stray to a considerable distance from the river, but only single individuals, and these always males; for this year, some days after I had seen them on the bridge, I found single male specimens in the "Hardt," a wood which is at some distance from the Rhine. The spot where I took them was about three-quarters of a mile from the town on the road which passes through this wood, so that by this we know that the Ephemera exists at least that distance up the stream; but how much further its distribution may extend in that direction, or to what distance down the river it may make its appearance, is unknown.

These appearances of large quantities of Ephemeræ have long since been noticed in Paris and Holland by Réaumur and Swammerdam. The latter says, "Sometimes in Holland the sky suddenly becomes darkened, as though covered with clouds, and this arises from an innumerable quantity of Ephemeræ which are produced all at once, and which after death cover the shore, the ships and other objects, forming sometimes a layer of an inch thick." Latreille, speaking of the species described by Réaumur, says, "The fall of a species remarkable for the whiteness of its wings produces the appearance of one of those winter days when the snow descends in large flakes."

Pictet was informed by DeCandolle that on one occasion a small Ephemera crowded into his house on the lake of Geneva, and that all the furniture in the rooms in which lights were burning were covered with a thick layer of them.

One circumstance connected with this subject is interesting: each of these different districts has its particular Ephemera. The insect of the lake of Geneva (*Cœnis lactea*, Pict.) is not the same as that which makes its appearance in Holland (*Ephemera Swammerdamiana*, Lat.), whilst this again is distinct from that which rises from the Seine in Paris (*E. albipennis*, Lat.?); and lastly, the species which inhabits the Rhine at this place differs from all the rest, and is as yet undescribed, or at all events is not described in the most comprehensive works on these insects,—Pictet's Hist. Nat. des Ephémérines.

Even the genus to which it belongs, although constituted by Pictet under the name of *Oligoneuria*, was but very imperfectly known to him; its character is said to be, that, of the seven genera composing the family, it presents the smallest number of longitudinal nervures in the wings. Pictet possessed only two specimens, both females, and belonging to one species, which he calls *O. anomala*; one of them was received from Vienna and said to come from Brazil; the derivation of the other was unknown.

The wings of the present Ephemera, which I will name *Oligoneuria rhenana*, after the shedding of the last membrane are transparent and of a pure white; the nervures are yellowish. The body is brownish-yellow in the female, of a purer brown in the male; the former is about 4 lines, the latter 5 lines, in length. The caudal setæ of the female are about half the length of the abdomen; those of the male as long as the whole body. The compound eyes of the male are of a globular form and include nearly the whole of the head, whilst in the female they are much smaller and inserted in the sides of the head. Only two wings are visible until after the casting of the last skin, when four make their appearance.—*Bericht über die Verh. der Naturf. Gesellsch. zu Basel*, x. 1852, p. 177.

METEOROLOGICAL OBSERVATIONS FOR NOV. 1853.

Chiswick.—November 1. Cloudy and fine. 2. Very fine. 3. Foggy. 4. Very fine: overcast. 5. Uniform haze: clear at night. 6. Rain: foggy: uniformly overcast. 7. Foggy: overcast. 8. Foggy: fine: clear. 9. Clear and fine. 10. Frosty: fine: foggy. 11. Dense fog: clear at night. 12. Overcast. 13. Foggy: densely overcast. 14. Foggy: overcast. 15. Dense fog: rain at night. 16. Fine. 17. Frosty: fine. 18. Sharp frost: very fine. 19. Frosty: fine: clear and frosty. 20. Overcast: rain: clear and frosty. 21. Frosty: clear. 22. Foggy. 23. Dense fog. 24. Overcast: rain. 25. Hazy and dull: rain. 26. Overcast. 27. Fine. 28. Overcast throughout. 29. Densely overcast: rain. 30. Hazy: slight rain.

Mean temperature of the month	40°·14
Mean temperature of November 1852	47 ·38
Mean temperature of Nov. for the last twenty-seven years	43 ·18
Average amount of rain in Nov.	2·38 inches.

Boston.—Nov. 1—4. Fine. 5. Cloudy. 6. Cloudy: rain A.M. 7. Cloudy. 8—12. Fine. 13. Fine: rain P.M. 14. Fine. 15. Foggy: rain P.M. 16. Rain: rain A.M. 17—19. Fine. 20. Rain: rain A.M. 21, 22. Fine. 23. Cloudy. 24, 25. Cloudy: rain P.M. 26. Rain: rain A.M. 27. Cloudy. 28. Cloudy: rain P.M. 29. Cloudy: rain A.M. and P.M. 30. Cloudy: rain A.M.

Sandwick Manse, Orkney.—Nov. 1. Cloudy A.M.: rain P.M. 2. Cloudy A.M.: clear P.M. 3. Clear, fine A.M.: clear P.M. 4. Damp A.M. and P.M. 5. Cloudy A.M. and P.M. 6. Rain A.M.: clear, fine P.M. 7. Drizzle, showers A.M.: clear P.M. 8. Rain A.M.: hail-showers, lightning P.M. 9. Cloudy A.M.: damp P.M. 10. Cloudy A.M.: showers P.M. 11. Sleet-showers A.M.: showers P.M. 12. Bright A.M.: clear, fine P.M. 13. Cloudy A.M.: clear, fine P.M. 14. Cloudy, frost A.M.: damp P.M. 15. Clear, frost A.M. and P.M. 16. Cloudy, frost A.M.: clear, frost P.M. 17. Clear, frost A.M. and P.M. 18. Showers A.M.: cloudy P.M. 19. Cloudy A.M.: rain, cloudy P.M. 20. Clear, fine A.M.: sleet-showers P.M. 21. Clear, fine A.M.: clear P.M. 22. Bright A.M.: clear, aurora S. P.M. 23. Bright A.M.: clear P.M. 24. Cloudy A.M. and P.M. 25. Bright A.M.: rain P.M. 26. Clear, frost A.M.: clear, aurora P.M. 27. Clear, frost A.M.: rain P.M. 28. Clear A.M.: clear, aurora P.M. 29. Rain A.M.: clear, aurora P.M. 30. Bright A.M.: clear, aurora P.M.

Mean temperature of Nov. for twenty-six previous years	42°·59
Mean temperature of this month	44 ·87
Mean temperature of Nov. 1852	41 ·52
Average quantity of rain in Nov. for thirteen previous years	4·38 inches.

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.
1853. Nov.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
● 1.	29·913	29·788	29·52	29·48	29·61	60	41	50	53	53	se.	s.	sse.	....	....	·12
2.	30·007	29·846	29·46	29·51	29·76	60	36	50	53	48	sw.	s.	ssw.	·02	....	·17
3.	30·076	29·973	29·76	30·02	30·12	56	36	44	47½	45	e.	ne.	ssw.	....	....	....
4.	29·944	29·854	29·63	30·02	29·92	53	45	46	50	50	e.	se.	se.	....	....	....
5.	29·835	29·773	29·55	29·83	29·78	50	44	48	50	49½	e.	ese.	sse.	·10	....	....
6.	30·050	29·851	29·60	29·94	30·07	58	45	48	50	46	se.	e.	s.	....	....	·30
7.	30·250	30·166	29·83	30·03	30·11	58	46	51	49	47	n.	w.	sw.	....	·38	·02
☽ 8.	30·322	30·252	29·88	29·88	30·00	55	25	42·5	45	42	w.	calm	w.	....	....	·18
9.	30·517	30·459	30·14	30·18	30·08	51	24	36	47½	46½	nw.	wnw.	ssw.	....	....	·11
10.	30·429	30·246	30·00	29·95	29·96	51	27	33	43	48½	nw.	w.	wsw.	....	....	....
11.	30·262	30·207	29·96	30·07	30·18	51	28	34	47	46	ne.	wnw.	w.	....	....	·26
12.	30·308	30·043	30·04	30·08	29·96	50	38	30·5	51	48	ne.	n.	sw.	·03	....	·06
13.	29·912	29·760	29·64	29·76	29·87	46	31	38	47	43	ne.	n.	w.	....	....	....
14.	29·740	29·672	29·43	29·82	29·67	45	30	38	40	43	nw.	nw.	calm	....	·04	....
○ 15.	29·685	29·631	29·43	29·62	29·63	40	36	30	42	38½	s.	nw.	s.	·11	....	·09
16.	29·695	29·644	29·45	29·62	29·66	46	25	39·5	42	40	w.	nw.	nw.	....	·07	....
17.	29·801	29·735	29·53	29·74	29·69	46	18	30·5	37½	37	n.	calm	sse.	....	....	·08
18.	29·995	29·956	29·70	29·53	29·62	41	21	27	46	45	sw.	nw.	s.	....	....	·26
19.	30·054	29·969	29·75	29·44	29·58	49	25	32	50½	45	s.	s.	w.	....	....	·06
20.	30·086	29·887	29·67	29·70	29·88	46	23	40	41	42½	s.	sw.	wsw.	·06	....	·10
21.	30·292	30·230	30·03	30·15	30·12	46	21	30	40	43	n.	n.	s.	....	·04	·13
22.	30·295	30·178	30·05	30·08	29·92	36	23	26	45	43	s.	nw.	sse.	....	....	....
☾ 23.	30·227	30·049	29·94	30·05	29·97	33	24	30	45½	42½	s.	calm	sse.	....	....	....
24.	30·057	29·924	29·79	29·66	29·85	41	29	33	44	42	s.	s.	sse.	·12	....	....
25.	30·095	29·959	29·80	29·65	29·52	46	33	34	42	45	se.	s.	s.	·26	·03	....
26.	29·974	29·781	29·55	29·88	30·04	43	31	40	37½	39	n.	ne.	se.	·05	·38	·20
27.	30·119	30·038	29·86	29·95	29·76	40	37	39	42½	43½	ne.	nw.	se.	....	·07	....
28.	30·291	30·126	29·84	29·82	29·94	45	37	38·5	45	38	s.	s.	se.	....	....	·09
29.	30·086	29·980	29·74	29·43	29·52	50	39	37	46	43½	s.	s.	sse.	·05	·05	·30
● 30.	30·058	30·025	29·72	29·70	29·93	52	47	47	41	49	se.	ssw.	se.	·01	·27	·09
Mean.	30·079	29·966	29·74	29·819	29·857	48·13	32·16	38·0	45·35	44·40				0·81	1·33	2·62

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VIII.—*Monograph of the British* Graphideæ. By the Rev. W. A. Leighton, B.A., F.B.S.E.

[With four Plates.]

Graphideæ.

Apothecium oblong or lirellæform. Disk at first connivent or veiled, oblong, subcanaliculate. In a normal state margined with a proper or thallodal margin, or both.

This is a very extensive tribe of Lichens, and is well marked, in its typical genera, by the peculiar form of the apothecium, which is elongated into a furrow-like form, simple or branched, sessile or immersed in the thallus, and termed a *lirella* from its shape. This lirella seems in reality to be the patellula of a *Lecidea* whose growth has ceased at two opposite sides or points, and been carried on and developed excessively at two other opposite points at right angles to the former. The carbonaceous excipulum is either entire, enclosing the sides and base of the lamina proligera, and surrounding the disk with a proper margin, as in *Opegrapha*; or is dimidiate and confined to the sides of the lamina proligera, the base being naked, as in *Graphis*; or disappears altogether in the abnormal genera, as *Arthonia*, by which it approximates to the genus *Xyloma* of the Fungi. Fries (L. Reform.) regards the plants as deformations of *Parmeliaceæ* and *Lecidinæ*, *Parmeliæ* and *Biatoræ* "in statu atypico," deforming their apothecia so as to become like those of *Leucogramma* and *Ustalia*, and *Lecideæ* compressing and elongating theirs similar to those of *Opegraphæ*. In the tropics also *Leucogramma* reverts to the type of *Parmelia*, just as *Opegrapha* in temperate regions reverts to *Lecidea*; whilst *Lecanactis* oscillates between the three tribes. The *Graphideæ* are most abundant in the tropics, the genera decreasing northwards, some few obsolete vestiges of tropical genera remaining in Southern Europe. The species also decrease in similar geographical mode, one only, *Arthonia radiata*, being found in Lapland. This geographical distribution he regards as of the highest importance both in distinguishing the species and determining abortive forms. Concerning few tribes has greater diversity of opinion prevailed (and it still prevails) as to what genera should or should not be included in it, and of course it has been subjected to numberless modifications and frequent changes of arrangement. The following succinct summary will show the history of the tribe so far as it could be gained from the works within our reach.

Ray, in the 3rd edition of his 'Synopsis,' p. 71. n. 48 (1724), mentions a lichen "peregrinis velut literis inscripta," which both Micheli and Dillenius identify with their plants. Micheli (Nova Genera, 1729) represents in tab. 56. f. 3, an *Opegrapha* growing on the hazel, which Fries (L. Reform. 463) refers to *Opegrapha stenocarpa*, Ach. He describes (p. 102) also two other forms, one growing on holly in England, and the other (which Dillenius considers as a variety only of the former) on hazel. He includes them in his Ordo 37, which is a singular conglomeration of heterogeneous plants, Lichens and Fungi. Dillenius (Musc. p. 125, 1741) regards the figure of Micheli (t. 56. f. 3) as identical with his own figure in tab. 18. fig. 1. A & B, representing a plant occurring on the oak and elm. They appear to me very dissimilar in appearance. Fries (L. Reform. 370 & 463) refers Dillenius's figure to *Graphis scripta*, Ach. Most probably both these elder writers intended to comprehend all *Opegraphæ* generally under their descriptions and figures, not having devoted themselves to distinguish the various species. Adanson in 'Familles des Plantes' (1763) first allotted a particular name to these plants, *Graphis*, which Ehrhart also adopted in his 'Plantæ Exsiccatæ.' Linnæus in his 'Systema Vegetabilium' (1767) and all his subsequent writings included them all under his *Lichen scriptus*. And this view was followed by all subsequent authors until Humboldt (Flor. Friberg. 1793) first published the genus *Opegrapha*, constituted originally (see Luyken, Tentam. 44, and Humb. Fl. Frib. 57) by Willdenow [? in MS., certainly not in his Prodr. Fl. Berol.], under which he arranges three species which had been previously described by preceding writers under another name, *Verrucaria*. The name *Opegrapha* was adopted by Persoon, Schrader (Spicil. Fl. Germ. 1794), Acharius (Prodr. 1798 & Meth. 1803), Lamarck and DeCandolle (Flor. Française, 1803), Dufour and other botanists universally. Persoon in 'Usteri Annal.' st. 7 (1794) and in the 'Act. Wetter.' first extends our knowledge of species by describing and figuring with his characteristic perspicuity and acuteness many additional ones. He also invented the expressive term *lirella* for the apothecium. DeCandolle (Flor. Française, 1803) comprehends *Opegrapha* in the 2nd Tribe, Pseudo-Lichenes, of his Order *Hypoxyla,* intermediate between Fungi and Lichenes, and comprising in the 1st Tribe (Pseudo-Fungi) the genera *Rhizomorpha, Sphæria, Næmaspora, Xyloma* and *Hypoderma*; and in the 2nd Tribe, *Hysterium, Opegrapha, Verrucaria* and *Pertusaria.* Acharius in his 'Lich. Univ.' (1810) distributes the comprehensive genus *Opegrapha* of previous authors into three separate genera, distinguished by the structure of the apothecium, viz. *Arthonia, Opegrapha* and *Graphis.* The first is characterized by an apothecium subrotund, plane, without a proper margin and covered with a black membrane; the second by an apothecium elongated, having a proper margin, perithecium entire and surrounding the base and sides, sessile and without a thallodal margin; and the third by an elongated apothecium, with a proper margin, perithecium lateral only, the base being naked, immersed, and with a thallodal margin. The name *Graphis,* though adopted from Adanson and Ehrhart, was not used by him in the comprehensive sense of these authors. The same arrangement, with some modifications and numerous additions to the species, was continued by Acharius in his 'Synopsis' (1814). Dufour published a Monograph of this tribe in the 'Journal de Physique' for 1818, and Chevallier in the same journal for February 1822 published a *précis* of his proposed larger work. The latter in his unfinished 'Histoire des Graphidées' (1824) forms a new order termed *Pherophoreæ,* equivalent to the 2nd Tribe, Pseudo-Lichenes, of DeCandolle's *Hypoxyla,* and divides it into two tribes:—1st, *Graphideæ,* containing *Opegrapha, Allographa, Arthonia* and *Schizoxylon*; 2nd, *Verrucarioideæ,* containing *Verrucaria, Pyrenula, Trypethelium, Glyphis* and *Chidothecia. Opegrapha* is divided into two sections, *Hysterina* = *Opegrapha,* Ach., and *Graphina* = *Graphis,* Ach. *Allographa* is made up of exotic species, and is founded on *Graphis Poitæi,* Fée, and *Graphis Afzelii,* Ach. [? if therefore equivalent to Fries's *Graphis,* S. O. V.]. *Arthonia* = *Arthonia,* Ach.; *Schizoxylon,* Pers. and Auct., according to Fries (S. O. V. 121) a genus of Fungi of his Order *Xylomacei.* The published portion of the work comprises only the first and a small part of the second subdivision of the section *Hysterina* of *Opegrapha,* and is illustrated with twenty coloured plates filled with representations, nat. size and magnified, many of them very faithful, and characteristic of the various forms rather than distinct species with which the author would bring us acquainted. Schærer in his 'Spicilegium' (1823–1836), and in his other works retains all under *Opegrapha* and *Arthonia*. Fée in the first part of his 'Essai sur les Cryptogames' (1824) divides the *Graphideæ* as follows :—"*Arthonia*, fausses lirelles sessiles, homogènes, immarginées, non impressionées" = *Arthonia*, Ach. L. Univ. "*Heterographa*, fausses lirelles sessiles, homogènes, maculiformes en vieillissant, pourvues d'une fente dans la jeunesse," founded on *Opegrapha faginea* and *quercina*, DC. (*Opeg. macularis*, Ach.), which is regarded by Fries as a fungus, and perhaps justly. "*Enterographa*, lirelles profondement immergées, homogènes, non impressionées," founded on *Opegrapha crassa*, DC. (*Sagedia aggregata*, Fries). "*Opegrapha*, lirelles sessiles, homogènes, impressionées" = *Opegrapha*, Ach. L. Univ. "*Graphis*, lirelles sessiles, hétérogènes, canaliculées" = *Graphis*, Ach. L. Univ. "*Sarcographa*, lirelles labyrinthiformes à base charnue." "*Fissurina*, fausses lirelles situées inférieurement, déterminant une fissure dans le thallus qui margine."

Eschweiler (Syst. Lich. 1824) makes nine genera out of *Opegrapha*, *Graphis* and *Arthonia* of Acharius, using the form and structure of the lirella as the foundation of his arrangement; viz. 1. *Diorygma*, type *Opeg. hieroglyphica*, Pers. Act. Soc. Wetter. 2. 16. t. 10. f. 3, "orbis novi incolæ." 2. *Leiorreuma*, which includes many tropical species of *Graphis*, Ach. As its type *Opegrapha Lyellii*, Eng. Bot. t. 1876. is given, but the section of that plant which is represented with an entire perithecium surrounding the base, as is really the case in the authentic specimens which I have examined in herb. Borrer., does not correspond with the section of the same part in the figure of *Leiorreuma hepaticum* given by Eschweiler, in which the perithecium is lateral only in accordance with the generic description. 3. *Graphis* = *Graphis*, Ach., according to the figures given, and those of Acharius, 'Lich. Univ.' (t. 3. figs. 14, 15) referred to. 4. *Opegrapha* = *Opegrapha*, Ach., section 1. *Hysterina*, Ach. 5. *Oxystoma*, type *Op. cylindrica*, Radd. Act. Soc. Ital. della Scienza, xviii. 1820, tome iii. fig. 1. 6. *Scaphis* = *Opegrapha*, Ach., section 2. *Alyxoria*, Ach. 7. *Lecanactis*, type *Arthonia lyncea*, Ach. 8. *Sclerophyton*, Eschw., "perithecio mere infero, nucleum tenuem suffulciente, disco planiusculo." 9. *Pyrochroa*, types *Graphis coccinea*, Holl.; *G. caribæa*, Ach.—all tropical plants. Eschweiler figures the sporidia of each genus, but in Fée's estimation incorrectly. Fries in his 'Systema Orbis Vegetabilis' (1825) re-arranges them in six genera:—1. *Graphis* = *Leiorreuma*, Eschw.; its type *Graphis Afzelii*, Ach. 2. *Opegrapha* in four subgenera, viz. A. *Hysterina* = *Opegrapha*, Eschw., and *Opegrapha* sect. *Hysterina*, Ach. B. *Oxystoma*, Eschw. C. *Scaphis*, Eschw., and *Opegrapha*, sect. *Alyxoria*, Ach. D. *Erumpentes* = *Graphis*, Eschw. [and by consequence *Graphis*, Ach.]. 3. *Lecanactis*, Eschw. 4. *Sclerophyton,* Eschw. Fries gives *Arthonia dendritica,* Duf., *Graphis,* Ach., as his type, but the structure in authentic specimens in herb. Borrer. of *Graphis dendritica* is very different from Eschweiler's figure. 5. *Ustalia = Pyrochroa,* Eschw., type *Graphis caribæa,* Ach. 6. *Coniangium,* types *Arthonia ochracea,* Duf., *Spiloma auratum,* E. Bot. Meyer in his 'Lichenum Dispositio' (1826) does not recognise the genus *Opegrapha,* but adopts the following:—*Graphis = Oxystoma, Scaphis, Lecanactis* and *Sclerophyton,* Eschw., and *Fissurina,* Fée; *Asterisca,* Meyer = *Sarcographa,* Fée; *Leucogramma,* Meyer; and *Platygramma,* Meyer = the greater part of the species of *Leiorreuma, Diorygma, Pyrochroa,* many species of *Arthonia,* and many of *Graphis,* Ach. Sprengel in his edition of Linnæus's 'Systema Vegetabilium' (1827) has *Graphis,* Adans., *Asterisca,* Meyer, and *Platygramma,* Meyer.

Wallroth, 'Crypt. Germ.' (1831), includes in the first tribe of his Ordo 2. *Lichenes Discocymatii*: 1. *Arthonia,* Ach. = *Coniocarpon,* DC., *Conioloma,* DC. and Eschw., and some species of *Spiloma* and *Arthonia,* Ach. 2. *Graphis,* Adans. = *Graphis,* Adans., Ehrh. & Ach., *Opegrapha,* Auct., *Arthonia,* Ach., *Trachilia,* Fries, *Gyrophora,* Ach., *Umbilicaria,* Hoffm., and some species of *Lecidea,* Spreng. Syst.

Fries (L. Reform. 1831) considers that all the European forms of *Graphis,* Ach., may be safely referred to *Opegrapha,* and regards the apparent deviations from it which are occasionally met with as merely approaches to tropical genera, rather than as species of those tropical genera which have, contrary to geographical data, penetrated into these more temperate zones. He therefore rejects *Graphis* and retains the old name *Opegrapha,* "per omnem orbem literatum jam receptissimum *Opegraphæ* nomen, *cum sub isto omnes species jam descriptæ et cognitæ sint.*" He includes therein *Opegrapha,* Humboldt, Pers. & Auct.; *Opegrapha* and some species of *Graphis,* Ach. L. Univ.; *Opegrapha, Graphis, Scaphis,* Eschw. Syst., and some species of *Graphis,* Meyer. He regards *Arthonia,* Ach., and *Spiloma,* Ach., chiefly as abortive forms of *Opegrapha.* The other genera which he arranges in his *Graphideæ* are *Lecanactis,* Eschw., type *O. lyncea,* T. & B.; *Coniangium,* Fries, type *Spiloma paradoxum,* Ach., and *Coniocarpon,* DC., type *Spiloma gregarium,* Turn. & Borr.,—appending *Umbilicaria,* Hoffm., as a genus intermediate between *Lecidinæ* and *Graphideæ.*

Eschweiler in 'Mart. Flor. Brasil.' (1833) modifies the views he had taken of the genera in his 'Systema,' and distributes them afresh, thus:—1. *Diorygma = Fissurina,* Fée. 2. *Graphis,* Adans., comprising two sections, I. *Eugraphis = Graphis,* Eschw. Syst.; *Graphis,* Ach. & Fée in part; *Opegraphæ erumpentes,* Fries, S. O. V.; with the characteristics, "Apothecium immersum, perithecio infra deficiente, discum canaliculatum elevato-marginante." II. *Opegrapha* = *Opegrapha*, Ach.; *Opegrapha* and *Scaphis*, Eschw. Syst.; *Opegrapha hysterina* and *Scaphis*, Fries, S. O. V.; *Opegrapha hysterina* and *Allographæ* species, Chev., with the distinctions, "Apothecium emersum, perithecio integro, discum plano-canaliculatum suffulciente." 3. *Oxystoma* = *Oxystoma*, Eschw. Syst., and *Opegrapha Oxystoma*, Fries, S. O. V., with an entire perithecium converging upwards. 4. *Leiogramma*, with, as it appears to me, somewhat of an indefinite character, the base of the perithecium being described as either entire or deficient, and yet he remarks, "perithecium licet subinde tenuissimum, in perfectis adultis *nunquam deest*." Hence he concludes that Meyer's characters of his genera *Leucogramma* and *Platygramme* are erroneous, the former being, in his estimation, a younger, the latter an adult state of the same species of *Ustalia*, Eschw. It is further remarked, that *Leiogramma* "a Graphide strictissime distinguitur defectu marginis proprii ob perithecium omnino latens," and that the nucleus is tetraquetrous. This genus is divided into three sections: I. *Leiorreuma*, "perithecio basi deficiente" = *Leiorreuma*, Eschw. Syst. & Icon. Sel. Crypt. t. 6. f. 2, 3; *Graphis*, Fries, S. O. V.; species of *Graphis* and *Arthonia*, Ach. & Fée; species of *Leucogramma*, and perhaps also of *Platygramme*, Meyer. *Opegrapha dendritica*, E. Bot. 1756, is cited as being referable here, but this plant has constantly a distinct though very thin perithecium subtending the base, and therefore would seem rather to belong to section 2. II. *Lecanactis*, "perithecio dimidiato infra subcontinuo" = *Lecanactis*, Eschw. Syst. & Icon. Sel. Crypt., and Fries, S. O. V.; and species of *Arthonia*, Ach. & Fée. The type of course is *Lecanactis lyncea*. III. *Medusula* = *Medusula*, Eschw. Syst. & Fries, S. O. V.; species of *Sarcographa*, Fée; species of *Asterisca*, Meyer. 5. *Sclerophyton* = *Sclerophyton*, Eschw. Syst., and Fries, S. O. V. 6. *Ustalia* = *Ustalia*, Fries, S. O. V., and Eschw. Icon. Sel. Crypt.; *Pyrochroa*, Eschw. Syst.; species of *Platygramme* and *Leucogramma*, Meyer. 7. *Arthonia* = *Arthonia*, Eschw. Syst. & Icon. Sel. Crypt.; species of *Arthonia*, Ach. L. Univ.

Borrer in Hooker's 'British Flora,' 2. (1833) arranges in the family *Graphideæ*: 1. *Arthonia* = *Arthonia*, Ach., and 2. *Opegrapha* = *Opegrapha* and *Graphis*, Ach., and *Platygramme*, Meyer. He sanctions Meyer's genus *Platygramme* as distinct, remarking that three of our British species, *dendritica*, *Lyellii* and *venosa*, belong to it.

Taylor in Mackay's 'Flora Hibernica,' part 2 (1836), follows the same arrangement.

Fée in the 2nd part of his 'Essai' published in 1837 states, that the study of the thecæ (asci) of the *Graphideæ* has convinced him that many of the genera are empiric, and has proved to him that his genus *Thecaria* and *Glyphis*, Ach., before arranged among the *Verrucarieæ*, should be added to the *Graphideæ*. He thinks that the genera *Coniangium* (*Spiloma paradoxum*, Ach.) and *Coniocarpon* (*Spiloma*, Ach.) are improperly placed among the *Graphideæ*.

Fries in 'Summa Veg. Scand.' (1846) includes in *Graphideæ*—1. *Umbilicaria*, Hoffm. 2. *Opegrapha* (comprehending *Graphis*, Ach., and *Opegrapha*, Ach.). 3. *Lecanactis*, Eschw. 4. *Arthonia*, Duf., "genus dubium." 5. *Coniocarpon*, DC. He omits in the enumeration of the species included under each genus all mention of *Opegrapha elegans, dendritica, Lyellii*, and *Coniangium vulgare*, possibly regarding the first as belonging to a distinct genus, and the three latter as referable to *Arthonia*, Duf.

Many of the genera above enumerated refer almost exclusively to tropical plants, and are wholly inapplicable to the structure of our indigenous ones. Moreover, Fries declares it to be in his opinion incorrect to consider the plants of temperate zones as species of tropical genera. Considering however that we act in direct violation of nature by comprising, as Fries has done, plants of such markedly different structure all under one genus, *Opegrapha*, it seems best to give up ourselves to the guidance of nature and follow the path which she may point out. With this principle in view, I have been under the necessity of creating some few additional genera in this already overloaded tribe, in endeavouring to arrange our indigenous species under genera founded conjointly on the structure of the perithecium, the nature and general character of the thallus, and the sporidia.

This essay is founded on the microscopical examination of several thousand specimens in the herbaria of Wm. Borrer, Esq., F.L.S.; Rev. T. Salwey; Rev. Andrew Bloxam; the late W. Thompson, Esq. of Belfast, and others, to all of whom my best thanks are offered for their zeal and liberality in communicating specimens; together with those in my own collection.

It should be observed that the figures of the sporidia in all the species are drawn to the same scale, and consequently are in relative proportion.

1. *Opegrapha*, Ach.

Apothecium lirellæform, sessile; perithecium carbonaceous, entire, or surrounding the sides and base; disk rimæform or canaliculate, surrounded with a prominent proper margin. Thallus crustaceous or membranaceous.

Name from ὀπὴ, *hollow*, and γραφὴ, *writing*.

* *Saxicolæ.*

1. *O. tesserata*, DC. Thallus tessellato-areolate; lirellæ slightly prominent, short, obtuse, dark brown; sporidia eight in asci, minute, oblong, pale, hyaline.

Opegrapha tesserata, DC. Flor. Franç. 2. 313 (1805); Chevallier, Hist. des Graphidées, 51. t. 11. f. 1; Borr. E. Bot. Suppl. 2632. fig. 2 (good); Hook. Br. Fl. 2. 146.
—— *petræa*, Ach. Syn. 72 (1814); Fries, L. Ref. 362.
—— *saxatilis*, *β. tesserata*, Schær. Enum. 159 (1851).

Holwick Scar on the Tees, Yorkshire! *Mr. W. Robertson in herb. Borrer.* Valley of Rocks, Linton, North Devon, *Mr. Borrer.*

Nothing need be added to the characteristic figures and descriptions both in 'E. Bot. Suppl.' and Chevallier's work, but to remark that the edges of the areolæ within the interstices are of a brownish-black colour, as if there were a dark substratum. By reason of the firm and persistent nature of the pale gelatinous contents of the lirellæ, the examination under the microscope was scarcely so satisfactory as could have been desired. It appeared to consist of erect oblong asci, in each of which were eight rather minute oblong pale sporidia, apparently without septum.

The thallus and sporidia distinguish this from *O. rupestris* and *O. saxigena*; the thallus, sporidia, and lirellæ from *O. cerebrina*, *O. saxatilis*, and *O. Chevallieri.*

Plate V. fig. 1. *a*, Vertical section of thallus and lirella; *b*, sporidia; *c*, ascus.

2. *O. cerebrina*, DC. Thallus continuous, chalky-white; lirellæ prominent, lumpy, rounded or squarish, full-black; sporidia in asci eight, linear-oblong, margined, uniseptate, bluish-slate or smoky colour, surrounded with a broad white margin.

Opegrapha cerebrina, DC. Flor. Franç. 2. 312 (1805); Chev. Hist. des Graphidées, 57. t. 12. f. 4; Borr. E. Bot. Suppl. 2632. fig. 1; Fries, L. Ref. 363; Hook. Br. Fl. 2. 146.
Lecidea plocina, Ach. L. Univ. 155 (1810); Syn. 16.
—— *cerebrina*, Schær. Spicil. 136. 196 (1823–1836); Enum. 159.

North of England! *Rev. J. Harrimann in herb. Borrer.*

The general aspect, colour and structure of the chalky continuous thallus distinguish this at first sight from *Op. tesserata*. The more lumpy, rounded or squarish form of the scattered, less frequently grouped lirellæ, which are more prominent and less immersed in the thallus, their full-black colour, their thinner, sharper and less swollen inflexed margins, and the singular sporidia are the marked characteristic distinctions from that species. Each sporidium seems enveloped in a hyaline membranous sac, which appears as a white margin surrounding it, the proper margin or sac of the sporidium itself being visible through its slate-colour.

Plate I. fig. 2. *a*, Vertical section of thallus and lirella; *b*, sporidia.

3. *O. saxatilis*, DC. Thallus pulverulent, chalky-white; lirellæ prominent, rigid, straight or stellato-divergent, tapering towards each extremity; sporidia in asci eight, obtusely or subclavately fusiform, 5-, 6- or 7-septate, the central cell the largest, pale yellow.

Opegrapha saxatilis, DC. Flor. Franç. 2. 312 (1805); Chev. Hist. des Graphidées, 56. t. 12. figs. 1, 2, 3; Fries, L. Reform. 366; Hook. Br. Fl. 2. 145 (in part); Tayl. Fl. Hib. pt. 2. 106 (in part); *α*, Massalongo, Comm. Lich. 102. t. 19. fig. 120.
—— *calcarea*, Turn. E. Bot. 1790 (1807).
—— *calcaria*, Ach. L. Univ. 250 (1810); Syn. 72.
—— *lithyrga*, Ach. Syn. 72. ex specim. Schleicheri in herb. Borrer!; Moug. & Nestl. Stirpes, 856!
—— *cymbiformis*, *ζ. hebraica*, B. *saxicola*, Schær. Spicil. 331 (1823–1836).
—— *varia*, *θ. calcaria*, Schær. Enum. 158 (1851).

Netley Abbey! *Mr. Lyell in herb. Borrer* (on chalk and on mortar). Stone Farm Rocks in Ardingley, Sussex! *Mr. Borrer* (on white sandstone). Killarney (on the same stone with *O. Chevallieri*)! *Miss Hutchins in herb. Borrer*. Lamphey, Pembrokeshire! *Rev. T. Salwey*. Bangor, Co. Down! *Wm. Thompson, Esq.* Newton Wood, Cleveland, Yorkshire! *Mr. J. G. Baker*. Great Ayton, Yorkshire! *Mr. G. Dixon*. Great Orme's Head, Caernarvonshire.

Thallus white, pulverulent, chalky, variable in thickness, sometimes entirely obliterated. *Lirellæ* scattered or confluent and crowded, peculiarly rigid in general appearance, full-black in colour, straight or slightly curved and nearly linear in an early state, slightly tapering towards each extremity; in a later and mature state the disk expands in width in the middle, and the lirellæ in consequence become narrowly oblongo-elliptical, very markedly pointed or tapered at the extremities, frequently in stellate groups, at other times with a single ray going off from another at nearly a right angle, sometimes two rays so as to form a trifid lirella, sometimes as represented by Chevallier and in 'E. Bot.' with three or four rays, sessile and prominent. The disk in the early state of the lirella is a straight chink or slit, nearly equal throughout its entire length, and the margins tumid and rounded. Subsequently the disk expands in width in the centre, pushing the margins outwards, which become thin, elevated and somewhat sharp, bulged or baggy, as would arise if growth had been arrested at the extremities, and still gone on in both directions in the middle of the lirella. Finally, the disk becomes still more elevated and expanded, occupying the whole upper surface of the lirella on a level with the margins, which are nearly obliterated and scarcely visible. *Lam. prol.* pale, more or less tinged with brown. *Sporidia* as above, sometimes however one extremity is a little broader and more obtuse than the other, and so of a subclavate fusiform shape; in an old state becoming of a brown colour and more expanded in width, the septa nearly or quite obliterated. The brown membranes of the whole eight sporidia are constantly seen still enclosed in the ascus, which is never observed in *Chevallieri* and *rupestris*. The septa vary in number, sometimes five, six or seven, four on one side and three on the other of the central cell, which is always the largest.

The specimen of *O. lithyrga* from Schleicher in herb. Borrer.! is a very indifferent one, is on a quartzose rock and nearly or quite denuded of the thallus, which is discoloured brown. The sporidia decide its proper arrangement.

The specimens from Ardingley are on coarse white sandstone, quite destitute of thallus, the lirellæ, which are crowded and numerous, resting on the stone itself.

Chevallier (*l. c.*) says, "sa croûte est tantôt épaisse d'un beau noir:" this state I have never seen.

The specimen of *O. saxicola*, Ach., from Schleicher in herb. Borrer.! seems to be something in a young state. It is too imperfect to say positively to what it really belongs, but judging from its general appearance, I incline to refer it to *O. rupestris* rather than to *O. saxatilis*, DC., with which Mr. Borrer (E. Bot. Suppl. *l. c.*) seems to consider it identical.

The rigid lirellæ, stellato-divergent, tapering towards either extremity, and the form and septa of the sporidia are the characters which keep it distinct from *Chevallieri* and *rupestris*.

PLATE V. fig. 3. *a*, Vertical section of thallus and lirella; *b*, sporidia.

4. *O. Chevallieri.* Lirellæ simple, linear, elongated, curved or bent back, flexuose and wavy, black; sporidia eight in asci, broadly clavate, rounded at each extremity, 3-septate, pale yellow.

Opegrapha lithyrga, Chev. Hist. des Graphidées, 54. t. 11. figs. 4 & 5 (excl. Ach. synon.) (1824).
—— *saxatilis*, Hook. Br. Fl. 2. 145 (in part) (1833); Tayl. Fl. Hib. pt. 2. 106 (in part).
—— *atra*, ε. *lithyrga*, Schær. Enum. 154 (1851).
—— *Chevallieri*, Leight. Lich. Brit. Exsic. 67! (1852).

North Wales, *Rev. Hugh Davies*. Killarney (on the same stone with *O. saxatilis*)! *Miss Hutchins*. Netley Abbey! *Mr. Lyell*. Rocks on the sea-shore at Derriquin, Co. Kerry! *Dr. Taylor*. North of England! *Rev. J. Harrimann*; all *in herb. Borrer*. Craigforda near Oswestry, Shropshire! Llanaber! Barmouth! *Rev. T. Salwey*. Colin Glen, Belfast! *Mr. W. Thompson*. Great Orme's Head, Caernarvonshire! South Stacks, Holyhead! Aber.!

Thallus thin, crustaceous, very minutely cracked and crumbly, white or pale yellow, sometimes entirely obliterated. *Lirellæ* numerous, crowded together in patches of greater or less extent, sometimes so thickly so as to be heaped together in black plicate or cerebrinal masses. In a perfect state, elongated, linear, of about the same width throughout their whole length, in various ways bent back upon themselves, curved, flexuose and wavy in a very peculiar and remarkable manner, generally quite simple, seldom if ever branched, sometimes subimmersed, at others sessile and prominent, obtuse at the extremities, smooth and somewhat shining or greasy-looking, the margins tumid, round, and incurved. The younger lirellæ are much shorter and not so curved. The disk is a narrow slit of about the same width throughout, which widens in age, and in extreme maturity becomes open and on a level with the margins which are obliterated, but never baggy as in *saxatilis*.

Dr. Taylor's specimen was on a slaty rock, entirely denuded of the thallus, with only a whitish discoloration, the lirellæ remarkably twisted together in innumerable crowded plicæ or gyrations, forming highly prominent, rounded, black shining masses or clusters. I have gathered similar specimens at the South Stacks, Holyhead, and received such from Rev. T. Salwey from Barmouth. Possibly it may be the var. *b. steriza,* Ach. Syn. 72.

The strongly curved, elongated, linear, simple lirellæ with their singular undulate, wavy and flexuose appearance distinguish this plant from *O. rupestris*; the lirellæ and sporidia from *O. saxatilis*.

Plate V. fig. 4. *a*, Vertical section of thallus and lirella; *b*, sporidia; *c*, upper surface of thallus and lirellæ.

5. *O. rupestris,* Pers. Lirellæ oblong or ovate, deformed; short, obtuse, variously branched, wider at one extremity; sporidia eight in asci, clavate, rounded at each extremity, triseptate, pale yellow.

Lichen Persoonii, Ach. Prod. 19 (1798).
Opegrapha rupestris, Pers. Ust. Ann. Bot. 11. 20; Fries, L. Ref. 364.
—— *Persoonii*, Ach. Meth. 17 (1803); Sm. E. Bot. 2345; Chev. Hist. des Graph. 53. t. 11. f. 2.
—— *Persoonii α*, Ach. L. Univ. 246 (1810); Syn. 71.
—— *saxatilis*, Schær. Spicil. 49. 328 (1823–1836).
—— *saxatilis α*, Schær. Enum. 159; Exsic. 94! Hook. Br. Fl. 2. 145 (in part) (1833).

Ireland! *Miss Hutchins.* Netley Abbey! *Mr. Lyell*; both *in herb. Borrer*. Barmouth, Merionethshire! *Rev. T. Salwey.* Larne, Co. Antrim! *Mr. W. Thompson.* Newton Wood, Cleveland, Yorkshire! *Mr. J. G. Baker.* Great Orme's Head, Caernarvonshire!

Thallus thin, crustaceous, of an irregular, scaly or crumbly appearance, dirty white. *Lirellæ* numerous, scattered, for the most part short and obtuse, often nearly round or triquetrous, sessile and somewhat prominent, in variously modified oblong or ovate shapes, straight or slightly curved, either plump and bluntly obtuse at both ends, or widened at one extremity and tapered or narrow at the other, smooth, slightly shining, dark brown. *Disk* varying in width and form according to the shape of the lirella, either an entire narrow slit or trifid, or furcate at one or both ends, more or less open, especially in old age; margins tumid, rounded, and incurved in a perfect state; in old age thinner, sharp-edged, and elevated persistently above the expanded depressed or concave disk.

A specimen from Nent Force, Cumberland! from *Mr. W. Robertson in herb. Borrer,* on granite, has the lirellæ small, round and tumid, or triquetrous, the disk varying much in shape. This may be the var. *β. aporea,* Ach.: the form of the lirellæ and sporidia shows distinctly its connection with *O. rupestris.* I have found precisely similar states on the Great Orme's Head, Caernarvonshire, and on the Eglwsg rocks near Llangollen.

The specimen of "*Lichen simplex,* E. Bot., from Rev. Hugh Davies" *in herb. Borrer,* was a thin slaty rock, on a small darker part of which were scattered a few fragments or frustules of a whitish, smooth, very thin, slightly cracked thallus, growing on a hypothallus of a dark brown or blackish colour, spreading copiously on all sides in a dendritic manner. Imbedded in the centre of the frustules of the thallus was a single minute shield, or sometimes two or three crowded together, dark brown, with a thick prominent margin surrounding a deep very concave disk of similar colour, which, when wetted, swelled and became convex, or at least level with the surface of the margin. A vertical section (see Plate V. fig. 6 *a*) exhibited the dark brown excipulum, interrupted however, of a *Lecidea* supporting a lamina proligera, the asci in which were filled with brown oblong sporidia, uniseptate (fig. 6 *b*), and were so numerous as to give the section a speckled appearance. On other paler and more shaly portions of the specimens were an abundance of irregularly rounded black bodies of various sizes, some as large as poppy seed, others as small as the shields before spoken of. The smaller of these bodies were somewhat like the plump tumid form of a lirella of an *Opegrapha*; the generality of the larger kind presented a prominent wrinkled or broken inflexed border or margin, surrounding either a sunk disk or a sunken ring which encompassed a central portion thick and irregularly raised to a level with the margins; whilst others again were gyrate like the apothecia of an *Umbilicaria.* All were sessile on the naked rock, without the slightest trace or appearance of any thallus. A vertical section (fig. 6 *a*, 1) showed the inflexed margins supporting the sides of a lamina proligera, whose upper surface was covered in the centre with the thick central portion, the base being naked and resting on the rock. The lamina proligera was pale and hyaline, consisting of paraphyses, amongst which were asci of an obovate-elongated or clavate shape filled with minute granular matter.

Schleicher's specimen! of *O. saxicola*, Ach., *in herb. Borrer*, seemed referable to this species, see p. 90 *ante*.

Distinguished from *O. saxatilis* by the shape of the lirellæ and sporidia; from *O. Chevallieri* by the form of the lirellæ; from *O. tesserata* and *O. cerebrina* by the thallus and sporidia.

PLATE V. fig. 5. *a*, Vertical section of thallus and lirella; *b*, sporidia.

6. *O. saxigena*, Tayl. Lirellæ linear, linear-oblong, oblong or ovate, deformed, obtuse at the extremities, chiefly simple and straight, dark brown; sporidia eight in asci, narrow, linear-oblong, rounded at each extremity, 3-septate, pale yellow.

Opegrapha saxigena, Tayl. Fl. Hib. pt. 2. 259.

Dunkerron! *Dr. Taylor in herb. Borrer.*

Thallus moderately thick, crustaceous, indeterminate, irregularly cracked, of a dirty rusty-brown colour in the older portions where the crust is thinner, in the younger and thicker portions and about the lirellæ, of a scaly, crumbling, leprose, yellow appearance. *Lirellæ* loosely congregated in groups, very various in shape, round or punctiform, oblong, linear-oblong, linear, ovate, subtriquetrous, modified by branching into an irregular, oblong, triquetrous form, generally simple, straightish or slightly curved and waved, very obtuse at the extremities, dark brown, smooth, somewhat shining, the margins incurved, tumid and round, slightly rugged or broken. *Disk* generally narrow, straightish, though varying in width and direction according to the form of the lirella, yet not widely open and expanded, the margins always rounded and incurved, tumid, not sharp-edged as in *O. rupestris*. The sporidia are sometimes broader at one end than the other, and so approaching a subclavate form.

So closely allied to *O. rupestris*, that, notwithstanding the above differences, we shall perhaps do well in hesitating to pronounce it decidedly distinct from that species.

A specimen! in Mr. Borrer's herbarium from Dr. Taylor, labelled by him "*Opegrapha saxigena*, Fl. Hib., var. *trochodes*, (new variety), Carig Mountain, Co. Kerry," proved on examination to be the deformed patellulæ of some *Lecidea*. (See Pl. V. fig. 8 *a* & *b*).

PLATE V. fig. 7. *a*, Vertical section of thallus and lirella; *b*, sporidia.

** *Corticolæ.*

7. *O. varia*, Pers. Thallus pulverulent, white; lirellæ prominent, sessile, round, oblong, elliptical or elongated and attenuated at each end; disk canaliculate or dilated in the middle, or plane and convex; proper margins prominent, inflexed, sometimes subevanescent; sporidia in asci eight, irregularly obovate or obovate-fusiform, 5-septate, the central cell larger, hyaline, pale yellow.

The so-called *varieties* of this very variable lichen seem to be more properly speaking *states*, arising from a greater or lesser development of the lirellæ dependent upon local circumstances, localities or atmospheric influences, or of more or less mature age. The sporidia are alike in all.

a. pulicaris, Lightf. Lirellæ oval, oblong or elliptical, minute, simple; disk concave, dilated in the middle; proper margins persistent, inflexed.

Lichen crustaceus, &c., Mich. Gen. Pl. p. 102. t. 54. ord. 37. f. 2? (1729).
—— *scriptus, β. pulicaris*, Lightf. Fl. Scot. 2. 801 (1777).
—— *pulicaris*, Hoffm. En. 14. t. 3. f. 2. *e*? (1784).
Verrucaria pulicaris, Willd. Fl. Berol. 370 (1787).
Lichen vulvella, Ach. Prodr. 22 (1798).
Opegrapha vulvella, Ach. Meth. 19. t. 1. f. 9 (1803); Wahl. Fl. Suec. 859.
—— *vulvella, α. & β. pulicaris*, Ach. L. Univ. 251 (1810).
—— *vulvella α*, Ach. Syn. 77 (1814).
—— *notha*, Mart. Fl. Erlang. 278. in part (1817).
—— *cymbiformis, α. pulicaris & β. phæa*, Schær. Spicil. 50. 329 (1823–1836); Exs. 97! 518! 520!
—— *cymbiformis*, Heppe, Fl. Wurzburg. 75 (1824); Fingerhuth, Eiffl. 24.
—— *ramealis*, Chevallier, Graphid. 65. t. 14. f. 3 (1824).
—— *stizorina*, Chevallier, Graphid. 66. t. 14. f. 4 (1824).
Graphis pulicaris, Wallr. Crypt. Germ. 335 (1831).
Opegrapha varia, a. pulicaris, Fries, L. Ref. 364 (1831); Hook. Br. Fl. 2. 145. in part.
—— *varia, α. pulicaris*, Tuckermann, N. Lich. 75.
—— *varia, γ. pulicaris & β. phæa*, Schær. Enum. 156.

On beech and ash. Sussex! *Mr. Borrer*. New Forest, Hants! *Mr. Lyell in herb. Borrer.*

Thallus effuse, thin, pulverulent, whitish, almost obliterated. *Lirellæ* numerous, scattered, prominent and sessile, minute, tumid, either oval, oblong, elliptical or elliptico-oblong, sometimes a little elongated, straight, sometimes curved, generally simple, occasionally triquetrous, obtuse at the extremities, dark brown-black, broad for the size, but variable in width, according to the greater or lesser degree of expansion of the *disk*, which is either regularly canaliculate and of the same width throughout, or more or less dilated, frequently very considerably in the middle.

Proper margins thick, tumid, prominent, rounded and inflexed, entire and uniform, persistent.

Plate V. fig. 9. Sporidia.

β. notha, Ach. Lirellæ round or oblong, deformed; disk plane or convex, obliterating the proper margins.

Opegrapha lichenoides, Pers. Ust. Ann. Bot. st. 7. p. 30. t. 2. f. 4. *a, b* (1794).
Lichen nothus, Ach. Prodr. 19 (1798).
Opegrapha notha α. & β, Ach. Meth. 17 (1803).
—— *notha*, Sm. E. Bot. t. 1890 (1808); Ach. L. Univ. 252; *a*, Syn. 76; Wahl. Fl. Carpat. 391; Fl. Upsal. 449; *a*. Fl. Suec. 859; DeCand. Fl. Franç. ed. 3. 2. 310; Mart. Fl. Erlang. 278. in part; Grev. Fl. Edin. 353; Heppe, Fl. Wurzb. 75; Fingerhuth, Eiffl. 24; Moug. & Nestl. Stirpes, 857.
—— *cymbiformis, β. lichenoides*, Schær. Spicil. 51. 330 (1823–1836); Exs. 282!
Graphis notha, Wallr. Crypt. Germ. 336 (1831).
Opegrapha varia, b. notha, Fries, L. Ref. 364 (1831).
—— *varia*, Hook. Br. Fl. 2. 145. in part (1836).
—— *varia, β. notha*, Tuckermann, N. Lich. 75 (1848); Leight. Lich. Brit. Exsic. 66!
—— *varia, α. lichenoides*, Schær. Enum. 156 (1850).

On oak. Sussex! *Mr. Borrer*. High Vawr Lane, Oswestry, Shropshire! *Rev. T. Salwey*. Montford Bridge near Shrewsbury, Shropshire!

Thallus effuse, thin, pulverulent, white. *Lirellæ* numerous, scattered and congregated, large, very prominent and sessile, various in size and form, generally of a round, oblong, or linear-oblong shape, obtuse at the extremities, simple and straight, opake black. *Proper margins* very narrow, almost obliterated by the expansion of the broad plane or tumid and convex *disk*.

Not to be confounded with *Lecanactis lyncea*, nor with *Lecidea albo-atra*, var. *corticola*, from which the different sporidia keep it distinct.

Plate V. fig. 9. Sporidia.

γ. diaphora, Ach. Lirellæ elongated, attenuated at both extremities; disk plane; proper margins persistent, flexuose.

"*Opegrapha varia*, Pers. Ust. Ann. Bot. st. 7. p. 30" (fide Ach.) (1794).
Lichen diaphorus, Ach. Prodr. 20 (1798), sec. specim. ab Achario seipso in herb. Borrer!
Opegrapha diaphora α, Ach. Meth. 19 (1803); L. Univ. 254; Mart. Fl. Erlang. 279.
—— *notha, 9. diaphora*, Ach. Syn. 77 (1814).
—— *cymbiformis, γ. hebraica*, Schær. Spicil. 51. 330 (1823–1836); Exs. 98! 519!
—— *varia, d. diaphora*, Fries, L. Reform. 365 (1831); Hook. Br. Fl. 2. 145. in part.
—— *varia, δ. diaphora*, Tuckermann, N. Lich. 75.
—— *varia, 9. diaphora & c. chlorina*, Schær. Enum. 157.

On oak. Sussex! *Mr. Borrer*.

Thallus effuse, thin, pulverulent, white. *Lirellæ* numerous, scattered or congregated close together, prominent and sessile, black, elongated, narrow, wider in the centre, acuminated at both extremities, for the most part simple, but frequently by juxtaposition becoming of a stellate arrangement, straightish or variously curved and flexuose, usually with other lirellæ of a smaller size, and either rotund or oblong, interspersed among them. *Proper margins* narrow, elevated and prominent, wavy, flexuose and inflexed. *Disk* broad, expanded, open and plane, without pruina.

To be distinguished from *O. saxatilis* by its place of growth and the different form of the sporidia.

PLATE V. fig. 9. Sporidia.

δ. *tigrina*, Ach. Lirellæ linear-oblong, obtuse at the extremities; disk channelled, nearly uniform; proper margins persistent, rounded and inflexed.

Opegrapha signata, β. tigrina, Ach. L. Univ. 262 (1810).
—— *diaphora* (excl. syn.), Sm. E. Bot. t. 2280 (1811).
—— *notha, ε. tigrina*, Ach. Syn. 77 (1814), sec. specim. a Schleichero in herb. Borrer.!
—— *versiformis*, Chevallier, Graphid. p. 13. t. 1. f. 1 *a* (1824).
—— *varia, η. tigrina*, Schær. Enum. 157 (1850).
"—— *varia*, Pers." Bohler's Lich. Brit. no. 52!

On beech, oak, elm. New Forest, Hants! *Mr. Lyell in herb. Borrer*. Hurst Pierpoint, Sussex! Haddisco, Norfolk! Coulsdon, Surrey! *Mr. Borrer*.

Thallus effuse, thin, pulverulent, dirty-white, often scarcely visible. *Lirellæ* numerous, scattered here and there, or crowded in groups, prominent and sessile, for the most part simple, straight or sometimes more or less curved, black, shining, linear-oblong, narrow and nearly of the same width throughout, obtuse and rounded at the extremities. *Proper margins* very thick, prominent, rounded and inflexed, entire and uniform, not wavy or crisped. *Disk* narrow, canaliculate, of about the same width throughout and concave, sometimes a little dilated about the middle and then plane.

PLATE V. fig. 9. Sporidia.

ε. *tridens*, Ach. Lirellæ elongated, stellately arranged; disk channelled; proper margins persistent, rounded and inflexed.

Opegrapha tridens a, Ach. L. Univ. 263 (1810); Syn. 79.
—— *varia, d. diaphora*, Fries, L. Ref. 365. in part (1831).
—— *varia*, Hook. Br. Fl. 2. 145. in part (1836).
—— *varia, ι. tridens*, Schær. Enum. 158 (1850).

On beech and elm. New Forest, Hants! *Mr. Lyell in herb. Borrer*. Sussex! *Mr. Borrer*.

Thallus effuse, much thicker than in the other varieties, pulverulent, almost tartareous, of a dirty-white, often tinged with tawny yellow (I could not detect any of the minute fibres mentioned by Acharius, L. Univ. 263), with numerous elevated black points or tubercles, the rudiments doubtless of the lirellæ, scattered irregularly. *Lirellæ* numerous, scattered, large, prominent, sessile, oblongo- or lineari-elongated, flexuose, more or less acuminate at the extremities, frequently also of the same width throughout, and with rather obtuse points, arranged by juxtaposition chiefly, sometimes by confluence into conspicuous stellate groups of three or more elongated flexuose rays. *Proper margins* thick, prominent, persistent, rounded and inflexed, more or less wavy. *Disk* expanded, according to age, either canaliculate and of uniform width throughout, or more or less dilated in the middle.

Specimens! *in herb. Borrer* from Acharius labelled "*Opegr. nimbosæ modific.*;" from Schleicher labelled "*O. nimbosa*," and "*O. phæa v. brunnea*;" and from Schærer labelled "*Opegrapha nimbosa*," according to the form and septa of the sporidia, are all referable to this species. Schleicher's *O. phæa v. brunnea* and Schærer's *Opegrapha nimbosa* are identical with each other, as is also *Opegrapha phæa*, Moug. and Nestl. Stirpes, 954!.

PLATE V. fig. 9. Sporidia.

[To be continued.]

IX.—*Characters of a new European* Pupa, *and of a new Australian* Bulimus. By W. H. BENSON, Esq.

THE following very interesting *Pupa* being undescribed either in Pfeiffer's or Küster's works, and not being contained in Mortillet's recent Catalogue of the South-Western species of Europe, in which list a new *Helix* and a new *Bulimus*, from Nice and its neighbourhood, are enumerated, I am induced by its fortunate discovery, at an early period of my residence here, to lose no time in describing such an important acquisition to the Italian and European fauna. I take the opportunity of publishing at the same time a beautiful addition to the Australian *Bulimi* brought to England by Dr. J. F. Bacon, whose health, severely shaken by a tropical climate, has ultimately rendered necessary a premature return to his native land.

Pupa Rivierana, nobis, n. s.

Testa rimato-perforata, exacte cylindrica, diaphana, nitidula, fusco-cornea, minutissime oblique costulato-striata; sutura profunda, apice obtuso; anfractibus $6\frac{1}{2}$ convexis, ultimo $\frac{1}{4}$ totius longitudinis æquante, antice leviter adscendente, basi circa umbilicum vix compressiuscula; apertura truncato-ovata, 3-plicata, obliqua; peristomate simplici, disjuncto, acuto, albido, marginibus expansiusculis, exteriori superne valde arcuato, labio subreflexo; plica unica in medio parietis, columellari 1 obliqua obtusata brunnea, palatali 1 elongata, albida; extus sulcum efformante, omnibus profundis.

Long. 2, diam. $\frac{5}{8}$ mill.

Hab. in regione Riviera Pedemontana ad basin collium prope Nizza maritimam sub lapide.

In form, size and sculpture approaching most nearly to the edentate *P. minutissima,* but more slender than that species. It is singular that this beautiful little shell should have escaped the researches of Risso, none of whose doubtful species exhibit any approach to it.

It differs from *triplicata,* Studer, in its much smaller size, more slender cylindrical form and stronger sculpture, in the greater comparative size of the columellar plait, in the transverse position of the parietal plait, and the more deeply set palatal tooth, which in some aspects is not visible from the aperture. It is also deficient in the stricture and callus observable behind the outer lip in adult specimens of that species. As in *P. triplicata,* and partially in the South African *P. fontana,* the palatal tooth causes a furrow on the outside of the lower whorl. The costulæ are flattened and narrow, and the intercostal spaces double the breadth of the ribs.

It has a whorl more than *P. Ascaniensis,* A. Schmidt, is larger and more lengthened in form, the forms and proportions of the teeth differ, and its peristome, which is fully formed, has no resemblance to that of the Aschersleben species. The sculpture, moreover, is more delicate, and the whorls more ventricose than in Archdeacon Schmidt's late interesting addition to the German fauna.

In M. Albin Gras' Mollusca of the Department of the Isère, his figure of *P. muscorum,* Michaud, var. à deux dents, pl. 4. f. 18, from the Bastille near Guy Pâpe, approaches *P. Rivierana.* He notes one tooth on the columella (the plate shows it to be parietal), and one on the lower edge (the plate shows this to be within the outer lip near the base, not deeply placed in the centre of the lower whorl, as in *Ascaniensis* and *Rivierana*). In the description M. Gras makes no mention of the sculpture, and no striæ or costulæ are observable in the plate, while the obtuse plait on the columella of *P. Rivierana* appears also to be deficient. Pfeiffer and Küster both refer Michaud's *P. muscorum* to *minutissima,* together with Draparnaud's shell, in which that author notices a slight parietal plait. Risso's *P. muscorum* is also referred, with a mark of doubt, to *P. minutissima*, but the size, the ivory peristome, and the angular plait (postice ad dextram) seem to identify his shell with *P. umbilicata*, which is not uncommon about Nice. Linnæus's prior name of *P. muscorum* being now by common consent attributed to *P. marginata*, Drap., the species intended by Draparnaud and his followers, whether referable to *minutissima* or to the species above described, can no longer bear the name assigned to them by those authors.

Küster notes as one of the characters which separate *P. umbilicata* from *P. Sempronii*, a species found at Bex and the Simplon, that the latter is deficient in the fold of the columella, which is always present in the other, to which he assigns the character "columella subplicata." Pfeiffer overlooks it altogether; it must however be confessed that ordinarily this plait is inconspicuous, and only to be observed when particular attention is directed to it. In one of my Nice specimens this feature is so strongly marked as to attract immediate notice.

[*Note.*—Specimens of *Pupa Rivierana* were collected by Mr. John Paget near Montpellier, quite identical with the Nice shell in habit, teeth, and columellar fold. They were by him referred to *P. minutissima*, although the parietal and palatal teeth had attracted his notice. The climate and situation of Montpellier are similar to those of Nice. I have found two specimens here, and Mr. Paget has since procured a third.—W. H. B. Jan. 10, 1854.]

Bulimus Baconi, nobis, n. s.

Testa perforata, globoso-ovata, tenui, pallida, castaneo-fusco-bifasciata, sericea, confertim striata, superne striis exilissimis decussata; spira conica, apice obtuso, papillari, sutura tenuiter crenulata; anfractibus 5 convexiusculis, ultimo inflato, dimidium testæ vix superante, bifasciato, fascia 1 superiori angusta, altera inferiori lata: apertura ovata, peristomate simplici acuto, margine columellari superne reflexiusculo.

Axis 23, diam. 15, alt. apert. 12, diam. 9 mill.

Hab. in Australia occidentali.

Found by Dr. Bacon in Darling's Range, six miles from Henley Park on the Avon River. In its transverse bands and colouring it differs from all the West Australian species, and inclines to the Tasmanian *B. Dufresnii*.

Nizza Maritima, December 1853.

X.—*A Catalogue of the Species of Ants found in Southern India*. By T. C. Jerdon, Esq., Assistant Surgeon, Madras Medical Establishment.

[Concluded from p. 56.]

2nd Tribe. Ponerites.

Genus Odontomachus, Lat.

The single species of Ant which I place under this head appears to correspond pretty well with the characters of the genus which have already been given.

24. *Odontomachus rufus*, Jerdon (p. 116).

Worker, length $\frac{1}{4}$th of an inch; head bulging at the sides, narrowed in front; eyes of moderate size, anterior; antennæ rather long, slender; jaws closely approached at their base, long, linear, with three strong pointed teeth at the end; thorax narrow; abdominal pedicle raised, pointed and conic; abdomen long, oval; head, thorax and legs rufous; abdomen dark brown.

I obtained this ant under stones in a jungle in the Salem district, and know nothing of its habits.

I have since obtained one individual also in the Wynaad, which may be the warrior of this species, if the society consist of different individuals. It is $\frac{1}{2}\frac{1}{4}$ths of an inch long, and appears only to differ, besides its larger size, in having the eyes smaller and more advanced, the teeth of the jaw blunt, and the thorax finely striated.

Harpegnathos*, Jerdon, new genus (p. 116).

Gen. Char. Jaws scythe-shaped, pointed, and finely serrated; head oblong, notched behind; eyes very large, situated at the anterior extremity of the head; antennæ rising between the eyes; abdominal pedicle slightly raised.

I cannot class this remarkable ant as an *Odontomachus*, and have therefore been compelled to institute a new genus for its reception; some of the characters given may not be generic, but, till other species are discovered, it is difficult to say which are, and which are not, of generic value.

25. *Harpegnathos saltator*, Jerdon (p. 117).

Worker, head long, granulated; jaws with a strong tooth near the base pointing downwards and inwards, and thence gradually

* This name is too like *Harpognathus* of Wesmael, who used it for a genus of *Staphylinidæ* in 1834.—F. M.

tapering to the tip, and finely serrated, $\frac{1}{6}$th of an inch long; thorax barely grooved; abdominal pedicle small, low, ovate; abdomen very long; sting large; head and abdomen blackish brown, thorax and legs rufous. Length $\frac{3}{4}$ of an inch.

I have not seen this remarkable ant in the Carnatic. I first saw it at Tellicherry, and subsequently in other parts of Malabar. It is also found in the Mysore country, as I learn from Mr. Hamilton, a most talented and industrious amateur entomologist.

I have given it the name of *saltator* from its power of making most surprising jumps, which it does when alarmed or disturbed. It is very pugnacious, and bites and stings severely. It makes its nest underground, generally about the roots of some plant. Its society does not consist of many individuals. It appears to feed on insects, which it often seizes alive.

Genus Ponera, Lat.

Its generic character has been given above.

26. *Ponera sculpta,* Jerdon (p. 117).

Worker, length from $\frac{5}{17}$ths of an inch to nearly $\frac{1}{2}$ an inch; head oblong, pointed in front and rounded behind; jaws large, triangular, armed with, alternately, a large and a small tooth; eyes very large, nearly medial; antennæ inserted on a line just in front of the eyes, rather long; thorax nearly uniform in width and height; abdominal pedicle raised, pointing forwards with two small spines; abdomen long, cylindric; legs long; the whole body curiously sculptured, being channeled and grooved in different directions, longitudinally, circularly, obliquely, giving a peculiar dull appearance; colour blackish green.

This is one of the commonest species of Ant in Malabar, extending from the level of the sea up to the top of the Neilgherries. It lives in the ground in small societies, often making its nest in a flower-pot, occasionally under a large stone. It does not work in concert, being generally seen solitary. It lives on animal substances, but apparently will also take vegetable matter. I have seen two fighting for a ripe seed of the Lantana.

I have not met with the female of this species.

27. *Ponera stenocheilos,* Jerdon (p. 118).

Worker, length $\frac{3}{8}$ths of an inch; head large, square behind, pointed and advancing anteriorly, widest in front of the eyes which are large; antennæ long; jaws very long, linear, ending in a strong tooth externally, and a smaller one at the internal angle; thorax narrow; abdominal pedicle raised, rounded, pointing backwards; abdomen very long; sting large; legs long; colour dingy greenish-brown.

I have found this ant very rarely in Malabar, and know nothing of its habits.

28. *Ponera processionalis*, Jerdon (p. 118).

Worker, length $\frac{1}{3}$rd of an inch; head oblong, advanced anteriorly; eyes medial, large; antennæ moderately long, thickened at the end; jaws triangular, strongly four-toothed; thorax wide, not grooved; abdominal pedicle of equal width with the thorax, square truncated; colour shining black.

I have met this species over most of India. It lives in the ground in very numerous societies, and is most frequent in jungly districts; occasionally a vast column of them, three or four deep, may be seen crossing a road, and I have traced the column for forty and fifty yards. It stings very severely.

29. *Ponera affinis*, Jerdon (p. 118).

Worker, length $\frac{1}{3}$rd of an inch; head oblong, notched behind, advanced anteriorly; jaws triangular, strongly toothed; antennæ thickened at the tip; eyes somewhat anterior, moderately large; thorax slightly grooved; abdominal pedicle pointed, thin; abdomen oval, colour dingy black.

I have only procured this ant once in Malabar, and know nothing of its habits.

30. *Ponera rufipes*, Jerdon (p. 119).

Worker, length $\frac{9}{16}$ths of an inch; head oblong; eyes anterior, small; antennæ short and thick; jaws triangular, finely toothed; thorax not furrowed, truncated posteriorly; abdominal pedicle wide, thick, truncated, and excavated posteriorly; abdomen long, the division of the joints strongly marked; body ridged, furrowed, and channeled throughout; antennæ, legs, and end of abdomen dark rufous, rest of the body dull black.

I have procured this ant only on one occasion, hitherto, in Malabar.

31. *Ponera pumila*, Jerdon (p. 119).

Worker, length about $\frac{1}{5}$th of an inch; head oblong; eyes rather small, advanced; jaws triangular, strongly toothed; antennæ thickened; thorax smooth; abdominal pedicle long, square; abdomen long, cylindric; dull black, with rufous legs and antennæ.

I found this ant in Malabar, where it is rare.

3rd Tribe. Formicites.

We now come to the last family, containing those ants that have no sting, and the abdominal pedicle of one knot only. It comprises two genera, *Polyergus* and *Formica*, but I do not think we possess any species of the former genus.

Genus Formica.

This genus comprises two distinct forms, the one with spines on the thorax, the other unarmed, which certainly ought to form two genera, inasmuch as this distinction is made to separate *Atta* from *Oecodoma*†.

* *Without spines on the thorax.*

32. *Formica compressa*, Fabr.? Jerdon (p. 119).

Syn. *F. indefessa*‡, Sykes, Trans. Ent. Soc. i. p. 104.

Worker, length $\frac{4}{10}$ths to $\frac{1}{2}$ an inch; head oblong, notched behind; eyes medial, of moderate size; jaws triangular, toothed; antennæ long; thorax widened anteriorly; abdominal pedicles somewhat diamond-shaped above, much raised and thin as seen laterally; legs rufous, the rest of the body black.

Warrior, $\frac{6}{10}$ths of an inch long; differs from the ordinary worker in the head being proportionally much larger, and the jaws having blunt teeth.

Male, length $\frac{4}{10}$ths of an inch; has a small triangular head, lateral eyes, three ocelli, the thorax raised in front, and the abdominal pedicle broader; wings do not reach to end of abdomen.

Female, $\frac{5}{8}$ths of an inch long; very similar to the male, has the jaws strongly toothed, somewhat oblong, and the abdomen proportionally large.

This species, well known in India as the Black Ant, is found throughout every part of this country which I have traversed, except the western coast, where I have never seen it. It appears to me that it lives in very numerous societies in the ground, the entrance to the nest being often round the trunk of a tree, or close to some building. The warriors are very numerous. Their food is chiefly vegetable secretions, sugar, &c., and Colonel Sykes has given an interesting account of the devastations committed by them on preserves, sugar, &c. They bite rather severely, but the pain is quite momentary. At certain times great numbers of the winged males and females are seen at the mouth of the nest, and they remain there for several days.

† In the former part of this paper, p. 49 *et seq.* this name is *misprinted Ocodoma*.

‡ Col. Sykes's specimens of *F. indefessa* are in the Museum at the East India House.—F. M.

When they take wing, they do so in vast numbers, and always at night.

33. *Formica angusticollis*, Jerdon (p. 120).

Worker, $\frac{1}{2}$ an inch long; head long, oblong, ending posteriorly in a narrow neck; eyes posterior, of moderate size; jaws triangular, strongly toothed; antennæ long; thorax low, narrow, uniform; abdominal pedicle conical, high, narrow; abdomen oval; colour dull black, with antennæ and legs rufous.

Warrior, $\frac{8}{12}$ths of an inch long; head very large, notched posteriorly; eyes much smaller; otherwise similar. I have only found this ant in forests in Malabar, and always singly.

34. *Formica smaragdina*, Fabr. (p. 121).

Worker, length about $\frac{4}{10}$ths of an inch; head long, triangular; antennæ long; eyes large, medial; jaws triangular, pointed, with sharp teeth; thorax not furrowed; abdominal pedicle long, low, narrow, linear; legs long; colour of a uniform pale rufous.

Male, $\frac{7}{24}$ths of an inch long; head diamond-shaped; eyes lateral, small; thorax raised in front; abdomen small; wings reaching beyond the abdomen; of a rufous colour.

Female, $\frac{7}{8}$ths of an inch long; head short, triangular; eyes lateral; three ocelli; thorax very large, wide; abdominal pedicle wide in the middle as viewed from above, very thin laterally; abdomen large; wings reaching beyond abdomen; entirely of a pale shining green colour.

This ant is well known in Malabar and the wooded parts of India, but is rare in the Carnatic, where I have only seen it in one or two large mango-groves. It forms a nest of living leaves which it draws together without detaching from the branch, and unites with a fine white web; sometimes this nest is above a foot in diameter, but usually smaller. The society consists of a vast number of individuals, and in large nests we find many females and males, both with and without their wings at all times of the year. They are very bold and pugnacious, and bite very severely. They live chiefly on vegetable secretions, and are very partial to the flowers and buds of some of the *Loranthi* which abound so on the western coast; they often form a temporary web round the flowers, or sometimes round the fruit of various trees, viz. the *Eugenia malaccensis, Artabothrys odoratissima*, &c., apparently only for the purpose of feeding undisturbed; they will, however, also sometimes feed on decaying animal matter. It is said that the web they form is occasionally used in writing on in the N.W. provinces of India, and that the ants are made use of to destroy a nest of wasps that may have established themselves in a house. In this case they are said to destroy all the wasps, but become so infuriated, that their own indiscriminate attacks are nearly as bad as those of their foes. In gardens they are most partial to mango-trees, and also to the large leaves of the Jaméi Malae (*Eugenia Malaccensis*), but in the jungles they select a vast number of trees, or rather make no selection at all.

35. *Formica longipes*, Jerdon (p. 122).

Worker, length $\frac{1}{5}$th of an inch; in form exceedingly similar to the last; head more oblong than triangular; eyes more posterior; antennæ very long; abdominal pedicle shorter proportionally; abdomen a longer oval; legs very long, of a pale rufous colour throughout, tinged with dusky on the abdomen.

This ant is found in all the forests of India, living in holes in the ground, in tolerably numerous societies, and feeding on vegetable secretions. I have not seen it at any distance from the jungles. At Tellicherry, for example, I have never seen it, but as soon as you go a little inland and get into the jungle you meet with it. It is often found about bungalows and out-houses.

36. *Formica timida*, Jerdon (p. 122).

Worker, length $\frac{9}{24}$ths of an inch long; head oblong, oval; eyes large, posterior; jaws triangular, strongly toothed; thorax smooth; abdominal pedicle raised, conical; colour dingy rufous, darkest on the head, and tinged with dusky on the abdomen. All the body covered with long scattered hairs.

Warrior, $\frac{1}{2}$ an inch long; differs from the ordinary worker in the head being much larger proportionally, and notched posteriorly; thorax thicker, and the abdomen shorter.

Female, like worker, but somewhat larger, with wings, and three ocelli. Male, $\frac{7}{24}$ths of an inch long; thorax much elevated; eyes large; head small; three ocelli; wings reach beyond the abdomen.

I have only found this ant on the Malabar coast, where it is very common, living chiefly on vegetable secretions. It has its nest under ground. It is very different in habit from the other large red ant (*F. smaragdina*), being most timid, and if approached or touched, dropping to the ground at once and hiding itself. It does not always confine itself to vegetable matter. On one occasion I had a box of pigeons containing some squabs placed in a room on the floor. I next morning found several of the squabs dead, covered with these ants, chiefly however the warriors.

37. *Formica stricta*, Jerdon (p. 123).

Worker, length $\frac{7}{20}$ths of an inch; head nearly square, slightly narrowed anteriorly; jaws rough, triangular, strongly toothed; eyes large, posterior; prothorax wide, metathorax narrowed; post-thorax in the form of a rounded narrow platform, ending in two points, and truncated; abdominal pedicle blunt, rounded, raised; abdomen short, oval; antennæ rufous; head and thorax dull greenish black, shagreened; abdomen shining glaucous green; legs shining black.

I have found this ant on flowers in Malabar, but have never seen its nest; it is not a very common species.

38. *Formica cinerascens*, Fabr. (p. 123).

Worker, length $\frac{3}{8}$ths of an inch; head large; eyes rather small, posterior; jaws strongly toothed; thorax wide in front, narrowed behind with two glands on each side above; abdominal pedicle elevated, conic; abdomen oval; colour dull black, except the abdomen, which is glaucous green, and somewhat pubescent. Female $\frac{1}{2}$ an inch long nearly; head smaller; thorax not so wide; abdomen long, oval; wings not reaching to the end of the abdomen.

Male, $\frac{3}{12}$ths of an inch long; similar in form to the female, but with much narrower abdomen, and head still smaller proportionally. Warrior, $\frac{5}{12}$ths of an inch long; head large; antennæ short; eyes minute.

This species lives in the ground in small societies. I have only seen it in the Carnatic. It is described as having the head fulvous, and a triangular spot on the abdomen; but as it is said by Fabricius to have been sent from Tranquebar, in the vicinity of which I have seen our present species, I think they are probably identical, and that the difference of colour is accidental, especially as there are only two species common in the Carnatic with glaucous abdomen, this and our *F. rufoglauca*.

39. *Formica velox*, Jerdon (p. 124).

Worker, length $\frac{5}{24}$ths of an inch to $\frac{6}{24}$ths; head long, oblong; eyes posterior, large; jaws strongly toothed; antennæ long; thorax smooth; abdominal pedicle raised, somewhat rounded, wide above; abdomen with the divisions of the segments strongly marked; legs long; colour dull blackish, with the abdomen greenish pubescent.

This ant is very common in Malabar, and I think is also found in the Carnatic. It frequents flowers, especially delighting in those that have great quantities of pollen, such as the *Cucurbitaceæ*, *Hibisci*, &c. It runs very speedily, and is very easily alarmed, dropping to the ground on being touched. I have not succeeded in finding its nest.

40. *Formica rufoglauca,* Jerdon (p. 124).

Worker, $\frac{7}{24}$ths of an inch long; head long, oblong; eyes large, posterior; jaws strongly toothed; thorax not grooved; abdominal pedicle raised, conic, wide above; abdomen fine silky glaucous green; head, thorax and legs bright rufous.

Warrior, $\frac{9}{24}$ths of an inch long; head large; eyes much smaller; antennæ shorter; abdominal pedicle flattened posteriorly; abdomen short and triangular; colour similar.

I have found this ant only in the Carnatic, in small societies, living in holes in the ground.

It is possible that this may turn out to be Fabricius's species *cinerascens*.

41. *Formica vagans,* Jerdon (p. 124).

Worker, $\frac{3}{24}$ths of an inch long; eyes large, medial; antennæ long; abdominal pedicle raised, rounded; legs very long.

Female, $\frac{3}{12}$ths of an inch long; the thorax shorter and wider, and abdomen very large; wings reaching beyond the abdomen.

This little ant is exceedingly common in the Carnatic, but I have not seen it on the Malabar coast. It takes up its quarters in any sheltered spot in a house, under a box, a stone, a hole in the wall, or such like places, and when disturbed flits with great speed to another suitable spot. Its society is very numerous in individuals, and there are many females and males, sometimes with, at other times without wings. It feeds both on vegetable and animal substances, preferring the former like all the true *Formicæ*.

42. *Formica assimilis,* Jerdon (p. 125).

Worker, exceedingly similar to the last.

Length $\frac{3}{24}$ths of an inch; differs in its colour, chiefly being of a shining reddish black, in its eyes being apparently large, the thorax narrower, and in being covered all over with scattered white hairs.

I have found it frequenting flowers in Malabar, but not abundant.

43. *Formica phyllophila,* Jerdon (p. 125).

Worker, length $\frac{7}{28}$ths of an inch; eyes small; anterior jaws triangular; thorax slightly furrowed posteriorly; abdominal pedicle thin, low, linear; abdomen large, triangular; legs and antennæ rather short; colour shining brown-black.

This little species forms a temporary nest usually between two leaves, or sometimes in a head of flowers. It lives in small societies, and feeds entirely on vegetable secretions.

44. *Formica nana,* Jerdon (p. 125).

Worker, length not $\frac{1}{12}$th of an inch; eyes anterior; thorax wide; abdomen long, elliptical; head and thorax brown; antennæ, legs and abdomen pale whity brown.

This minute species is found in all parts of India, and is abundant in Mysore; but from its small size is noticed with difficulty. It feeds on flowers and vegetable secretions.

** *With spines on the thorax.*

45. *Formica nidificans,* Jerdon (p. 125).

Worker, $\frac{5}{24}$ths of an inch long; head triangularly ovate, elevated; eyes moderate; jaws strongly three-toothed; thorax wide anteriorly, narrowed behind, with two small spines anteriorly pointing forwards, and two large ones behind pointing upwards and backwards, and two rudimentary spines or points behind and beneath these latter; abdominal pedicle square, raised, with two large upright spines, and a smaller one on each side; abdomen short; head and abdomen rufous; thorax dark glossy brown.

Female, $\frac{1}{3}$rd of an inch long, similar to the worker; three ocelli on top of the head: wingless.

This ant makes a small nest about half an inch, or rather more, in diameter, of some papyraceous material, which it fixes on a leaf. I have opened two, each of which contained one female and eight or ten workers. It is very rare, and I have only seen it in Malabar.

46. *Formica sylvicola,* Jerdon (p. 126).

Worker, $\frac{3}{12}$ths of an inch long; head narrowed in front and rounded behind; eyes posterior, salient; antennæ inserted in front of the eyes, with a strong crest bordering their insertion internally; jaws short, with five teeth, the upper one much the longest and bent; thorax wide, with two spines on its anterior angles, and two stronger ones posteriorly pointing backwards and upwards; abdominal pedicle large, square, ending behind in two large curved spines, pointing backwards and outwards, and two points or tubercles behind and between them; abdomen short, oval, colour dull black; abdomen shining glaucous green.

Female, $\frac{9}{24}$ths of an inch long, differs in the anterior thoracic spines being apparently shorter, and in having three ocelli: wingless.

This ant has the same habits as the last, but is not found except in the jungles. It appears very closely allied to *F. hastata* of Latreille, from India, and to several other species said to be from Southern Asia; and as many of these may be found in

India, I add here a brief description of them taken from St. Fargeau's work on Hymenoptera :—

"*Formica sexspinosa,* Latr. Body black, covered with a fine silky yellowish down, especially on the abdomen; head oblong, narrowed posteriorly; antennæ long; posterior angles of the head salient; jaws large, triangular, with three or four teeth; eyes small, globular, salient; thorax with two spines anteriorly on its lateral angles, and two on the posterior extremity pointing backwards; abdominal pedicle thick, rounded in front, truncated posteriorly, with two spines *almost as large* as those on the posterior extremity of thorax. Length $7\frac{2}{3}$ lines (French). From Southern Asia.

"*Formica hastata,* Latr. Black, finely shagreened and slightly hairy; head short; antennæ long; jaws short, with two teeth and a larger curved one at the end; space between the antennæ elevated, with an arched crest on each side; eyes small, round; thorax cubical, compressed, its surface flat, and the ridge on each side sharp, anteriorly wide and square, with a spine on each side, at the humeral angles strong, sharp, straight, and reaching to the head; its posterior part truncated, with a strong spine at each angle pointing obliquely upwards; abdominal pedicle large, triangular, with its upper edge concave, a small tooth in the middle, and a strong arched spine on its lateral angles directed backwards, with a little tooth beneath each. Length 4 lines. From India.

"*Formica relucens,* Latr. Exceeding like the last (*F. hastata*), but differs in the following points—body covered with silky, golden, shining down, with a few larger hairs; thorax with two spines anteriorly and none posteriorly; abdominal pedicle with four spines, the upper ones nearly straight. Length 4 lines. From Southern Asia.

"*Formica Ammon,* Latr. Very like the two last; body black, striated, with a few hairs; thorax ashy; anterior angles advanced; posteriorly the lateral angles prolonged into a large straight spine, pointing backwards; abdominal pedicle large, triangular, with the upper angles prolonged into a very long curved spine, directed backwards; abdomen covered with a silky golden down. Length $2\frac{1}{3}$ lines. From Southern Asia.

"*Formica carinata,* Fabr. Head rounded, black; thorax black, divided into three by two deep transverse lines; the anterior portion with a spine on each side directed forwards, and the posterior part with two small straight spines; abdominal pedicle large, square, with two raised sharp bent spines. Length? of medium size. Southern Asia."

I have very little doubt but that many more species of ants will be discovered even in the southern portion of the Peninsula, and I hope myself to add others to the present list, and more especially to gain additional information on their habits.

XI.—*Note on the Greenland and Iceland Falcons.* By John Hancock, Esq.

Since the publication of my paper in 1838 on the Greenland and Iceland Falcons, I have had the opportunity of examining a great number of specimens of both species, and have found much to corroborate the opinion I then expressed of the distinctness of the two kinds. I must now have seen upwards of 150 specimens, and have had in my possession at one time no less than seventy individuals. This extended experience enables me to correct an error in the description of *Falco Grœnlandicus.* I find that I have confounded the young with the adult of this species, and am wrong regarding the immature.

When I drew up my paper I considered all the white birds from Greenland to be mature, describing the nest plumage from a dark specimen, which having a white quill-feather coming, seemed to prove that it was the young of this species. There is now no doubt that this is wrong, and that this individual is really an immature Iceland falcon,—the white quill-feather being abnormal.

The Greenland falcon is never dark like the young of the other species; in fact, the nest plumage of the former is always whiter than the mature plumage of the latter, and is not unfrequently as white as that of the mature of its own species.

The mature Greenland falcon is distinguished from the young, not so much by its greater whiteness as by the character of the markings, which on the back and scapulars are always cordate inclining to sagittiform; the head, under parts and tail are frequently unspotted, but not by any means constantly so. The young is characterized by having the upper parts marked with large oblong spots, and the head and under parts with long narrow dashes. In both old and young the markings are of a dark warm gray, almost black in the former, which is also distinguished by the cere, beak, feet and toes being of a pale yellow or straw colour; while in the young, these parts, with the exception of the beak, are of a light livid blue. Some of the young are very white, so that they can be distinguished only by the form of the spots and colour of the naked parts. In such the spots or dashes on the head and under parts are reduced to mere lines, scarcely wider than the shafts of the feathers, and the tail is not uncommonly devoid of all markings. Other nest birds are comparatively dark, with the spots large and crowded. The former, on maturity, are very little spotted, and have all the under parts, head and tail not unfrequently pure white; the latter never attain the same degree of whiteness, but change into the dark and richly marked varieties of the adult.

There is no doubt with regard to the mature and immature state of this species. I possess several specimens with the large oblong markings of the nest plumage, which are moulting, and in every case the new feathers have the cordate spots of maturity; and to show that no change takes place afterwards, it is only necessary to refer to the beautiful specimen which was kept alive in the Zoological Gardens, Regent's Park. This individual was a male; it had the plumage very light; and when I first saw it in 1849 it exhibited both mature and immature feathers; the old and faded ones, on the upper parts, having the oblong spots of the first plumage, the new feathers of the back and scapulars being all marked with cordate spots. I took a drawing of the bird in this state. On completing its moult it was one of the whitest specimens I have ever seen. It lived until May 1852, and must consequently have changed its plumage twice after having assumed its mature dress; but no further alteration took place in the form of the markings, and the bird was as white on its first moult as it was when it died. Another living specimen, which I had in my possession some years ago, moulted once. This was mature when I received it, and it was as white then as after its moult; and no change whatever took place in the character of its plumage. It may also be stated that I have several specimens in the mature plumage which have partially cast their feathers, and those coming are exactly like the old ones—neither darker nor whiter—the feathers of the upper parts bearing the same characteristic cordate spots. Thus there appears ample proof that the birds with oblong spots on the upper parts change at once into those with cordate spots, and that the latter undergo no subsequent alteration; the one is therefore evidently the young of the other, and is undoubtedly in the first or nest plumage, unless this species be an exception to the rule, that all the true falcons get the mature plumage on the first moult: the Iceland falcon, peregrine, merlin, hobby, red-legged falcon and kestrel all do.

Falco Grœnlandicus then differs from *F. Islandicus* in both the mature and immature states, and is characterized by its greater whiteness of plumage. The former, in fact, may be stated to have white feathers with dark markings, the latter dark feathers with white markings; besides that the mature Iceland falcon is further distinguished by conspicuous transverse bands above and on the flanks, and by the blue colour of the beak and bright yellow of the cere and feet. It is now certain that the continuity or non-continuity of the bars of the tail is not of specific importance, as I originally thought. No further observations need be made here respecting the young and adult plumages of *F. Islandicus*, as in my former paper I described from birds shot at their breeding station, having in my possession a brood with their two parents. It therefore only remains to be shown that no change takes place in this species after it has attained its mature garb; and of this there is now sufficient evidence.

In August 1847 I received a living mature male Iceland falcon; it had not quite completed its first moult, having still a few of the nest feathers, and was a fine characteristic specimen. It died in June 1850, after having cast its feathers three times; and its last plumage was precisely similar to that of its first mature dress—being no whiter nor in the least changed in the markings. Another individual may be alluded to which was brought to England in 1846, and which I saw in November 1848, after it had completed its second moult. It was afterwards sent to the Zoological Gardens, Regent's Park, where I saw it again in the beginning of last year (1853); and though it must then have changed its plumage four times since I first examined it, there was no perceptible difference in its whiteness, or in the character of its markings. Other examples might be cited, for I have had many opportunities of seeing this species alive; but the above would seem quite sufficient to prove that the Iceland falcon undergoes no further change after having attained its mature plumage.

In conclusion it may be stated that the characters of the two forms are permanent and sharply defined, never blending into each other; and that the young as well as the mature birds can always be distinguished. But whether these two falcons are to be considered distinct species or mere races must depend upon the views entertained regarding what is to constitute specific character. For my own part I see no reason to doubt the correctness of the opinion I originally expressed.

XII.—*On the Structure of the* Echinoderms. By Johannes Müller.

[Continued from p. 24.]

Ambulacra of the Asteridæ.

With the restriction of the ambulacra to the ventral surface in the *Asteridæ*, all differences among the feet disappear. They are always locomotive and either conical, as in all *Asteridæ* without an anus, *Astropecten, Luidia, Ctenodiscus*; or cylindrical with a sucking disc and without a calcareous plate, as in all those genera of *Asteridæ* which are provided with an anus. The discrimination of *Astropecten* from *Archaster* is therefore easy; it should be remarked, however, that it is often difficult at once to recognise the anus, though it is easy to do so, if in *Archaster* we remove the external crowns of the *paxillæ* in the middle of the starfish by which it is hidden, as the ground is by the foliage of closely planted trees. In *Astropecten Parelii*, v. D. et K. (Kongl. Vet. Acad. Handl. f. 1844, p. 247. tab. 7. figs. 14–16), the definiteness of this character was recently well exemplified. M. Sars had informed me that this *Astropecten* formed an exception to the law which I had enunciated with respect to the feet; I therefore concluded that this starfish would turn out to be no *Astropecten*, but an *Archaster*, a genus hitherto not known to inhabit the European seas. M. Sars has since that time furnished me with a specimen preserved in spirits, in which I at once discovered the anus, when the external crowns of the paxillæ were removed so as to render the skin of the back visible.

In comparing the *Asteridæ* and *Echinidæ* as Blainville and Agassiz endeavoured to do, we soon perceive that the inter-ambulacral plates, instead of being analogous in the two families, are quite differently arranged. It is not the marginal plates of the *Asteridæ* alone which lie between the radii, and the upper marginal plates are already dorsal.

In the *Asteridæ* we must distinguish different kinds of inter-ambulacral plates from one another. Those which rest upon the external processes of the ambulacral plates have a certain peculiarity as marginal plates of the ambulacra or *adambulacral plates*; they exactly agree in number with the ambulacral plates. To the second kind belong the more or less well-marked *marginal inter-ambulacral plates* at the peripheral edge, which are sometimes in single, sometimes in double series. Between the adambulacral and marginal there are often *intermediate* inter-ambulacral plates. In *Astropecten* this area is exceedingly small, and is reduced to a few easily overlooked plates behind the angles of the mouth; in the pentagonal forms it is very large. In form and size these plates often, as in *Astrogonium*, differ both from the adambulacral and from the marginal inter-ambulacral plates.

The marginal inter-ambulacral and the adambulacral plates extend to the end of the arms; the intermediate plates cease for the most part earlier. In those *Asteridæ* whose arms are round and whose margin is not developed, the series of plates which marks off the dorsal pore-area from the ventral surface is the equivalent of the marginal plates. In these forms also the number of the series of plates from the groove of the arm to the pore-area varies very greatly; in some there are only two series of plates, the intermediate plates disappearing, as in *Echinaster* and *Scytaster,* whilst in *Ophidiaster* there are many series of plates between the groove of the arm and the pore-area, the outermost of which, as adambulacral plates and marginal plates, extend completely to the extremity of the arm, the others, as intermediate rows of plates, are more or less, and, indeed, gradually, diminished. It is obvious that the inter-ambulacral plates of the Sea-urchins and *Asteridæ* are differently, and, in fact, so differently disposed, as to give rise to the main distinctive peculiarities of a Sea-urchin and of a Starfish.

Still greater are the differences between the ambulacra of the *Asteridæ* and *Echinidæ* in the vertical direction. The nervous cord and the ambulacral canal of the *Asteridæ* lie, covered by the integument, over the mutually applied ambulacral plates, that is, upon the outer side of the vertebral processes of these plates; in the *Echinidæ,* however, they lie beneath the ambulacral plates on the inner surface of the shell. The vertebral processes of the ambulacral plates of the *Asteridæ* are absent in most *Echinidæ,* but in the *Cidaridæ* they have a perfectly analogous structure at the anterior extremity of the ambulacra, where the ambulacral plates on the inner side of the series of pores send off perpendicular processes into the cavity of the shell, between which lie the trunks of the ambulacral organs. The ampullæ are external. The clavate ends of a number of these processes unite to form a continuous colonnade, while they leave between their bases intervertebral passages, apertures for the branches given off by the ambulacral vessel to the ampullæ and the pores of the shell. There is no union of the vertebral processes of the right and left side. The analogy of the auricular processes at the anterior extremity of the corona of the Sea-urchins with the vertebral processes of the *Asteridæ,* which is remarked in the 'Anatomische Studien über die Echinodermen' (Archiv, 1850), is more apparent than universally true. The auricular processes are, indeed, in most Sea-urchins, processes of the ambulacral plates, and the ambulacral organs pass between them; but in *Cidaris* we meet with an exception, the inter-ambulacral plates giving off the auricular processes for the muscles of the jaws.

Besides *Cidaris, Clypeaster rosaceus* and *altus* (or the genus *Echinanthus* altogether) possess that part of the ambulacral plates which is analogous to the vertebral processes of the *Asteridæ* in the internal table of their ambulacral plates. In this case all the ambulacral plates take a part in its formation, and the right and left portions are even united by a suture. This ambulacral floor lies, as in the *Asteridæ,* beneath the trunks of the ambulacral vessels and nerves. On the other hand, the external table of the ambulacral plates lies over the trunks of the nerves and vessels, like the membranous covering of the ambulacra of the *Asteridæ.* Herein we have sufficient evidence that in fact the structure of the ambulacra in the *Echinidæ* and *Asteridæ* is widely different, and *Cidaris* and *Echinanthus* may be considered to furnish the key to the proper understanding of these deviations.

The *Ophiuridæ* depart a step further than the *Asteridæ* from the Sea-urchins. The ambulacral plates have still retained their vertebral form in the *Ophiuridæ,* and the ambulacral canal runs in a groove over them; above the ambulacral vessel, however, lies the flat nervous cord of the arm, and above that are the peculiar plates, the ventral discs of the arms; but under the vertebral portions or analogues of the ambulacral plates there are no ampullæ, the latter structures being totally absent in the *Ophiuridæ.* The lateral branches of the ambulacral vessel pierce the ventral portion of the vertebral segment horizontally as far as the suckers, which are arranged along a groove of this part of the skeleton. Pores leading to internal diverticula, comparable to the ambulacral pores of the *Asteridæ* and Sea-urchins, are non-existent. The nervous trunk of the arm gives a branch to every sucker, for which an appropriate groove is excavated upon the ventral surface of the vertebral segment.

In comparing the Sea-urchins with the *Asteridæ,* particular interest attaches to the five plates of the apex of the former, which, from their position between the genital plates, have been called intergenital plates—a term long in use, for which Agassiz has lately substituted the name of ocellar plates, which I think almost too theoretical to be safely used. Each of these plates is situated at the end of an ambulacrum without being itself an ambulacral plate; it is pierced, and in the aperture the ocular bulb discovered by Forbes is situated. This body, the fact of whose existence has been confirmed by Agassiz and Valentin, and which I also have seen (in *Cidaris*), is the analogue of the coloured ocular spot discovered by Ehrenberg at the extremity of the arms of the *Asteridæ.* In both cases the nervous cord of the radius enters the bulb, passing in the Sea-urchins from within outwards, through the aperture in the plate. Agassiz justly lays very great weight on this analogy, and ascribes to the *Asteridæ* also an ocellar plate at the end of the ambulacrum, between which and the ambulacrum the new ambulacral plates are formed, as in the Sea-urchins. Here also the new inter-ambulacral plates are formed at the point of the arms, but this can only hold good of those which reach the extremity of the arm. In most *Asteridæ* many series of plates do not attain the end of the arms, as in *Ophidiaster, Asteriscus, Astrogonium*. He supposes further, that the plate in question has the same relations in the *Asteridæ* as in the Sea-urchins, and that the eye is in the *Asteridæ* also seated in it (Ann. d. Sc. Nat. t. vi. 1846, pp. 309, 311). It is here presupposed that the radial nerve has an internal course underneath the ambulacral plates in the *Asteridæ* as in the *Echinidæ*, which, however, is true only of the latter and not of the former. Neither is there any aperture in the azygos plate which lies at the end of the ambulacrum and at the beginning of the dorsal part of the arm. The analogy of the plates in the Sea-urchins and *Asteridæ*, however, is not weakened, but is strengthened, by this circumstance. It is in all cases the terminal plate, the outermost of the radius. In the *Asteridæ*, which have large marginal plates developed in their peripheral border, it is the marginal plates, viz. the upper marginal plates, which have the same shape as this apical radial plate and form one series with it. The marginal plates are, therefore, in a manner repetitions of the apical plate of the radius, which unite the radii in festoons and separate the abdominal or inter-ambulacral side from the dorsal or antambulacral side. The terminal plate is smooth when the marginal plates are smooth (*Astrogonium*); in other cases, when all the inter-ambulacral and ambulacral plates are granulated (*Scytaster, Ophidiaster*), it is covered with granules. As the terminal piece of the arm, this plate has relations to the antambulacral as well as to the ambulacral and inter-ambulacral sides, and it is equally true for the antambulacral side that new plates are formed in its vicinity to extend those series which reach the end of the arm.

In the *Ophiuridæ* the terminal portion of the radius is a peculiarly formed articulation without either spines or suckers, between which and the next all the new articulations of the radius arise, as has been shown by the history of the development of the *Ophiuridæ*. This articulation is obviously the analogue of the terminal piece of the arm of the Starfishes. The mode in which the terminal articulation of the arm of the young Ophiurid is penetrated by the ambulacral canal, whose cæcal extremity is visible for a long time projecting from the end of the articulation, is described in the memoir upon the *Ophiuridæ* of the Adriatic.

In the Asterid-larva described by Busch, there is a prominent azygos process of the ambulacral canal; not however at the point of the arm, but on its ventral surface. This would appear to result from the position of the ambulacral canal of the Asterids, which is superficial and uncovered by any hard structure. In the vermiform Asterid-larva which I have described, the cæcal extremities of the ambulacral canals project from the extremities of the arms, in which respect this larva agrees much more closely with the *Ophiuridæ* than with the *Asteridæ*. We are not yet acquainted with its earliest condition, and it is very desirable to ascertain whether its form resembles a Pluteus or a Bipinnaria. There is no evidence to enable us to say whether the terminal segment of its vermiform body should be referred to the anus or madreporic plate of the body of a starfish. If it were an Ophiurid, this segment must be considered as the remains of the dome of the larva.

The terminal articulation of the arm of an *Ophiura* is neither ambulacral nor purely anti-ambulacral, but as it were an osseous node, from which the ambulacral plates, the ventral and dorsal or anti-ambulacral discs, and the inter-ambulacral lateral discs take their origin. The terminal plate of the arm of the Asterid may be considered to be such a node. The ocellar plate of the Sea-urchin is the terminal plate of a radius whose antambulacral side is absent. In analysing the radii of *Dysaster* into a trivium and bivium, the genital plates, of which there are four, remain at the apex of the trivium; the ocellar plates however follow their radii.

Oral Skeleton of Echinidæ, Holothuriadæ *and* Ophiuridæ.

According to H. Mayer's elaborate analysis the oral skeleton of the regular *Echinidæ* consists of five pairs of *alveoli* for the five enamelled teeth, of ten *epiphyses* for the inter-connexion of the former, and of five other radial pieces upon which the epiphyses articulate. These are the pieces which Des Moulins calls *rotulæ*, Valentin *falces*. An additional suspensory apparatus of the oral skeleton is constituted by the five 'compasses' of Valentin, which have been shown by Mayer to consist each of two portions; they are present only in the regular Sea-urchins, and are totally absent in the *Clypeasteridæ*.

The two epiphyses of each pair of alveoli are, in the regular Sea-urchins, provided with processes, which in *Echinus*, &c., become united into an arch at the base of the alveoli; in *Cidaris* and *Echinocidaris* the processes are present, but no longer united into arches; in *Diadema* the processes of the epiphyses have entirely vanished. In the *Echini* therefore, the ten epiphyses form with the five rotulæ a continuous circle; in *Cidaris, Echinocidaris* and *Diadema* an interrupted one. In the 'Anatomische Studien über die Echinodermen' I have compared this circle with the oral ring of the *Holothuriadæ*. The rotulæ or radii of the Lantern resemble those pieces of the calcareous ring in the *Holothuriadæ*, over which the five ambulacral canals pass outwards; in the Sea-urchins they have the same relation to the five ambulacral canals. The *Holothuriadæ* have neither alveoli nor teeth.

In the *Clypeasteridæ* the oral apparatus has exactly the same composition as in the regular Sea-urchins, with a somewhat different form of the epiphyses and rotulæ. That their oral skeleton possesses only the five pair of jaws, the remaining parts being wholly absent, as Agassiz states with regard to those genera described in his monograph upon the *Scutellidæ*, is true of no genus of this family. On the other hand, in all the genera of *Clypeasteridæ*, this apparatus consists of twenty-five calcareous pieces, viz. ten *semi-alveoli*, their ten articular *epiphyses*, and five *rotulæ*. The rotulæ of the Clypeasters were observed by Des Moulins, who, however, failed to find them in the other genera. Their form differs from that of the regular Sea-urchins, inasmuch as they are deep and disc-shaped; the ambulacral canal passes as usual beneath them and above the inter-alveolar muscles, to the circular canal. The articular epiphyses of the alveoli are connected with them by a joint, and they hold the alveoli sufficiently apart to prevent the ambulacral canal, which passes under the rotula, from being compressed by the action of the inter-alveolar muscles. In most genera of the *Clypeasteridæ* the epiphyses of the alveoli have almost the same form as the rotulæ, and are united by sutures with the alveoli. Des Moulins has not recognised the epiphyses, but Don Antonio Parra observed both the epiphyses and the rotulæ in *Clypeaster rosaceus*, stating that there are three small pieces between the alveoli:—"En la union de dos de estas piezas, por la parte superior, dexan un hueco en el que están calocadas maravillosamente tres piececitas, de figura de la pepíta de un melón verde, èstas se designan por la fig. 8." (Descripcion de differentes piezas de historia natural, Havana, 1787, p. 141.) So that the structure of the oral skeleton in the *Clypeasteridæ* was well understood in the last century, and long before that of the regular Sea-urchins.

The genera of the *Clypeasteridæ* all possess the same pieces, and are distinguished merely by the form of the alveoli and the position of their articulating surfaces, which in *Clypeaster* and *Arachnoides* are nearer the oral cavity, in the others are at the external angles of the jaws. In *Arachnoides placenta*, however, the rotulæ are remarkable for their excessive and unusual predominance in size over the epiphyses and the elevation of their bases above the alveoli, while the epiphyses are small and have the ordinary form. In *Lobophora* both the rotulæ and the epiphyses are very depressed in correspondence with the flattening of the alveoli. Short thin muscles pass from the auriculæ to the under surface of the alveoli.

The teeth of the Clypeasters, which are fixed in the groove of the alveoli, are only naked at their outermost extremity, the rest being covered by a proper soft membrane which must be regarded as the sac-like matrix of the tooth.

In describing and figuring the teeth of a *Galerites* (Mem. Geol. Survey, Lond. Decade 3. pl. 8) Forbes expresses the opinion, that perhaps all *Cassidulidæ* have teeth. I have examined a specimen of *Echinoneus* which still retained its buccal and anal plates, and although dry had lost nothing from its interior. However I could find no teeth in the contained matters, which consisted only of coarse sand, small Gasteropod shells, and fragments of shells, such as we meet with in sea-sand, and which proceeded from the contents of the intestine.

The stellate gap in the skeleton above the mouth of the *Ophiuridæ* and *Asteridæ* is well known not to be the mouth, but its antechamber. The mouth itself is round and lies deeper in a membranous diaphragm. The anterior chamber is therefore comparable to the vestibule in front of the mouth of the *Holothuriadæ*.

In the *Ophiuridæ* the stellate gap above the membranous diaphragm is surrounded by twenty pieces, which are simply the most anterior ambulacral plates united with five pair of inter-ambulacral plates. The anterior ambulacral plates are in pairs like all the others; they are as usual united with the following ambulacral plates by muscles and articulations, but their union with one another takes place not by suture but by a toothed joint, and is therefore moveable. These anterior ambulacral plates bound the open angles of the oral gap, while the inter-ambulacral pieces correspond with its salient angles; the ambulacral plate is united with the inter-ambulacral plate of the angle of the mouth by a firm suture. The union of the inter-ambulacral plates constituting any one of the salient angles of the mouth takes place by a denticulation, which allows of motion by means of transverse muscles which approximate the crura of the open angle and unite the anterior ambulacral plates of two ambulacra. The external edges of the angles of the mouth are beset with calcareous papillæ towards the oral clefts—*papillæ marginales*—marginal papillæ of the oral cleft. Upon the vertical edge of the oral angle again, we find in many genera a multitude of papillæ, the *papillæ angulares* or papillæ of the oral angles (dental papillæ, Müller and Troschel); below these in the *Ophiuridæ* stand the dentiform labial plates, arranged in a vertical series, and which I denominate *palæ angulares* instead of teeth. Are these oral angles of the *Ophiuridæ* and *Euryalidæ* to be considered as alveoli, and are they homologous with the alveoli of the Sea-urchins? In such case the alveoli of the Sea-urchins, which consist of two halves, and whose angles are also inter-radial in relation to the mouth, must be considered to be metamorphosed inter-ambulacral plates, separated by a great space from the plates of the corona, but connected by muscles with the auriculæ, and these alveolar muscles would be the analogues of the inter-vertebral muscles of the *Ophiuridæ*.

Important considerations, however, are opposed to this interpretation. On more close examination, the apparent analogy of the oral angles of the *Ophiuridæ* with the alveoli of the Sea-urchins completely disappears. In fact there exists upon the vertical obtuse edge of the oral angle, both in the *Ophiuridæ* and *Euryalidæ*, a peculiar azygos plate (*torus angularis*), upon which the papillæ angulares and the dentiform plates are seated. These azygos plates upon the oral angles are wanting in all *Asteridæ*; they would themselves have a claim to be considered analogous to alveolar plates, if the so-called dental plates of *Ophiuridæ* were to be regarded as true teeth. The five azygos alveolar plates of the *Ophiuridæ* in question, however, have no similarity with the conjugate alveoli of the Sea-urchins; nor have the dentiform plates or *palæ* of the *Ophiuridæ* more resemblance to the enamelled teeth of the Sea-urchins, since they exhibit the ordinary osseous structure. Furthermore, if we take into consideration the manner in which the *palæ* are inserted upon the plates of the oral angles, it clearly results that they are not teeth at all. They are in fact moveable and united with the angular plates by two muscles, which are inserted into deep excavations or perforations lying in pairs in these plates. These perforations in part pierce the torus angularis and extend as far as the bases of the oral angles. The other insertion of the muscles is into the upper edge of the base of the palæ, so that when they contract, the outer ends of the palæ are drawn upwards. They are doubtless used as manducatory organs. The papillæ angulares above the palæ are also moveable, but they possess no such muscles at their bases; the *Euryalæ* have only papillæ angulares on the plates of their oral angles, but no palæ. The peculiar plates at the oral angles of the *Ophiuridæ* are therefore to be regarded as bases of the lips to which the labial papillæ or *dentes spurii* are attached. The comparison of the oral angular plates (tori angulares) or most anterior inter-ambulacral plates of the *Ophiuridæ* with the alveoli of the Sea-urchins is therefore incorrect. This results also from other facts observable in the Sea-urchins themselves. In *Cidaris*, in fact, the corona is continued in the form of moveable ambulacral and inter-ambulacral plates up to the mouth, so that even the series of feet are uninterruptedly continuous to the same extent. While in *Echinus* there is only a single pair of oral suckers between the corona and the mouth in the line of the ambulacrum, the series of moveable ambulacral plates of *Cidaris* terminate above the dental apparatus in the form of five lobes surrounding the mouth; they are distinguished from the angles of the mouth of the *Ophiuridæ* by being ambulacral or radial, while those of the *Ophiuridæ* are inter-radial.. The dental apparatus of the Sea-urchins, therefore, is something peculiar which is not possessed by the *Ophiuridæ*.

There is in the latter an analogue of the calcareous ring of the *Holothuriadæ* which has hitherto been unnoticed, lying beneath the most anterior ambulacral plates and the oral angles, and affording a basis for further comparison. These parts become visible in an *Ophioderma, Ophiocoma,* &c., or in an *Astrophyton,* if the internal surface of the ambulacral skeleton,—that which is turned towards the abdominal cavity,—be examined. Here also we observe the nervous ring and the circular canal of the ambulacra; the ambulacral nerve and vessel pass at the oral end of the ambulacrum from above downwards over the most anterior ambulacral plates, so that they appear upon the under surface in the midst of the cleft of the anterior ambulacral plates; here each enters its ring. The nervous ring lies in a groove, which is excavated transversely upon the inner surface of the united plates of the oral angle. This groove, which is readily visible in all *Ophiuridæ,* is covered by the peculiar *peristomial* calcareous plates with which we are now concerned. The membranous ring which constitutes the proper mouth of the *Ophiuridæ* below the oral angles is strengthened at its circumference by these calcareous plates. As a rule, there are ten calcareous plates, which in the *Ophiuridæ,* however, constitute no complete ring; they are conjoined in pairs and lie upon the lower surface of the oral angles. In *Ophioderma* two additional plates occur where these two plates meet, one in front of and the other behind their junction. In *Ophiolepis ciliata* these peristomial plates are least obvious and may readily be overlooked; but, on the other hand, the circular canal of the ambulacral vessels is here most readily visible, and may be injected or inflated from the Polian vesicles.

The latter are disposed inter-radially close to the ab-oral edge of the peristomial plates. From the circular canal ten branches pass through little perforations of the most anterior ambulacral plates to the lower oral suckers, which are situated in the stellate cleft above the membranous oral disc.

In *Astrophyton* the two plates which lie upon the lower surface of the oral angle are united into a single one, but five additional azygos plates make their appearance which are absent in the

Ophiuridæ; they lie at the oral ends of the ambulacra in front of the pair of ambulacral plates, so that the nervous cord and ambulacral canal pass downwards between them and the first ambulacral plates. These also would appear to be parts of the oral ring, although their position is peculiar. The nervous circle of the *Asteridæ* is also placed beneath the oral angles at the circumference of the membranous oral disc, where likewise there is a groove; it lies upon the oral disc under the angles, and may be immediately discovered from without, by breaking them off. The circular canal of the ambulacral vessels has the same position as in the *Ophiuridæ.*

The torus angularis is absent in the *Asteridæ;* the angles themselves consist of a pair of inter-ambulacral plates,—the most anterior pair of adambulacral plates, in fact,—which are applied together to form an angle. Between every pair of ambulacra we observe upon the inner surface an azygos plate, which cannot be enumerated among the intermediate inter-ambulacral plates, and is therefore hardly to be compared with the inter-ambulacral discs on the ventral perisoma of the *Ophiuridæ.*

It appears to me to be exceedingly probable that the parts of the oral ring of the *Ophiuridæ*, here described, are the same as those which constitute the calcareous ring in the *Holothuriadæ;* those parts of the ring which lie in the direction of the radii to which the longitudinal muscles of the *Holothuriadæ* are affixed, and over which the branches of the circular canal pass to the ambulacra, being absent in the *Ophiuridæ.* The peristomial plates of the *Ophiuridæ* are then the analogues of those portions of the lantern of the Sea-urchins to which the alveoli are fixed.

The nervous cord lies invariably beneath the perisoma of the mouth and the oral angles; in *Holothuria*, under the perisoma of the mouth; in *Echinus*, beneath the perisoma of the mouth where it is continuous with the ambulacra; in the *Asteridæ* and *Ophiuridæ* also beneath the oral angles of the calcified perisoma. The nervous ring lies invariably close to the proper mouth; where there is a membranous oral disc, at its circumference, and always above the oral calcareous ring when this exists. The circular canal of the ambulacral vessels lies more or less deeply below the calcareous ring when this is present; in the *Echinidæ* the dental apparatus lies between the nervous ring and the circular canal.

The relations of the oral ring of the *Ophiuridæ* are perfectly different from those of the *buccal plates* of the Sea-urchins which cover the external surface of the oral membrane, as in the *Spatangidæ**, *Echinoneus*, and the regular Sea-urchins. These

* In the *Spatangidæ* the mouth lies excentrically to the excavation of the corona and to the circular canal which surrounds its edge, and is close

are everywhere continuous with the plates of the perisoma, and either irregular and without suckers as in the *Spatangidæ* and *Echinoneus,* or partially ambulacral as in *Echinus* (the ten suckers round the mouth), or divided like the corona into inter-ambulacral and ambulacral plates with suckers, as in *Cidaris.* In the *Holothuriadæ* these plates upon the oral disc are absent, and the oral membrane in the *Ophiuridæ* also is naked.

[To be continued.]

XIII.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, F.Z.S., C.M.E.S.

[Continued from vol. xii. p. 272.]

113. Oriolus melanocephalus, Linn. *Ka-cooroolla,* Cing.; lit. Yellow Bird. *Mam-coel,* Mal.; lit. Mango Coel from its colour. Mango Bird and Golden Oriole of Europeans.

The Ceylon race of this common and widely distributed species differs from the Indian in having the tertiaries much less tipped with yellow; nor is this an accidental circumstance, but constant in every one of the many specimens I have examined. It may not be amiss to mention here that many of our island species differ in some degree from their continental brethren, though perhaps not sufficiently to constitute distinct races. Mr. Blyth, whose great experience in Indian ornithology enables him, perhaps better than most, to judge of these gradations of colour and size, early noticed the peculiarities of our fauna in our correspondence, and I cannot do better than give his own words on this subject*. "Others," says he, "are doubtfully distinct, as *Megalaima zeylanica* from *M. caniceps* of S. India; *Leucocerca compressirostris* (J. A. S. B. xviii. 815) from *L. albofrontata*; and we might have here placed *Malacocercus striatus* as

to the posterior lip-like edge of the excavation. The anterior lip is not formed by the opposite edge of the shell, but by the plated buccal membrane.

* The late lamented Mr. Strickland was so much struck with these differences, that at his request the publication of these "Notes" was suspended until we might together go over a series of Ceylon killed specimens and compare them with examples from India and the Indian Archipelago. I am not sorry for the delay, since it has enabled me to add several species new to the fauna of Ceylon which have been received from Mr. Thwaites of Peradenia within the last two months; but I have been deprived of the invaluable notes and remarks promised me, and which would have rendered these memoranda of much use to the naturalist, by the untimely death of my learned and accomplished friend.

doubtfully distinct from *M. Bengalensis, Dicrurus leucopygialis* from *D. cærulescens,* and *Pomatorhinus melanura* from *P. Horsfieldi. Corvus splendens* and *Acridotheres tristis* are of a much darker hue in Ceylon than in Bengal and N. India; so is *Micropternus gularis* of Ceylon as compared with the bird of S. India. *Hypsipetes Nilgiriensis* is on the contrary paler in Ceylon and more like the Himalayan *H. psaroides. Acrocephalus dumetorum* (xviii. 815) has in Ceylon a distinguishing greenish shade. The difference of *Palumbus Elphinstonii* of Ceylon from that of the Nilgiris has been already indicated: and lastly, *Oriolus melanocephalus* of Malabar and Ceylon may be constantly distinguished from that of Bengal, Nepal, Assam, &c. by the markings of the wings, as especially the quantity of yellow at the tips of the tertiaries; this being much more developed in the Bengal race, in which it occupies the whole outer web of the first and second tertiaries, and about $\frac{3}{4}$ in. of the outer webs of the two next, whereas in the Ceylon and Malabar race it forms merely a series of small terminal spots to the tertiaries; the yellow tips of the coverts of the primaries are also constantly reduced in size in *O. melanocephalus* of Malabar and Ceylon*."

O. melanocephalus is very abundant in all parts of the island, and its glowing colouring adds much to the brilliancy of the eastern landscape; in my mind, palm trees, orioles, and white egrets are always associated with tropical scenery, and I often recall the delight I felt in my first shooting excursion in the swamps and paddy fields near Colombo, when orioles and other birds then new to me flitted from tree to tree before me. The note of the oriole is a clear, flute-like whistle, uttered on the wing as also when at rest: it is generally found in pairs, and is very partial to the jambo and other densely clothed trees.

114. Oriolus Indicus, Briss.

A single pair only of these birds fell under my notice: they were shot by a native at the back of the Bishop's residence near Colombo.

115. Criniger Ictericus, Strickland.

Abounds in the mountain zone. I have not seen it elsewhere. Dr. Kelaart writes that it "is a common species in the low country;" he surely alludes to

116. Pycnonotus flaviriatus, Strickland. *Ca-cooroolla,* Cing., which is a very common species throughout the low country, and not uncommon in the hills. From its frequenting the cin-

* See also his "Remarks on the modes of variation of nearly affined species or races of Birds chiefly inhabitants of India."

namon gardens Europeans call it the "Cinnamon Thrush." It builds in low bushes, constructing a loose untidy-looking nest of fibres and grasses, in which it deposits four or five globose eggs of an earthy colour profusely freckled. The young are hatched about June; it has an abrupt mellow song.

117. Pycnonotus penicillatus, Kelaart.

Discovered at Nuwera Elia by Dr. Kelaart, where he states it is "found in great abundance."

118. Pycnonotus hæmorrhaus, Gmel. *Kondacla,* Mal., and *Konda cooroolla,* Cing., from the resemblance of the top-knot of the bird to the knot in which the Cingalese and Tamils tie their hair, and which is called "*Kondeh.*"

This bulbul is everywhere very abundant; it feeds on all kinds of insects, and builds a deep cup-shaped nest in bushes or trees. I saw one placed in the trellis-work of a verandah, close to the entrance of the house, through which the family continually passed and repassed. The birds sat unconcernedly on their eggs and hatched them. The eggs are—axis 10 lines, diam. 8 lines, and of a pale cream-colour, profusely blotched with darker markings, which are most frequent on the obtuse end.

119. Pycnonotus atricapillus.

Syn. *Ægithina atricapilla,* Vieill.

Is common in the southern and central provinces. Its habits are those of the flycatcher, lying in wait and pouncing suddenly on its prey. I believe it breeds in low bushes, as I once found an unfinished nest which I feel sure belonged to this bird; a pair hovered about all the time I examined it. It was a loose structure of fibres and hair.

120. Hypsipetes Nilgherriensis, Jerdon.

I have not seen this species lower than Avishavelly; there it appears scantily, and increases in numbers with the altitude, until it becomes one of the most common of the hill tribes. It always flies in small flocks and feeds on berries, which it culls either from the loftiest tree-tops far beyond gun-shot, or from the low bushes by the road-side.

121. Cyornis rubeculoides, Vigors.

I obtained a few specimens of this elegant little flycatcher during their migration from the main land. I first shot them on the 14th of October, 1851, and a few subsequently at Point Pedro; they then disappeared, and I saw no more of them.

122. Hemipus picatus, Sykes.

Rare, though widely distributed. I procured a specimen or two in Colombo near Jaffna; it frequents trees, and when seen is generally in small parties of four or five. The stomachs of those dissected proved full of small flies.

123. Ochromela nigrorufa, Jerdon?

Among the drawings made by E. L. Mitford, Esq., of the birds which fell under his notice at Ratnapoora, was one which certainly represented this bird. He described it to me as migratory, appearing in June, and added that they fed much on spiders.

124. Myiagra cærulea, Vieill.

This lovely little azure flycatcher is widely distributed, though Dr. Kelaart has not noticed it at Nuwera Elia. It generally hunts in small flocks, and at times I have heard it utter a short but pleasing song. I think it is migratory.

125. Tchitrea Paradisi, Linn. *Vāl cooroovi,* Mal.; lit. Tail Bird. *Ginihora,* Cing. (the Red Bird); lit. Fire Thief. *Raddehora,* Cing. (the White Bird); lit. Cotton Thief.

This "Bird of Paradise" of the Europeans is common in Ceylon. Nothing can exceed the gracefulness of the adult cock birds, when in full plumage they fly from tree to tree, their long tails fluttering in elegant undulations. I have often watched them, when seeking their insect prey, suddenly turn on their perch, and whisk their long tails with a jerk over the bough as if to protect them from injury. The white plumage is only assumed in the second year; the red tint apparently fades, leaving the feathers white, though the shaft turns black. I have a specimen shot in February in which this change is going on; most of the feathers have altered their hue, some more or less, others not at all. Certainly they migrate, but breed with us; the nest is a neat, well-built, cup-shaped structure, composed of mosses and lichens outwardly, and lined with hair and wool. I found one nearly completed in the fork of a satin-wood tree at Tangalle; the eggs I could never procure.

126. Leucocerca compressirostris, Blyth.

Of this bird Mr. Blyth thus writes: "Like *L. albofrontata,* but with the bill much more compressed; perhaps a variety only."

I procured two at Tangalle, and a third in a little native village near Anarajahpoora. I shot them in tamarind trees. They secured their prey in the usual manner of flycatchers, and were fearless birds, allowing me to approach and watch them closely for some time before I shot. I fancy those at Tangalle had a nest in the boughs of the tamarind, but though I searched closely I could not find it.

127. Cryptolopha cinereocapilla, Vieill.

I procured this bird in plenty at Ambegamoa in March. Dr. Kelaart found it at Nuwera Elia. I consider it as strictly a hill species. It frequents high trees in small parties, and darts at minute insects at rest on the leaves.

128. Butalis latirostris, Raffles.

A migratory visitant, appearing in Colombo in October; it is very common and widely distributed. It likes to sit on the outside branches of trees, from which it darts on its insect prey like our English species.

129. Butalis Muttui, Layard.

Length 5 inches, of closed wing 3 inches, of tarsi nearly 7 lines, bill (to the end of gape) $8\frac{1}{2}$ lines; upper mandible dark brown with pale tip, lower mandible yellowish. General resemblance of *But. latirostris*, but of a far more rufous colour; this colour most prevalent on the outer webs of the wing-primaries, the outer tail-coverts, and sides of the breast and belly. Throat, belly and vent white; breast rufous ashy; back of the head dark brown; irides light brown.

I name this new species after my old and attached servant Muttu, to whose patient perseverance and hunting skill I owe so many of my best birds. This one he brought in one morning at Pt. Pedro during the month of June: he described its habits as precisely similar to *B. latirostris*. As a specimen it is unique.

130. Stoporala melanops, Vigors.

Rare; only appearing in the hills. I procured it at Ambegamoa,—Dr. Kelaart at Nuwera Elia.

131. Pericrocotus flammeus.

Is common, inhabiting high jungle. It does not, however, extend further into the Northern province than Vavoniavlancolom, where it is entirely replaced by

132. Pericrocotus peregrinus, Linn.,

which is however mingled with it in all localities. In habits these two species are similar, hunting about trees for small insects and larvæ, but never descending to bushes. It always appears in flocks, and when one bird flies off to another tree, the whole party follow in succession.

133. Campephaga Macei, Less.

Found in the S. and W. provinces generally in pairs, but it is decidedly a rare bird. I know nothing of its habits save that it feeds on insects and utters a hoarse cackling note. I have observed it much on dead trees.

134. Campephaga Sykesi, Strick.

Is far more common than the preceding, and extends over the whole island. Like *C. Macei* also it is only found in pairs, frequenting high trees and avoiding the neighbourhood of habitations; it feeds on insects. Irides dark hair-brown.

135. Artamus fuscus, Vieill.

The "*wood-swallow*" is a widely distributed but local species, small parties being found in various parts of Ceylon. These parties generally consist of three or four families, each of which has its own tree. When the nestlings have left their cradle they may be seen sitting side by side on a branch, whilst the old birds fly off for insects and return to feed their offspring by turns. Even after the young birds can shift for themselves they keep up their gregarious habits, and return to their bough after each hunting excursion. Their fellows receive them open-mouthed, as if repelling the intrusion, but finally they all settle down in good fellowship. The flight of this species is very elegant; they soar upwards to a great height, and then sail down again in widening circles to the branch from which they started. They build a cup nest, composed of fibres and grasses, in the heads of cocoa-nut trees, on the base of the large fronds, but I never succeeded in getting the eggs.

136. Edolius Paradiseus, Linn.

I obtained this racket-tailed shrike in the jungles near Anarajapoora, as detailed in a previous Number of this publication. Mr. Blyth makes the following observations upon it:—"The *Edolius* is also peculiar, and nearly resembles *E. Paradiseus* of the Malay countries, but has the frontal crest more developed, though much less so than in the *Edolii* we have seen from S. India."

This species seems confined to the jungles of the Wanny, and to frequent lofty trees, amid the boughs of which they sing very sweetly.

137. Dicrurus macrocercus, Vieill.

I cannot help thinking that Dr. Kelaart has wrongly identified this species in his 'Prodromus Faunæ Zeylanicæ,' for he writes—"*E. Malabaricus*, or king crow, is seen in all parts, generally in pairs, in the open fields; they perch on the backs of cattle."

Surely he refers to *Dicrurus macrocercus*, which is the Colombo species, and much addicted to perching on cattle: this is also a habit of *D. longicaudatus*, one of the Jaffna species, and my old note upon it, which I copy verbatim, is curiously like Dr. Kelaart's own observation. I do not, however, think he ever saw *D. longicaudatus*, not having visited the Jaffna peninsula, to which it is confined, and not including it in his list; *D. macrocercus* therefore is probably the bird to which he alludes. Even this latter name is likely to be changed, for Mr. Blyth writes, after comparing a number of Ceylonese specimens with some of the Indian race, "The Cingalese small race is so constant in its characters, that it may bear the distinctive name of *D. minor*. The Javanese race is perfectly similar to that of India."

D. minor is common about Colombo, frequenting the natives' gardens; it feeds on insects, upon which it darts from a spray, to which it returns after each short excursion. They sing not unpleasingly, and often pour out a note of joy as they follow each other in rapid coursings through the trees.

138. Dicrurus edoliformis, Blyth.

Not uncommon. I procured a few specimens during a short sojourn I made at Ambegamoa; their habits were not different from those of the other *Dicruri*; they seem to keep entirely to the jungle. The species was first discovered by Dr. Templeton in 1847, and described by Mr. Blyth in J. A. S. xv. 297.

139. Dicrurus longicaudatus, A. Hay. *Erattoo valan cooroovi*, Mal.; lit. Double-tailed Bird.

Common in the Jaffna peninsula, and extending as far as Anarajahpoora; it frequents open lands and perches on the backs of cattle to seek for ticks, on which it feeds largely. It usually goes in pairs and is fond of sitting on the "matties," of which the fences in the open country are generally composed. From these it sallies forth in quest of insects, which it captures either on the wing or in the grass, and I have often seen it *on the ground itself* seeking its food, a habit I never saw displayed by any of our other *Dicruri*. It has a hoarse unmusical note.

140. Dicrurus cærulescens, Linn.

I procured one or two specimens of this species at Pt. Pedro, but it probably is only an accidental visitor.

141. Dicrurus leucopygialis, Blyth.

A common species about Colombo. The European name for all these birds is "king crow," which seems to be derived from an inveterate habit they all have of chasing every crow from their vicinity. *D. leucopygialis* is very partial to the cocoa-nut tree, on the fronds of which it sits, pouring out a lively song, and battling with its fellows or some stray crow. When one of these latter comes in sight the king crow rushes down, screaming and darting upon his back; in vain the crow attempts to elude his persecutor by doubling and twisting among the branches. His enemy pertinaciously follows in pursuit, and by his cries attracts all within hearing, and the crow runs the gauntlet among them till out of his adversaries' dominions. I see Dr. Kelaart includes this species in his list, marked with an asterisk, denoting that he does so on the authority of Mr. Blyth. He must be acquainted with this bird, and has doubtless mistaken it for the *E. Remifer* of Temminck, which he has enumerated in his Catalogue, and which does not exist in the island.

142. Irena puella, Horsf.

Is very rare, but one specimen has fallen under my notice, and one is named by Dr. Kelaart; both were shot in the central province near Kandy.

143. Lanius superciliosus, Linn.

Our bird is a variety, but not sufficiently distinct to constitute a species, being simply paler and wanting the rufous crown of the Indian bird. It is exceedingly abundant in all open lands dotted with small bushes. I saw them in greater numbers about Hambantotte than in any other part of Ceylon; they frequented low bushes.

144. Lanius erythronotus, Vigors.

Is confined to the Jaffna peninsula, where they are not uncommon. They frequent the Euphorbia trees, building a cup-shaped nest composed of mosses and lichens lined with wool and hair: the young are fledged in June, but I was not so fortunate as to find the eggs. I never detected either of our indigenous "Butcher birds" fixing an insect on a thorn previous to devouring it; nor did I ever see an insect so impaled; yet the birds were very abundant in the N. Province, and even in my own compound, several pairs were constantly about. I am inclined to think that this habit is attributed to them without due investigation.

145. TEPHRODORNIS AFFINIS, Blyth.

Peculiar to Ceylon, where it affects wooded grass lands; it is not uncommon about Jaffna, Colombo and Kandy. It is migratory, and appears in October. The iris of this species is a greenish yellow.

[To be continued.]

XIV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By THOMAS WILLIAMS, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[Continued from vol. xii. p. 408.]

Articulata.—The annulose are most naturally succeeded by the articulate classes. The word 'annulose' differs in signification not more from the word 'articulate,' than in structure the annulose differs from the articulate animal. In the former a mechanically perfect *joint* never occurs. An 'articulation,' complete in all its mechanical appliances, is not produced in the animal kingdom below the Myriapod. The feet and tentacles of the Annelid, the spines and hard appendages of the Echinoderm, the soft processes of the Medusan, and the feelers of the Zoophyte are equally remote in construction from the leg of the insect or the claw of the crab. A '*joint*' is the symbol of organic superiority: it is not an arbitrary symbol; it is a unit in an *assemblage* of signs which proclaim a new and higher combination in the arrangements which constitute 'life.' At this limit in the animal series, the fluids and the solids of the organism undergo a signal exaltation of standard. The system of the chylaqueous fluid exists no longer in the adult organism,—it is present only in the embryonic. It is supplanted by that of the blood-proper. This capital fact supplies the material wherewith the physiologist forges the golden key which is capable of unlocking treasures long hidden from the eye of science. Coincidentally with *the joint*, at the frontier of the articulate subkingdom, there occurs a heart to circulate the blood, fibrine, and with it an order of floating corpuscles more highly organized in the fluids; a wondrous development of the muscular apparatus, striæ in the muscle-cell, a rapid increase in the dimensions of the cephalic ganglia, and in those of the organs of the special senses. It is here, in the history of the reproductive system, that the diœcious character is first unquestionably assumed. These are note-worthy events in the ascensive march of organic architecture! *Why*, at this particular link in the chain, are these events declared? How are they to be explained? Is it *necessary* in the scheme of creation that the Annelid should chronologically antecede the Myriapod? Are the fluids of the Annelid *plus* fibrine suddenly invested with such new building capacity as to be enabled to construct a Myriapod? The æra will assuredly arrive when organic science will satisfactorily answer such transcendental questions; there repose, beneath the curtain of the theories of spontaneous generation, specific transmutation, progressive development, &c., truths more recondite than any yet projected by the genius of the author of 'The Vestiges,' &c., or defended by the ingenuity of his countless reviewers.

The Myriapod is the lowest articulate animal, the Annelid the highest annulose: though constituting juxtaposed classes, they are yet divided by deep differential characters. The circulating system of the articulated animal is distinguished by one remarkable fact: only the *central* (dorsal) vessel enjoys the power of contracting and dilating; *every other* part of the circulatory apparatus is *passive*. The *supra-spinal vessel* in the Myriapod and the insect is *not pulsatile*; it is like the abdominal aorta in fishes. It is separated from the contractile centre by the intervention of narrow branches, the aortic arches, which embrace the œsophagus. The pulse-wave imparted to the fluid current by the ventricular action of the dorsal vessel is *broken* by these straitened tubes. The system of the branchial capillaries in the fish converts the saltatory manner in which the blood moves in the interval between them and the heart into a continuous non-pulsatile current. Thus the velocity of the current, and the force with which it travels, are reduced. A slackened course is impressed upon the blood-stream in every part of the body. From these anatomical facts will hereafter flow physiological consequences of great importance; they will unriddle the arcana of the *second* stage of respiration. The parietes of the peripheral channels, though undoubtedly constituting independent membranes, are adherent externally to the solid structures amid which they penetrate. In this particular they differ strikingly from the corresponding parts of the true-blood system of the Annelid. In the latter case, *every* vessel, the minutest and the largest, is detached from all other structures, appearing everywhere in form of independent systolising and diastolising tubes.

The *dorsal* vessel of the articulate animal is much more perfect, viewed as an hydraulic instrument of propulsion, than that of the Annelid. In a few species of Annelids, indeed, a cordiform development of this vessel occurs; it is, notwithstanding, little distinguished from the rest of the apparatus; centralization is not required. Every segment of the system, periphery and centre, is actively operative in circulating the contents. In the instance of the articulate animal the mechanical conditions are different: the dorsal vessel *alone* is the active instrument of circulation.

The circumferential segments of the system *cannot* contract upon the contained fluid; the central organ therefore in this class is invested with additional strength; it is adapted for more powerful work. In its peripheric parts the circulatory apparatus of the articulate animal may be described as inferior to the analogous divisions of that of the Annelid. The conditions are reversed with reference to the centres. This character is not restricted to the air-breathing or tracheary Articulata; it prevails amongst the Crustacea. From Hunter to Newport this question has formed an arena of microscopic controversy:—are the vessels provided with separate and independent coats, or does the blood only traverse fortuitous channels in the "cellular membrane" of the solids? It is not devoid of interest, in the study of the *material conditions* of solid nutrition: it is not difficult of solution: it will be afterwards answered in detail. *No* channel through which *chylaqueous fluid* circulates is contractile. In no invertebrate animal, from the highest Annelid to the Zoophyte, does this anatomical character know an exception. It is *this* character which is extended to the anatomical disposition of the blood-tubes in the Articulata; it will be subsequently shown to belong equally to the circulatory system of the Mollusca. Although the fluids of the Articulate and Molluscan organisms represent true blood, the conduits through which it moves are not detached and independent structures. Although *more* complex and *more* raised in vital standard than the chylaqueous fluid of the Annelid and the Echinoderm, the blood of the Articulata and Mollusca is *less* complex and *less* raised in the scale of composition than that of vertebrated animals. It is thus easy to demonstrate that there obtains a direct and constant relation between the vital standard and chemical composition of the living fluids, and the anatomical characters of the tubular apparatus in which they perform their circulatory orbits. These facts have especial reference to the theory of respiration afterwards to be propounded.

The muscular system of the Articulata, as compared with that of the Annulose classes, manifests features of great superiority. The muscle-cell is more densely charged with fibrinous contents: the property of contractility is far higher in degree. The ceaseless activity of these animals flows from their remarkable muscularity. It is mechanically obvious that such a powerful muscular system as that of the Articulata presupposes an apparatus of fixed solids on which to act, and through which to produce mechanical results. Contemporaneously with this system accordingly appears the dermal skeleton of these classes. It is quite certain that such a highly developed state of the muscle-system as that which exists in the articulated animal *implies of necessity** the presence of a considerable proportion of fibrine in the blood. The production of *fibrine* in the fluids supposes a high standard of respiration, and a correspondently developed nervous system.

Of these several events, which takes the *lead*? Is it possible that an increase in the complexity of solid systems, the integumentary, the nervous, and the muscular, can *go before* the increasing complexity which occurs at this stage in the zoological series in the composition of the fluids? The question involves the absurdity of conceiving an effect without a cause, a sequence without an antecedence. Nature makes first the mortar, *then* builds; the fluids are first prepared, *then* the superstructure of the solids is raised.

The function of respiration always, in every animal, is inseparable from the blood-making physiological actions. It is commonly supposed that it is with the system of *the fluids* that the office of breathing immediately connects itself. Extraordinary facts will be afterwards adduced which will render this supposition no longer exclusively tenable. The tubular apparatus of the fluids evolves itself at some point or other of its periphery, such that the amount of oxygen received shall be proportional, not to the abstract *bulk* of that fluid, but to its vital composition. A very small *vertebrated* animal weighing fivefold *less* than a given *in*vertebrated animal, will consume in equal times fiftyfold more oxygen than the latter. 'Respiration,' therefore, is not an isolated physiological act, separable physically and dynamically from that complex assemblage of events which conspire in the maintenance of the living organism: it is an integer in the arithmetic sum of life. Its real value can only be determined by a study of it in its connections. Given the vital and chemical composition of the fluids, to estimate the proportion of oxygen demanded by any appointed organism? The problem is not empirical; it is scientific in the highest degree. It is an absolute rule in the physics of organization, that the structure and the function are directly proportional. An imperfect instrument can only produce imperfect results. The complex fluids and highly organized solids of the articulated animal render indispensable the provision of an *adequate* machinery for the inhalation of the vivifying principle. Thus then are

* See the author's papers "On the Blood," now being published in the British and Foreign Medical and Chirurgical Review, for a full exposition of this subject.

traced irrefutably the physiological circumstances which *necessitate* at this limit in the scale a new order of respiratory organs. The object is inimitably accomplished; for the *first time* in the serial history of animal life, an *air-breathing* being is introduced on the stage. Nature surmounts all difficulties by adroitly resorting to an unexpected but matchless variation of her former plan; all at once, and without apparent reason, a new and extraordinary system of organs is contrived; an exquisite apparatus of *aëriferous vessels* is so skilfully blended with all the other and normal constituents of the living body, that an *air*-breathing animal results without deformity of exterior contour: in a small space a large result is realized. An insect is a diminutive animal; its muscular and nervous systems are intensely active; its fluids are highly corpusculated and fibrinized; a considerable proportion of oxygen is absolutely essential. Could it by any other expedient have been adequately supplied? But the simple distribution of patulous tracheæ throughout all the structures of the body, by which air is rather brought to the blood than blood to the air, would most imperfectly accomplish the great function of breathing. It was not enough to provide an elastic inimitable spiral, by which the passive patency of each tube is maintained. Such property as that of physical elasticity in a structure so singularly beautiful answers *another* end; it *recoils* on the *contracting* of the tube. The *contracting* of the tracheæ is in the insect the act of *ex*spiration; by this act the diameter of the tubes of the universal tracheary system is diminished, and the air is driven out through the spiracular orifices: this act is *rythmically* followed by that of *in*spiration, in which the physical elasticity of the spiral, by rebound, restores the tube to its former diameter*. No part of the circulating system but the dorsal vessel is capable of contracting and dilating. This

* I have diligently sought for the announcement of this fact amongst the varied and excellent writings of Mr. Newport, M. E. Blanchard, and M. Léon Dufour. No allusion whatever is anywhere made to this property of *rythmic* contraction and dilatation, which I have proved, by *repeated* observations on larvæ and adult insects and Myriapods, the tracheæ to possess. The omission is the more surprising, since, *without* such a property, the tracheary system would be *mechanically imperfect* as an apparatus of respiration. As the *vessels* do not contract, there would be no provision for renewing the air in the extremes of the system. The working of the general muscles of the body external to the system would obviously prove a most imperfect substitute. What is denied indeed to the vessels is conferred on the tracheæ. I cannot *prove* that the parietes of the tracheæ are capable of *originating* this movement. I cannot demonstrate them to be muscular. It is possible that the opening and shutting of the air-tubes may only follow from those alternate acts of contraction and dilatation in the abdominal segments by which the dorsal and ventral arches of the abdomen are alternately elevated and depressed like the ribs of the vertebrated animal.

fact explains an observation which the author has often made, that, considering the exalted muscular activity of the Articulata, of insects in particular, the *current of the blood in its channels moves at a disproportionately slow rate.* This diminished velocity is compensated, in the most perfect manner, by the rythmic contractility possessed by the parietes of the tracheæ. In virtue of this property the required *motion* is imparted to the *air* rather than to the *blood.* As well observed by M. E. Blanchard, the voluntary muscles of the body by their peculiar distribution *favour* the course taken by the blood, both in the arterial and venous moiety of the system. No valves exist. The mechanism of nutrition and respiration in the tracheary Articulata would be most unsuccessfully studied without the guiding knowledge of these general facts.

The characters then which distinguish an annulose from an articulate animal are more deeply graven in the interior of the organism and in its physiological actions than on the visible and exterior forms by which they are respectively characterized. There is deep meaning in the freaks of nature.

In the water-breathing Articulata the system of air-tubes just described suddenly disappears. The large size of the crustacean renders practicable the introduction of complex *branchial* organs. They accomplish that office which in the myriapod and the insect devolved upon the aëriferous tracheæ. Nature has nowhere blended the two methods of respiration in the same class. There exists no adult *water*-breathing myriapod or insect. An *air*-breathing crustacean can nowhere be found. Her plans are consistent.

One more *general* fact of organization with respect to the Articulata remains to be stated. *Nowhere* from the myriapod to the crustacean is any trace whatever to be discovered of the existence of a *true ciliary epithelium*! Why should a structure so constant and profuse in all classes *below* the Articulata so suddenly and so completely disappear at the lower limit of this class? If in the epidermic system of the articulated animal there be something incompatible with the evolution of the ciliary variety of epithelium, why should it *not* occur on the mucous? In no single instance, in any species of myriapod, insect or crustacean, on the mucous tract of the alimentary canal, or anywhere else, has any indication whatever of the presence of vibratile epithelium been ever yet discovered. This extraordinary fact cannot be arbitrary and unmeaning. Cilia are here suppressed for some reason and from some cause—what can it be? The solution should be sought in the rapid and unwonted evolution of the *muscular* system which takes place at this point. In the organism of the articulated animal there does not exist *motive force* enough to sustain *two* motive systems at one and the same time: one is supplanted by the other. Ciliary is commuted into muscular motion. While studying the mechanism of respiration in the articulated animal, vibratile epithelium will therefore nowhere demand attention: its agency will be found to have been substituted by other instruments.

An exposition of the preceding general principles has seemed to the author indispensable to an intelligent study of the novel and extraordinary details, upon which it is proposed next to enter.

[To be continued.]

XV.—*Catalogue of Reptiles collected in Ceylon.* By E. F. Kelaart, M.D., F.L.S. &c.

Order SAURIA. Lizards.

Suborder I. Leptoglossæ. Slender-tongued Lizards.

Fam. *Monitoridæ.* Monitors.

Monitor Dracæna, *Gray.*
Hydrosaurus Salvator, *Wagler.*

Fam. *Scincidæ.* The Scincs.

Riopa punctata, *Gray.*
—— Hardwickii, *Gray.*
Mabouia elegans (?), *Gray.*
Tiliqua rufescens, *Gray.*

Fam. *Acontiadæ.*

Nessia Burtoni (?), *Gray.*
Acontias (?) Layardi, n. s., *nobis.*

Fam. *Typhlopsidæ.* Typhlops.

Argyrophis Bramicus, *Daud.* *Two varieties; one with a pale white streak beneath.

Fam. *Uropeltidæ.* Rough-tails.

Uropeltis grandis, n. s., *nobis.*
—— Saffragamus, n. s., *nobis.*
—— pardalis, n. s. *nobis.*
Rhinophis (?) Blythii, n. s., *nobis.*
Siluboura Ceylonicus, *Gray.*
Dapatnaya Lankadivana, n. s., *nobis.*
—— Trevelyanii, n. s., *nobis.*

Suborder II. Pachyglossæ. Thick-tongued Lizards.

Fam. *Geckotidæ.* The Geckos.

Hemidactylus trihedrus, *Lesson.*
—— maculatus, *Dum. et Bib.*
—— Pieresii, n. s., *nobis* (Prod. Faunæ Zeylanicæ, p. 159).
—— Coctæi, *Dum. et Bib.*
—— frenatus, *Schlegel.*
—— Leschenaultii?, *Dum. et Bib.* apud *Blyth.*
Boltalia sublævis, *Gray.*
Peripia Peroni, *Dum. et Bib.*
Gymnodactylus (?) Kandianus, n. s., *nobis* (Prod. F. Z. p. 186).

Fam. *Agamidæ.* The Agamas.

Litana Ponticereana, *Cuvier.*
Lyriocephalus scutatus, *Wagler.*
Ceratophora Hoddartii, *Gray.*
Salea Jerdoni, *Gray.*
Calotes ophiomachus, *Gray.*
—— Rouxi (?), *Gray,* apud *Blyth.* *C. viridis* (?), Gray, apud nos.
—— mystaceus, *Dum. et Bib.*
—— versicolor, *Dum. et Bib.*

Fam. *Chameleonidæ.* The Chameleons.

Chameleo vulgaris, *Daud.*

Order OPHIDIA. Serpents.

Innocuous Serpents.

Fam. *Boidæ.*

Burrowing.

Cylindrophis maculata, *Wagler.*

Terrestrial.

Python molurus, *Gray.*

Fam. *Colubridæ,* Bonaparte.

Terrestrial.

Calamaria Scytale?
Lycodon. Two or more species.
Xenodon purpurascens, *Schlegel,* var.
Coluber Korros, *Reinwardt.*

Arboreal.

Dipsas multimaculata (?), *Schlegel.*
Drynius prasinus, *Reinwardt.* Two or more varieties.
Leptophis pictus, *Gmelin.*
—— ornatus, *Shaw.*
—— sp.

Aquatic.

Tropidonotus umbratus, 2 var., *Daudin et*
—— stolbatus, *Linn.*
—— schistosus, *Daud.*
Cerberus cinereus, *Cuvier.*

Venomous Serpents.

Fam. *Viperidæ.* Vipers.

Terrestrial.

Bungarus candidus, *Linn.*
Naja lutescens, *var.* nigra.

Arboreal.

Trigonocephalus hypnale, *Wagler.*
—— Grammeus, *Shaw.*
*Trimesurus Ceylonensis ?, apud *Gray.*
Megæra trigonocephala, *Wagler.*
Daboia elegans, *Gray.*
—— Russellii ?, *Gray.*

N.B.—There are about six or eight more Ceylon snakes which have not yet been identified.

Order CHELONIA.

Fam. *Testudinidæ.*

Testudo Indica, *Gmelin.*
—— stellata, *Schweig.*

Fam. *Emydidæ.*

Emys trijuga, var. *Emys seba,* Gray, apud Blyth.

Fam. *Trionycidæ.*

Emyda punctata, *Gray.*

Fam. *Chelonidæ.*

Caretta imbricata, *Gray.*
Chelonia virgata, *Gray.*

Order EMYDOSAURIA.

Fam. *Crocodilidæ.*

Crocodilus porosus, *Schweig.*
—— palustris, *Lesson.*
—— bombifrons, *Gray.* *C. palustris,* male, apud Blyth.

AMPHIBIA.

Order BATRACHIA.

Fam. *Ranidæ.*

Rana cutipora, *Dum. et Bib.*

Rana Malabarica, *Dum. et Bib.*
—— Bengalensis, *Gray.*
—— tigrina, *Daudin.*
—— Newera Elliana, n. s., *nobis.*
—— Kandiana, n. s., *nobis.*
—— Leschenaultii?, *Dum. et Bib.*

Fam. *Hylidæ.*

Polypedates leucomystax, *Gravenhorst.*
—— cruciger, *Blyth.*
—— stellata, *nobis* (Prod. F. Z. p. 194).
Limnodytes mutabilis, n. s., *nobis.*
—— maculata, n. s., *nobis.*

Fam. *Bufonidæ.*

Bufo melanostictus, *Schneider.*
Engystoma marmorata, *Gray.*
—— cinnamomea, n. s., *nobis.*

N.B.—Mr. Blyth in his Report (J. A. S. Bengal, No. 4. 1853) enumerates among the reptiles we sent him the following new species:—*Rana robusta, Limnodytes lividus, L. macularis, Pyxicephalus fodiens,* Jerdon, and *Engystoma rubrum.*

Order PSEUDOPHIDIA.

Fam. *Cæciliidæ.*

Ichthyophis glutinosus, *Gray.*

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 22, 1851.—John Edward Gray, Esq., F.R.S. &c., Vice-President, in the Chair.

Description of Fifty-four New Species of Helicea, from the Collection of Hugh Cuming, Esq. By Dr. L. Pfeiffer.

1. Streptaxis discus, Pfr. *S. testâ latè umbilicatâ, discoideâ, subregulari, lævigatâ, albido-hyalinâ; spirâ planâ, vertice prominulo; anfractibus 6½, vix convexiusculis, irregulariter varicosis, ultimo depresso, subtus deviante, pone aperturam rotundato, deflexo; aperturâ subhorizontali, transversè sinuato-auriformi, plicâ obliquâ parietali et dentibus peristomatis coarctatâ; peristomate candido, reflexo, margine supero impresso, obsoletè dentato, dextro dente distinctiore munito, basi intus transversè calloso.*

Diam. maj. 14, min. 11, alt. 4½ mill.
Hab. —— ?

2. Helix Richmondiana, Pfr. *H. testâ imperforatâ, trochiformi, solidâ, striatâ et irregulariter granulatâ, nitidâ, castaneâ; spirâ castaneâ, sursum pallidiore, apice obtusiusculâ; anfractibus $5\frac{1}{2}$, planis, sensim accrescentibus, ultimo compressè carinato, anticè vix deflexiusculo; basi plano; aperturâ perobliquâ, subrhombeâ, ad carinam rostratâ, intus livido-opalinâ; peristomate nigro-fusco, subincrassato, marginibus callo tenui junctis, supero expanso, basali dilatato, reflexo.*

Diam. maj. 54, min. 47, alt. 30 mill.

Hab. ad Richmond River, Australia.

3. Helix semidecussata, Pfr. *H. testâ perforatâ, conoideâ, solidâ, supernè minute decussatâ, opacâ, unicolore rufo-fuscâ; spirâ conoideâ, acutiusculâ; anfractibus 7, vix convexiusculis, ultimo carinato, non descendente, basi convexo; aperturâ diagonali, angulato-lunari; peristomate simplice, recto, obtuso, margine columellari supernè brevissimè reflexiusculo.*

Diam. maj. 33, min. 30, alt. 18 mill.

Hab. in insulâ Mauritii.

4. Helix Souleyetiana, Pfr. *H. testâ perforatâ, conoideo-depressâ, solidulâ, rugoso-striatâ, supernè inter strias sub lente confertissimè undulato-lineatâ, pallidè fulvâ; spirâ breviter conoideâ, obtusiusculâ; anfractibus 6 subplanis, lentè accrescentibus, ultimo acutè carinato, infra carinam castaneo-fasciato, convexo, medio profundè excavato; aperturâ perobliquâ, angulato-lunari; peristomate simplice, marginibus subparallelis, dextro antrorsum subarcuato, columellari subincrassato, supernè brevissimè reflexo.*

Diam. maj. 52, min. 36, alt. 18 mill.

Hab. ——?

5. Helix radians, Pfr. *H. testâ imperforatâ, depressâ, tenui, lævigatâ, nitidissimâ, pellucidâ, corneâ, strigis albidis irregulariter radiatâ; spirâ brevissimâ, convexâ; suturâ impressâ, submarginatâ; anfractibus $4\frac{1}{2}$, planiusculis, ultimo non descendente, supernè angulato, basi convexo, medio subimpresso; aperturâ subverticali, angulato-lunari; peristomate simplicissimo, recto.*

Diam. maj. 9, min. 8, alt. 4 mill.

Hab. in insulâ Tahiti.

6. Helix Gartneriana, Pfr. *H. testâ umbilicatâ, coniformi, solidâ, irregulariter elevato-striatâ, opacâ, nitidulâ, lutescenti-carneâ; spirâ conicâ, apice obtusâ; suturâ submarginatâ; anfractibus 7, convexis, ultimo peripheriâ subangulato, lineâ rubrâ cincto, anticè non descendente, subtus planiusculo; umbilico angustissimo, pervio; aperturâ parum obliquâ, subtetragonâ; peristomate albo, margine supero ferè angulatim arcuato, expanso, basali substricto, columellari lilaceo, brevi, verticali, reflexo.*

Diam. maj. 22, min. 19, alt. 22 mill.

Hab. ——?

7. Helix liturata, Pfr. *H. testâ imperforatâ, turbinato-semiglobosâ, striatâ, minutè rugoso-malleatâ, nitidulâ, roseo-carneâ,*

fasciis punctatim vel lituratim interruptis rufis ornatâ; spirâ depresso-turbinatâ, apice acutiusculâ; anfractibus 5, *convexiusculis, ultimo vix descendente, peripheriâ rotundato, fasciâ castaneâ, subtessellatâ circumdato, basi convexiusculo; aperturâ diagonali, rotundato-lunari; peristomate simplice, margine dextro vix expansiusculo, columellari subcalloso.*

Diam. maj. 23, min. 20, alt. 15 mill.

Hab. ——?

8. Helix Brardiana, Pfr. *H. testâ umbilicatâ, subturbinato-depressâ, tenui, striatâ, fulvâ, pellucidâ, maculis luteis opacis irregulariter variegatâ; spirâ subturbinatâ, apice acutiusculâ; anfractibus* 5, *vix convexiusculis, ultimo non descendente, peripheriâ angulato, basi convexiore; umbilico angusto, pervio; aperturâ parum obliquâ, rotundato-lunari; peristomate simplice, tenui, undique expanso, margine columellari subdilatato, patente.*

Diam. maj. 14, min. 12, alt. $8\frac{1}{2}$ mill.

Hab. in insulâ Bourbon.

9. Helix Sturmiana, Pfr. *H. testâ mediocriter umbilicatâ, depresso-semiglobosâ, solidâ, supernè confertim plicatâ, parum nitidâ, unicolore fusco-lutescente; spirâ brevi, convexâ, obtusâ; anfractibus* 4, *planiusculis, rapidè accrescentibus, ultimo anticè descendente, subdepresso, peripheriâ rotundato, basi convexo, lævigato; aperturâ parum obliquâ, lunato-ovali, intus margaritaceâ; peristomate simplice, marginibus conniventibus, callo tenui junctis, supero recto, basali subreflexo.*

Diam. maj. 22, min. $18\frac{1}{2}$, alt. 12 mill.

Hab. ——?

10. Helix Layardi, Pfr. *H. testâ perforatâ, turbinatâ, tenuiusculâ, ruguloso-striatâ, parum nitente, pellucidâ, pallidè corneâ; spirâ conoideâ, apice acutiusculâ; anfractibus* $5\frac{1}{2}$, *convexiusculis, ultimo carinato, non descendente, basi convexo; aperturâ parum obliquâ, rotundato-lunari, vix angulatâ; peristomate recto, tenui, acuto, margine columellari supernè brevissimè reflexiusculo.*

Diam. maj. 13, min. ferè 12, alt. 9 mill.

Hab. in insulâ Ceylon (*Mr. Layard*).

11. Helix Woodiana, Pfr. *H. testâ umbilicatâ, depressâ, tenui, lævigatâ, nitidissimâ, corneo-fuscâ; spirâ parum elevatâ, vertice subtili; suturâ impressâ; anfractibus* 5, *vix convexiusculis, lentè accrescentibus, ultimo depresso, obsoletè angulato, non descendente, basi planiusculo; umbilico angusto, pervio; aperturâ subverticali, lunari; peristomate simplice, recto, acuto, margine columellari vix reflexiusculo.*

Diam. maj. 10, min. 9, alt. $4\frac{1}{2}$ mill.

Hab. in insulâ Ceylon (*Mr. Layard*).

12. Helix Forsteriana, Pfr. *H. testâ umbilicatâ, globoso-depressâ, tenuiusculâ, undique minutè granulatâ, diaphanâ, corneo-isabellinâ, fasciis* 2 *angustis rufis supernè ornatâ; spirâ parum elevatâ, convexo-conoideâ, vertice acutiusculo; anfractibus* 6, *con-*

vexiusculis, ultimo anticè vix descendente, basi subplanulato; umbilico mediocri, pervio; aperturâ obliquâ, rotundato-lunari; peristomate simplice, marginibus remotis, dextro recto, basali reflexo, columellari in laminam triangularem, violaceo-fuscam, fornicatim dilatato.

Diam. maj. $20\frac{1}{2}$, min. 18, alt. 12 mill.

Hab. in Australiâ boreali.

13. Helix ptychomphala, Pfr. *H. testâ umbilicatâ, depresso-globosâ, tenui, supernè confertim costulatâ, lineis concentricis paucis obsoletè decussatâ, nitidâ, castaneo-corneâ; spirâ vix convexâ; anfractibus 4, vix convexiusculis, ultimo non descendente, obsoletissimè angulato, basi convexo, lævigato, corneo-virente, circa umbilicum mediocrem, pervium confertim plicato; aperturâ parum obliquâ, irregulariter truncato-ovali, multo altiore quam latâ; peristomate simplice, obtuso, margine columellari elongato, substrictè descendente, supernè fornicatim reflexo.*

Diam. maj. 22, min. 20, alt. 13 mill.

Hab. ad Portum Essington.

14. Helix Poiretiana, Pfr. *H. testâ perforatâ, conicâ, solidâ, striatulâ, nitidâ, carneo-albidâ, strigis pallidè fusculis irregulariter pictâ; spirâ conicâ, obtusiusculâ; suturâ impressâ, subtilissimè crenulatâ; anfractibus 7, vix convexiusculis, ultimo subrotundato, fasciâ unâ fuscâ signato, anticè breviter descendente; aperturâ diagonali, lunato-rotundatâ; peristomate acuto, margine dextro repando, basali subincrassato, columellari fornicatim reflexo, perforationem ferè tegente.*

Diam. maj. $19\frac{1}{2}$, min. $18\frac{1}{2}$, alt. 23 mill.

Hab. ad Portum Essington.

15. Helix Dillwyniana, Pfr. *H. testâ umbilicatâ, depressâ, solidâ, irregulariter rugosâ et subtilissimè malleatâ, nitidâ, cretaceâ; spirâ subplanâ, vertice papillatim prominulo, castaneo; anfractibus $4\frac{1}{2}$, planiusculis, ultimo rotundato, anticè breviter deflexo, basi inflato; umbilico angusto, non pervio; aperturâ perobliquâ, latè lunari, intus albâ; peristomate acuto, intus incrassato, margine supero subhorizontali et dextro arcuato expansis, basali substricto, reflexo, columellari brevissimo, angusto, patente.*

Diam. maj. 31, min. 25, alt. 14 mill.

Hab. ——?

16. Bulimus glaucophthalmus, Pfr. *B. testâ imperforatâ, ovato-oblongâ, solidâ, striatulâ, nigro-castaneâ, epidermide hydrophanâ fusco-cinereâ strigatâ; spirâ convexo-conicâ, apice saturatè cæruleâ, obtusâ; suturâ impressâ; anfractibus 5, convexiusculis, ultimo spirâ breviore, basi obsoletè angulato; columellâ subdeclivi, dilatatâ, planâ, albâ, basi subdentatâ; aperturâ obliquâ, truncato-ovali, intus lividâ; peristomate simplice, brevissimè expanso, margine dextro repando.*

Long. 36, diam. 25 mill.

Hab. in insulis Philippinis.

17. Bulimus suturalis, Pfr. *B. testâ imperforatâ, oblongo-conicâ, tenui, striatulâ, nitidulâ, alabastrino-albidâ; spirâ conicâ, apice obtusâ; suturâ parum impressâ, candidâ, confertissimè noduloso-crenatâ; anfractibus 7, planiusculis, ultimo $\frac{3}{7}$ longitudinis subæquante, infra medium obtusè angulato et fasciis 2 nigricanti-castaneis ornato; columellâ supernè fusco-callosâ, subtortâ; aperturâ obliquâ, truncato-oblongâ; peristomate simplice, vix expansiusculo.*

Long. 43, diam. 23 mill.

Hab. in Africâ occidentali.

18. Bulimus luctuosus, Pfr. *B. testâ perforatâ, oblongo-acuminatâ, solidulâ, obsoletè decussatâ, vix nitidulâ, atro-castaneâ; spirâ elongatâ, apice obtusâ; suturâ impressâ, submarginatâ; anfractibus 7, convexiusculis, ultimo $\frac{1}{3}$ longitudinis paulo superante, basi circa perforationem angustam subcarinato; columellâ verticali, levissimè arcuatâ; aperturâ parum obliquâ, subsemiovali, ad columellam angulatâ, intus lividâ; peristomate simplice, recto, margine columellari fornicato, breviter reflexo.*

Long. 39, diam. 17 mill.

Hab. in Africâ occidentali.

19. Bulimus infundibulum, Pfr. *B. testâ umbilicatâ, ovato-conicâ, subfusiformi, confertim striatâ, opacâ, albâ; spirâ convexo-conicâ, apice attenuatâ, roseâ, acutiusculâ; suturâ lineari; anfractibus 9, ferè planis, ultimo $\frac{3}{7}$ longitudinis subæquante, basi attenuato, circa umbilicum latum, pervium, infundibuliformem compresso; aperturâ subverticali, angustâ, oblongâ; peristomate simplice, marginibus supernè approximatis, dextro breviter expanso, columellari subdilatato, patente.*

Long. 18, diam. 7 mill.

Hab. in Andibus Peruvianis.

Nearly allied to *Bul. umbilicaris*, Souleyet.

20. Bulimus subinterruptus, Pfr. *B. testâ perforatâ, subfusiformi-oblongâ, tenuiusculâ, lævigatâ, sub lente spiraliter striatâ, nitidulâ, albidâ, fasciis 5 latis, subinterruptis, spadiceis ornatâ; spirâ elongato-conicâ, acutâ; suturâ parum impressâ; anfractibus 6, planiusculis, ultimo spiram paulo superante, basi attenuato; columellâ substrictâ, recedente; aperturâ obliquâ, angustâ, acuminato-semiovali; peristomate simplice, tenui, lutescente, margine dextro latè expanso, columellari triangulatim e basi dilatato, supernè latè reflexo.*

Long. 37, diam. $13\frac{1}{2}$ mill.

Hab. in Andibus Boliviæ.

21. Bulimus varicosus, Pfr. *B. testâ perforatâ, oblongo-acuminatâ, tenui, striatâ, sub lente obsoletè decussatulâ, parum nitente, albidâ, strigis castaneis sparsis irregulariter variegatâ; suturâ irregulariter crenulatâ; spirâ elongato-conicâ, acutiusculâ; anfractibus 6, convexiusculis, varicosis (varicibus prioribus obtusis, ultimo acutè prominente), ultimo spirâ vix breviore, basi subcompresso;*

columellâ supernè subtortâ; aperturâ parum obliquâ, oblongo-ovali; peristomate simplice, tenui, margine dextro latè expanso, columellari dilatato, applanato, patente.

Long. 35, diam. 14 mill.

Hab. in republicâ Mexicanâ.

22. Bulimus attenuatus, Pfr. *B. testâ subperforatâ, fusiformi-oblongâ, solidiusculâ, sublævigatâ, nitidâ, albâ, strigis latis, maculatim subinterruptis, spadiceis, ornatâ; spirâ conicâ, acutiusculâ; anfractibus ferè 6, convexiusculis, ultimo spiram paulo superante, anticè striato, basi attenuato; columellâ intrante, tortâ, funali; aperturâ vix obliquâ, ovali-oblongâ; peristomate simplice, tenui, margine dextro breviter expanso, columellari breviter reflexo, supernè adnato.*

Long. 34, diam. 13 mill.

Hab. Vera Cruz.

23. Bulimus elæodes, Pfr. *B. testâ imperforatâ, ovatâ, tenuiusculâ, rugoso-striatâ, transversè submalleatâ, diaphanâ, nitidâ, castaneo-olivaceâ; spirâ conoideâ, apice obtusâ; anfractibus 4, convexiusculis, ultimo $\frac{4}{7}$ longitudinis subæquante, anticè descendente, basi subrotundato; columellâ intrante, subtortâ, roseâ; aperturâ subverticali, ovali, intus margaritaceâ; peristomate roseo, subincrassato, breviter reflexo, marginibus callo supra regionem umbilici dilatato junctis.*

Long. 36, diam. 18 mill.

Hab. in Andibus Novæ Granadæ.

24. Bulimus scytodes, Pfr. *B. testâ imperforatâ, ovato-conicâ, tenui, remotè striatâ, undique minutè granulatâ (granulis non seriatis), haud nitente, fuscâ, maculis rufis majoribusque nigricantibus irregulariter adspersâ, lineis longitudinalibus flexuosis, angulatis, luteis, sæpe geminatis vel anastomosantibus pictâ; spirâ brevi, convexo-conicâ, obtusiusculâ; anfractibus 4, convexiusculis, ultimo magno, $\frac{4}{7}$ longitudinis æquante, anticè deflexo, basi rotundato; columellâ filari, intrante, leviter arcuatâ; aperturâ parum obliquâ, ovali, intus concolore, nitidâ; peristomate simplice, tenui, rubello, undique breviter expanso.*

Long. 35, diam. $17\frac{1}{2}$ mill.

Hab. in Andibus Novæ Granadæ.

25. Bulimus meleagris, Pfr. *B. testâ imperforatâ, acuminato-ovatâ, tenuiusculâ, striis incrementi confertis et lineis spiralibus granulatâ, parum nitente, fulvâ, fusco-strigatâ et irregulariter guttatâ; spirâ conicâ, acutâ; suturâ subcrenulatâ; anfractibus $5\frac{1}{2}$, planiusculis, ultimo spiram paulo superante, convexiore, anticè descendente, basi rotundato; columellâ filari, leviter arcuatâ; aperturâ obliquâ, oblongo-ovali, intus submargaritaceâ; peristomate simplice, recto.*

Long. 31, diam. 14 mill.

Hab. in Andibus Novæ Granadæ.

26. Bulimus nigrolimbatus, Pfr. *B. testâ imperforatâ, ovatâ,*

tenui, rugosá, striis confertis spiralibus subgranulatá, parum nitidá, olivaceo-fulvá, strigis angustis castaneis variegatá; spirá conicá, apice obtusá; anfractibus 5, convexiusculis, ultimo spiram paulo superante, convexiore, basi rotundato; columellá tenui, subcallosá, subrecedente; aperturá obliquá, angulato-ovali, intus plicatá, margaritaceá; peristomate simplice, recto, obtuso, nigrolimbato.

Long. 28, diam. 14 mill.
Hab. in Andibus Novæ Granadæ.

27. Bulimus dubius, Pfr. *B. testá subperforatá, oblongo-fusiformi, tenui, striatá, nitidulá, albo-lutescente, strigis spadiceis subundulatis ornatá; spirá gracili, elongato-conicá, apice obtusulá; suturá submarginatá; anfractibus 6, vix convexiusculis, ultimo spirá paulo breviore, basi attenuato, subcompresso; columellá subverticali, fere ad basin aperturæ elongatá; aperturá vix obliquá, oblongá, utrinque angustatá, intus concolore; peristomate simplice, recto, margine dextro levissime arcuato, columellari breviter fornicatim reflexo, subappresso.*

Long. 28, diam. 10 mill.
Hab. in Andibus Novæ Granadæ.

28. Bulimus nubeculatus, Pfr. *B. testá umbilicatá, ovato-oblongá, solidulá, sublævigatá, nitidá, pallidè corneá, saturatius nubeculatá; spirá conicá, apice obtusulá; suturá profundá; anfractibus $5\frac{1}{2}$, convexis, ultimo $\frac{3}{7}$ longitudinis æquante, basi rotundato; columellá verticali, ad basin aperturæ porrigente; aperturá parum obliquá, subellipticá, basi subangulatá, intus albidá; peristomate simplice, recto, margine dextro perarcuato, columellari dilatato, fornicatim reflexo, libero.*

Long. 16, diam. $8\frac{1}{2}$ mill.
Hab. in Americâ centrali (*Morelet.*)

29. Bulimus Eganus, Pfr. *B. testá perforatá, conico-ovatá, tenui, lineis longitudinalibus et spiralibus sub lente obsoletè decussatá, vix nitidulá, quasi pruinosá, fusco-corneá; spirá conicá, apice obtusá; suturá mediocri; anfractibus 5, modice convexis, ultimo spiram paulo superante, medio obsoletè angulato, basi vix compressiusculo; aperturá obliquá, subellipticá, basi subangulatá; peristomate simplice, tenui, margine dextro repando, columellari sursum dilatato, reflexo, subappresso.*

Long. 13, diam. $6\frac{1}{2}$ mill.
Hab. Ega Brasiliæ.

30. Bulimus acalles, Pfr. *B. testá subperforatá, ovato-conicá, tenui, longitudinaliter confertim striatá et distantius plicatá, haud nitente, fulvo-griseá; spirá conicá, obtusiusculá, fulvescente; anfractibus $4\frac{1}{2}$, vix convexiusculis, ultimo spiram superante, basi rotundato; columellá vix arcuatá, subrecedente; aperturá obliquá, ovali, intus fulvo-carneá; peristomate simplice, recto, margine dextro arcuato, columellari supernè reflexo, subadnato.*

Long. 10, diam. 6 mill.
Hab. in Andibus Peruvianis.

31. Bulimus Dillwynianus, Pfr. *B. testâ perforatâ, ovato-oblongâ, solidâ, ruditer striatâ et irregulariter malleatâ, vix nitidulâ, carneâ, fusculo punctatâ et variegatâ; spirâ convexo-conicâ, apice obtusulâ; suturâ impressâ, marginatâ; anfractibus 5, convexiusculis, ultimo spiram paulo superante, basi attenuato, subcompresso; columellâ valide torto-plicatâ; aperturâ vix obliquâ, sinuoso-oblongâ; peristomate albo, expanso-reflexo, margine dextro leviter arcuato, columellari supernè dilatato, perforationem fere claudente.*

Long. 39, diam. $16\frac{1}{4}$ mill.
Hab. in Andibus Novæ Granadæ.

32. Achatina fulgurata, Pfr. *A. testâ conico-ovatâ, tenui, striis longitudinalibus supernè confertis, in anfractu ultimo obsoletis, lineisque spiralibus granulatâ, corneo-luteâ, strigis latis fulguratis nigricantibus ornatâ; spirâ conicâ, obtusâ; anfractibus $6\frac{1}{2}$, superis parum convexis, ultimo ventricoso, lineis paucis spiralibus infra suturam granulato, infra medium sublævigato; columellâ cærulescente, vix arcuatâ, supra basin aperturæ elliptico-semiovali abruptè truncatâ; peristomate simplice, recto.*

Long. 67, diam. 36 mill.
Hab. in Africâ occidentali.

33. Achatina plicatula, Pfr. *A. testâ oblongo-fusiformi, tenui, longitudinaliter confertim plicatulâ, lineis spiralibus obsoletè decussatâ, diaphanâ, parum nitente, fusco-carneâ; spirâ elongato-conicâ, apice obtusâ; suturâ marginatâ, minutè crenulatâ; anfractibus 7, vix convexiusculis, ultimo spiram æquante, paulo convexiore, basi attenuato; columellâ callosâ, vix arcuatâ, ad basin aperturæ semiovali, intus nitidissimæ, abruptè truncatâ; peristomate simplice, tenui.*

Long. 60, diam. 25 mill.
Hab. in Andibus Novæ Granadæ.

34. Achatina albicans, Pfr. *A. testâ ovato-conicâ, tenui, longitudinaliter striatâ, lineis spiralibus infra medium anfractûs ultimi obsoletis decussatulâ, diaphanâ, vix nitidâ, albicante; spirâ pyramidatâ, obtusiusculâ; suturâ submarginatâ; anfractibus $6\frac{1}{2}$, vix convexiusculis, ultimo spirâ paulo longiore, basi vix attenuato; columellâ verticali, substrictâ, supra basin aperturæ rhombeo-semiovalis horizontaliter et breviter truncatâ; peristomate simplice, recto, margine basali leviter arcuato.*

Long. 46, diam. 23 mill.
Hab. in Africâ occidentali.

35. Achatina inornata, Pfr. *A. testâ turrito-oblongâ, solidâ, confertim striatâ, pallide fulvâ, strigis saturatioribus variegatâ; spirâ turritâ, apice obtusiusculâ; suturâ lævi, confertissime crenulatâ; anfractibus $7\frac{1}{2}$, planiusculis, ultimo $\frac{2}{5}$ longitudinis subæquante, basi vix compresso, læviore; columellâ perarcuatâ, albo-callosâ, obliquè abruptè truncatâ; aperturâ sinuoso-semiovali, intus albâ; peristomate simplice, obtuso, margine dextro repando.*

Long. 28, diam. 11 mill.
Hab. in insulâ Ceylon.

36. Achatina violacea, Pfr. *A. testâ oblongo-conicâ, solidâ, striatâ, parum nitente, violaceâ; spirâ elongato-conicâ, sursum rubellâ, apice obtusâ; suturâ lævi, marginatâ; anfractibus 7, convexiusculis, ultimo $\frac{2}{5}$ longitudinis subæquante, infra medium angulato; columellâ subarcuatâ, tenuiter callosâ, supra basin aperturæ obliquæ, angulato-ovalis breviter truncatâ; peristomate simplice, recto.*

Long. 38, diam. 18 mill.

Hab. in Africâ occidentali.

37. Achatina (Glandina) attenuata, Pfr. *A. testâ oblongo-fusiformi, gracili, tenui, lævigatâ, nitidissimâ, fulvâ, strigis arcuatis saturatioribus pictâ; spirâ elongato-conicâ; apice obtusiusculâ; suturâ lævi, subsimplice; anfractibus 7, planiusculis, ultimo $\frac{3}{5}$ longitudinis subæquante, basi attenuato; columellâ subcallosâ, leviter arcuatâ, subtortâ, basi obliquè truncatâ; aperturâ angustissimâ, oblongâ, supernè acutâ, prope basin sinistrorsum dilatatâ; peristomate simplice, margine dextro repando.*

Long. 31, diam. 11 mill.

Hab. in Americâ centrali.

38. Helix subrugata, Pfr. *H. testâ subperforatâ, depresso-turbinatâ, distanter subrugatâ, pellucidâ, pallide corneâ; spirâ breviter conoideâ, acutiusculâ; anfractibus $5\frac{1}{2}$–6, planiusculis, ultimo carinato, basi convexiusculo, lævigato; aperturâ diagonali, subangulato-lunari; peristomate recto, acuto, margine columellari supernè vix reflexiusculo.*

Diam. maj. 13, min. $11\frac{1}{2}$, alt. $6\frac{1}{2}$ mill.

Hab. ad Clarence River, New South Wales.

39. Helix otostoma, Pfr. *H. testâ angustè umbilicatâ, sublentiformi, solidâ, acutè carinatâ, striatâ et subtiliter granulatâ, olivaceo-nigricante vel castaneâ; spirâ subconoideo-convexâ, obtusâ; anfractibus 5, planiusculis, ultimo utrinque convexo, anticè subito deflexo, supra et infra carinam ascendentem profundè scrobiculato; aperturâ perobliquâ, subrhombeo-ensiformi, ringente; peristomate continuo, ad anfractum penultimum sinuoso, medio laminam longe intrantem emittente, margine supero dente conico obtusulo munito, basali medio subangulatim descendente, parte sinistrâ dentem validum, compressum, parte dextrâ dentem leviter et irregulariter bifurcatum gerente.*

Diam. maj. 31, min. 26, alt. 13 mill.

Hab. in Andibus Novæ Granadæ.

40. Helix annulifera, Pfr. *H. testâ umbilicatâ, depressâ, lentiformi, carinatâ, solidâ, striatâ et minutè granulatâ, saturate castaneâ, ad carinam acutam latè albo-fasciatâ; spirâ breviter conoideâ, obtusâ; anfractibus 5, planiusculis, ultimo anticè breviter deflexo, basi convexo, anticè strangulato et scrobiculato; umbilico mediocri; aperturâ subhorizontali, irregulari, ringente; peristomate subincrassato, albo, continuo, margine parietali perarcuato, laminam elongatam intrantem emittente, in umbilicum descendente et cum basali parallelo juncto; margine basali usque ad medium*

substricto, acutè dentato, tum angulatim descendente, latè reflexo, laminâ linguæformi latâ munito, ad carinam ascendente, a dextro expanso canali angusto, supernè in annulum apertum desinente separato.

Diam. maj. 34, min. 29, alt. 13 mill.

Hab. Panama.

This is the shell figured by Prof. E. Forbes in Trans. Zool. Soc. 1850, p. 53. Moll. t. 9. f. 4, under the name of *H. labyrinthus* var. *sipunculata.*

41. Helix Gaskoini, Pfr. *H. testâ umbilicatâ, turbinato-depressâ, solidâ, obliquè rugato-plicatâ, nitidâ, albâ; spirâ conoideo-convexâ, obtusâ; anfractibus* $5\frac{1}{2}$*, convexis, ultimo anticè deflexo, medio carinato, basi convexiusculo, sublævigato; aperturâ perobliquâ, lanceolato-ovali; peristomate subincrassato, marginibus callo umbilicum mediocrem, pervium semioccultante junctis, supero breviter expanso, basali reflexo.*

Diam. maj. 31, min. 27, alt. 15 mill.

Hab. in insulâ Haiti (*Sallé*).

42. Bulimus Tasmanicus, Pfr. *B. testâ imperforatâ, ovato-conicâ solidulâ, rugoso-striatâ, vix nitidâ, albidâ; spirâ conicâ, acutiusculâ, apice suberubescente; anfractibus 5, vix convexiusculis, ultimo spiram paulo superante, basi rotundato; columellâ filari, subrecedente; aperturâ obliquâ, ovali, intus pallide fulvescente; peristomate simplice, recto, margine dextro leviter arcuato, columellari vix reflexiusculo, adnato.*

Long. 25, diam. 11 mill.

Hab. Van Diemen's Land.

43. Bulimus Belcheri, Pfr. *B. testâ imperforatâ, ovato-oblongâ, solidâ, glabriusculâ, fulvido-albidâ, castaneo-fasciatâ; spirâ convexo-conicâ, obtusâ; anfractibus 5, convexiusculis, ultimo spirâ vix breviore, ad suturam et basin latè, medio angustè fasciato; columellâ planâ, substrictâ, supra basin recedente; aperturâ obliquâ, truncato-oblongâ; peristomate subincrassato, nigricante, reflexiusculo.*

Long. 40, diam. $23\frac{1}{2}$ mill.

Hab. in insulis Philippinis.

44. Bulimus Newcombianus, Pfr. *B. testâ sinistrorsâ vix subperforatâ, ovato-turritâ, tenuiusculâ, plicis validis longitudinalibus sulcisque spiralibus sculptâ, olivaceo-fuscâ; spirâ turritâ, gracili, obtusulâ; anfractibus* $5\frac{1}{2}$*, summis planis, sequentibus convexiusculis, ultimo* $\frac{3}{7}$ *longitudinis subæquante, medio inflato; columellâ callosâ, substrictè recedente; peristomate recto, acuto, margine externo leviter arcuato, subrepando, columellari reflexo, subappresso.*

Long. $14\frac{1}{2}$, diam. $5\frac{1}{2}$ mill.

Hab. in insulis Sandwich.

This species is nearly allied to *Achatinella plicata*, Gould, which must be rather referred to the genus *Bulimus*, in which there being already a *Bulimus plicatus*, I have marked it in Mr. Cuming's Museum with the name of *Bulimus liratus*.

45. Bulimus porphyrostomus, Pfr. *B. testâ imperforatâ, ovato-conicâ, solidâ, rugoso-plicatâ, pallide carneâ, epidermide deciduâ fusco-olivaceâ indutâ; spirâ conicâ, obtusiusculâ; anfractibus* 6, *vix convexiusculis, ultimo spiram æquante, basi subattenuato; columellâ oblongè plicatâ, albâ; aperturâ verticali, angustâ, oblongâ, obliquè recedente, intus saturatè purpureo-castaneâ, nitidâ; peristomate incrassato, recto, albo, marginibus callo crasso, albo, medio tuberculifero junctis.*

Long. 62, diam. 28 mill.

Locality unknown.

46. Bulimus microdon, Pfr. *B. testâ breviter rimatâ, subfusiformi-turritâ, obliquè costulato-striatâ, albidâ, strigis sparsis corneis, lacteo-marginatis ornatâ; spirâ elongatâ, apice acutiusculâ; anfractibus* 12, *vix convexiusculis, ultimo* $\frac{2}{9}$ *longitudinis subæquante, infra medium filoso-unicarinato; columellâ supernè plicâ dentiformi munitâ; aperturâ vix obliquâ, truncato-ovali; peristomate simplice, margine dextro breviter expanso, columellari dilatato, angulatim reflexo.*

Long. 15, diam. 4 mill.

Hab. in insulâ Jamaica.

47. Achatina Newcombi, Pfr. *A. testâ turritâ, solidâ, longitudinaliter rugoso-striatâ, cingulis obtusè elevatis sculptâ, castaneâ; spirâ elongatâ, sursum in conum convexiusculum, acuminatum attenuatâ; anfractibus* 9, *planiusculis, ultimo* $\frac{2}{7}$ *longitudinis subæquante, infra medium angulato, fasciâ pallide cincto, basi nigro; columellâ lamellâ angustâ, tortâ, albâ munitâ, basi subtruncatâ; aperturâ obliquâ, subrhombeâ; peristomate simplice, recto.*

Long. 71, diam. 19 mill.

Hab. in insulis Sandwich (*Newcomb*).

48. Achatinella melampoides, Pfr. *A. testâ oblongâ, solidâ, ruguloso-striatâ, vix nitidulâ, saturatè fuscâ; spirâ convexo-conicâ, acutiusculâ; suturâ impressâ, submarginatâ; anfractibus* 6, *vix convexiusculis, ultimo spirâ paulo breviore, basi rotundato; columellâ medio acutè tuberculatâ; aperturâ verticali, sinuato-ovali; peristomate recto, acuto, intus labiato, margine columellari calloso, albo, appressè reflexo.*

Long. 13, diam. $5\frac{2}{3}$ mill.

Hab. in insulis Sandwich.

49. Partula nodosa, Pfr. *P. testâ perforatâ, conico-ovatâ, solidulâ, obsoletè decussatulâ, castaneâ, ad suturam fasciâ latâ albâ et interdum nonnullis pallidis ornatâ; spirâ conicâ, acutâ; anfractibus* $5\frac{1}{2}$, *planiusculis, ultimo spiram subæquante; columellâ supernè profundè plicatâ, tum subnodosâ; aperturâ subverticali, oblongâ, angustâ; peristomate extus vix expanso, intus callo acutè prominente munito, marginibus subparallelis, dextro strictiusculo.*

Long. 16, diam. 8 mill.

Hab. in insulis Tahiti et Navigatorum.

50. Partula filosa, Pfr. *P. testâ perforatâ, conico-ovatâ, solidâ, lineis impressis spiralibus, confertis sculptâ, haud nitente, castaneâ, strigis filaribus cinereis ornatâ; spirâ conicâ, obtusiusculâ; anfractibus 5, planiusculis, ultimo spiram æquante, convexiore; columellâ supernè vix plicatâ; aperturâ parum obliquâ, subtriangulari-semiovali; peristomate expansiusculo, intus callo crasso prominente munito.*

Long. 16, diam. $8\frac{1}{4}$ mill.

Hab. in insulis Navigatorum.

51. Helix glabriuscula, Pfr. *H. testâ perforatâ, conoideo-semiglobosâ, tenui, lævigatâ, pellucidâ, nitente, lutescente, rufo angulato-lineatâ; spirâ convexo-conoideâ, acutiusculâ; anfractibus $5\frac{1}{2}$, convexiusculis, ultimo non descendente, basi planiusculo; aperturâ obliquâ, subdepressâ, lunari; peristomate simplice, recto, margine columellari declivi, supernè vix reflexiusculo.*

Diam. maj. $3\frac{1}{2}$, min. 3, alt. 2 mill.

Hab. in Novâ Seelandiâ (*Strange*).

52. Helix solida, Pfr. *H. testâ imperforatâ, conoideo-semiglobosâ, crassâ, striatâ, fulvescente, epidermide tenui, fuscâ, non nitente obductâ; spirâ convexâ, obtusâ, apice rubellâ; anfractibus 5, convexiusculis, ultimo convexiore, dimidium altitudinis formante, medio obsoletè angulato, anticè vix descendente; columellâ strictâ, declivi, latâ, albidâ; aperturâ obliquâ, subtetragono-lunari, intus albâ; peristomate subincrassato, vix expansiusculo, fusco-limbato.*

Diam. maj. 37, min. 33, alt. 27 mill.

Hab. prope Nanjan, insulæ Mindoro.

53. Helix oblita, Pfr. *H. testâ perforatâ, sublenticulari, tenuissimâ, supernè confertim arcuato-plicatâ, pellucidè, pallidè corneâ; spirâ depresso-turbinatâ, acutiusculâ; anfractibus 6, vix convexiusculis, ultimo non descendente, medio obtusè denticulato-carinato, basi convexiore, radiatim striato; aperturâ parum obliquâ, lunari; peristomate simplice, tenui, recto, margine basali leviter arcuato, ad perforationem breviter reflexo.*

Diam. maj. 23, min. 20, alt. $11\frac{1}{2}$ mill.

Hab. in Indiâ.

54. Helix vilis, Pfr. *H. testâ umbilicatâ, depresso-globosâ, tenuiusculâ, granulato-striatâ, corneâ; spirâ breviter conoideâ, acutiusculâ; anfractibus 5, vix convexiusculis, celeriter accrescentibus, ultimo anticè deflexo, peripheriâ obsoletè subangulato, basi convexo; umbilico angusto, non pervio; aperturâ diagonali, fere circulari; peristomate intus valide labiato, marginibus approximatis, columellari supernè dilatato, patente.*

Diam. maj. 11, min. 9, alt. 6 mill.

Hab. ——?

September 9, 1851.—Sir Roderick Impey Murchison, G.C. St.S., F.R.S. &c., in the Chair.

Professor OWEN read an elaborate paper "On the Skeleton of *Troglodytes Gorilla,*" which will be published in the Transactions of the Society.

Nov. 11, 1851.—W. J. Broderip, Esq., Vice-President, in the Chair.

DESCRIPTIONS OF SEVERAL NEW SPECIES OF MUREX, RISSOINA, PLANAXIS, AND EULIMA, FROM THE CUMINGIAN COLLECTION. BY ARTHUR ADAMS, F.L.S. ETC.

1. MUREX IOSTOMUS, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ; anfractibus planulatis, squamulosis, spinis acutis, in serie elevato disposito ornatis, cinereâ; anfractu ultimo spinis elevatis, bifidis, in seriebus quatuor dispositis instructo, varicibus sex, longitudinalibus; aperturâ ovato-oblongâ, intus violaceâ; labio subtuberculari; labro fimbriato.*
Hab. Philippines. Mus. Cuming.

2. MUREX SOLIDUS, A. Adams. *M. testâ solidâ, profundè umbilicatâ, albâ; spirâ brevi, obtusâ; anfractibus planulatis, longitudinaliter plicato-varicosis (varicibus in anfractu ultimo* 7), *transversim liratis; liris, ad plicas, incrassatis, interstitiis longitudinaliter cancellatis; aperturâ subrotundatâ; canali recto, aperturam æquante; labro simplici, intus lævi.*
Hab. Ichiboe, West Africa. Mus. Cuming.

3. MUREX EURACANTHUS, A. Adams. *M. testâ ovato-fusiformi, umbilicatâ; spirâ acuminatâ; anfractibus planis, serie tuberculorum spiniformium in medio dorsi, albâ, spinis et parte anticâ rubro tinctis; anfractu ultimo liris squamulosis, et spinis tubulosis, longis, in seriebus duobus dispositis, ornato; aperturâ ovatâ, oblongâ; labio anticè producto et tuberculato; canali brevi, subrecurvâ.*
Hab. ——? Mus. Cuming.
Figured by Mr. Reeve as *M. noduliferus,* which is very different from the present species.

4. MUREX EXASPERATUS, A. Adams. *M. testâ ovato-fusiformi, umbilicatâ, albâ, nitidâ; spirâ acuminatâ; anfractibus angulatis, in medio longitudinaliter plicato-varicosâ, transversim liratâ; liris subspinulosis ad plicas; aperturâ ovatâ; canali mediocri, subincurvato; labro intus sulcato.*
Hab. ——? Mus. Cuming.

5. MUREX LIGNARIUS, A. Adams. *M. testâ ovato-fusiformi, subumbilicatâ; spirâ acuminatâ, rufo-fuscâ; anfractibus supernè excavatis, in medio liris duabus, elevatis, nodulosis; transversim liratâ, liris elevatis rugulosis, inæqualibus, longitudinaliter trivaricosâ, varicibus, in medio, spinis duabus, elevatis, fimbriatis; aperturâ ovato-rotundatâ, intus albâ; canali aperturam æquante, subrecurvato.*
Hab. West Africa. Mus. Cuming.

6. Murex fusiformis, A. Adams. *M. testâ fusiformi, cinereâ, fulvo variegatâ; spirâ productâ; anfractibus rotundis; varicibus longitudinalibus, subelevatis, nodospinosis, et lineis elevatis, transversis, latè clathratâ; aperturâ oblongo-ovatâ; canali aperturam æquante, recto; labro extus varicoso, intus sulcato.*

Hab. Africa. Mus. Cuming.

7. Murex spinosus, A. Adams. *M. testâ ovatâ, umbilicatâ, albâ, lineis rufo-fuscis transversis ornatâ; anfractibus rotundis, transversim liratâ; varicibus longitudinalibus regularibus* (6 *in anfractu ultimo*), *spinis longis, rectis, acutis, armatis; canali subrecurvato, aperturam æquante; aperturâ ovato-rotundatâ.*

Hab. ——? Mus. Cuming.

8. Murex serotinus, A. Adams. *M. testâ ovato-fusiformi; spirâ peracutâ, serotinâ, longitudinaliter plicatâ, transversim liratâ; liris, ad plicas, nodulosis; aperturâ ovatâ, oblongâ; labio anticè bituberculato; labro extus incrassato, margine dentato, intus lirato; canali mediocri, subrecurvato.*

Hab. ——? Mus. Cuming.

9. Murex bifasciatus, A. Adams. *M. testâ ventricosâ, profundè umbilicatâ; spirâ brevi; anfractibus rotundatis; albâ; anfractu ultimo fasciis duabus, latis, rufo-fuscis ornato, transversim elevatè liratâ, liris rugosis; longitudinaliter varicibus æqualibus* (*in anfractu ultimo* 9) *subelevatis, rotundatis, fimbriatis; aperturâ ovato-rotundatâ; labio subproducto, fulvo; canali aperturâ breviore, valde recurvato.*

Hab. Senegal. Mus. Cuming.

10. Murex crassus, A. Adams. *M. testâ ovato-fusiformi, umbilicatâ, solidâ, fulvâ; spirâ mediocri; anfractibus rotundatis, supernè angulatis, obsoletè transversim liratâ, varicibus crassis, distantibus, irregularibus* (4 *in ultimo anfractu*), *ornatâ; aperturâ ovatâ, intus violaceâ; labro extus incrassato, intus dentato.*

Hab. China. Mus. Cuming.

11. Murex Pagodus, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ, lævi, albâ, anticè maculis fuscis sparsim pictâ; anfractibus septem, concavis, seriebus spinarum ornatis, spinis regularibus, tubulosis, recurvatis, marginibus fimbriatis; aperturâ subrotundatâ; columellâ lævi; canali recurvato, ad dextram inclinato, aperturam æquante.*

Hab. ——? Mus. Cuming.

12. Murex excavatus, A. Adams. *M. testâ ovato-fusiformi, subumbilicatâ, albâ, solidâ; spirâ acuminatâ; anfractibus concavis* (*quasi excavatis*) *ad partem anticam; in medio angulatis, longitudinaliter plicatâ, transversim liratâ, liris ad plicas nodulosis; anfractu ultimo liris duabus elevatis ornato; aperturâ semiovali; canali mediocri, vix recto; labro intus sulcato.*

Hab. ——? Mus. Cuming.

13. Murex inornatus, A. Adams. *M. testâ fusiformi, valde umbilicatâ; spirâ acuminatâ; anfractibus rotundis, albidâ, liris transversis, elevatis, squamulosis, et varicibus longitudinalibus, rotundatis (in anfractu ultimo 7), ornatâ; aperturâ ovali; canali subrecurvato, aperturam æquante; labro extus fimbriato, intus lirato.*

Hab. ——? Mus. Cuming.

14. Murex obeliscus, A. Adams. *M. testâ ovato-pyramidali, subtrigonali; spirâ elevatâ; anfractibus planis, apice obtuso, albâ, seriebus transversis macularum rufo-fuscarum ornatâ, transversim liratâ, liris subgranosis, varicibus tribus, longitudinalibus, varice intermedio, brevi, triangulari, ad partem posticam instructâ; aperturâ ovatâ; canali valde recurvato.*

Hab. ——? Mus. Cuming.

15. Murex liratus, A. Adams. *M. testâ ovato-fusiformi, subumbilicatâ; spirâ acuminatâ; anfractibus planiusculis, albâ, varicibus rufo-fuscis ornatâ, transversim liratâ; liris transversis, angustis, asperulatis, varicibus longitudinalibus, rotundatis, subfimbriatis (7 in ultimo anfractu); aperturâ subrotundatâ, intus albâ; columellâ posticè callosâ; canali brevi, recto, vix clauso; labro intus lirato.*

Hab. ——? Mus. Cuming.

16. Murex pulcher, A. Adams. *M. testâ ovato-fusiformi, subtrigonali; spirâ acuminatâ; anfractibus rotundatis, nodulosis, varicibus tribus subspinosis; liris transversis, elevatis, anfractu ultimo varicibus prominentibus, subspinosis, ornato; varicibus anticè fimbriatis et spinosis; aperturâ ovato-rotundâ; labio tuberculato; labro intus crenato-lirato, canali perlongo, subrecurvo, vix clauso.*

Hab. St. Croix, 60 fathoms; *M. Sueuson.* Mus. Cuming.

17. Murex Singaporensis, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ; anfractibus rotundatis; fulvâ, longitudinaliter plicatâ, plicis rotundis, transversim liratâ, liris asperulatis, squamulis aculeatis obsitis; aperturâ ovatâ, oblongâ, intus lividâ; canali aperturam æquante, subreflexo; labro intus dentato.*

Hab. Singapore. Mus. Cuming.

18. Murex niveus, A. Adams. *M. testâ ovatâ, umbilicatâ, niveâ; spirâ brevi, acuminatâ; anfractibus rotundatis; longitudinaliter plicatâ, plicis rotundis, prominentibus, crassis* (8–10 *in anfractu ultimo*), *transversim liratâ, liris squamulis, confertis, longitudinalibus, obsitis; aperturâ ovatâ, oblongâ; canali brevi, subrectâ; labro intus lirato.*

Hab. ——? Mus. Cuming.

19. Murex Cumingii, A. Adams. *M. testâ oblongo-fusiformi, trivaricosâ; spirâ subproductâ, anfractibus rotundatis, pallidè rufo-fuscâ, fasciis tribus, transversis, rufo-fuscis, ornatâ; vari-*

cibus longitudinalibus, tribus, continuis, obtusis, liris intermediis nodosis, liris transversis inæqualibus, rufo-fusco articulatis, instructâ; aperturâ ovali, labro intus crenato-lirato extus fimbriato, fimbriis non squamulosis, canali clauso, anticè recurvato.

Hab. Philippines. Mus. Cuming.

Somewhat closely allied to *M. triquetra* of Born.

20. Mitra Marquesana, A. Adams. *M. testâ ovato-fusiformi, anfractibus planis, spirâ acutâ, carneolâ, maculis albis et lineis undulatis, longitudinalibus rufo-fuscis, eleganter pictâ, longitudinaliter substriatâ, transversim liratâ, interstitiis valde punctatis; aperturâ spiram majorem æquante, columellâ plicis quinque instructâ, labro margine crenato.*

Hab. Marquesas. Mus. Cuming.

Markings very similar to those of *M. serpentina*, Lamk. The *Mitra* figured in Mr. Reeve's Monograph, as *M. nebulosa* of Swainson, is quite different from that species, and requires therefore a change of name; I have called it *M. propinqua*.

21. Ancillaria lineolata, A. Adams. *A. testâ ovato-fusiformi; spirâ brevi, subacutâ, suturis albis, pallidè fulvâ, lineis longitudinalibus, confertis, fuscis, ornatâ; anfractu ultimo cingulâ elevatâ transversâ, ad marginem labri, in dente acuto desinente; aperturâ oblongâ; columellâ tortuosâ, albâ, anticè plicis obliquis instructâ.*

Hab. ——? Mus. Cuming.

A very pretty species, distinguished by the fine longitudinal brown lines.

22. Planaxis obscura, A. Adams. *P. testâ ovato-conicâ, epidermide fusco obtectâ; fusco-rufescente; anfractibus planis, suturâ distinctâ, transversim valde sulcatâ, interstitiis longitudinaliter striatis; aperturâ ovato-oblongâ, columellâ longitudinaliter sulcatâ; labro subdilatato, margine acuto, intus valde lirato.*

Hab. ——? Mus. Cuming.

23. Planaxis fulva, A. Adams. *P. testâ ovato-conicâ, fulvâ; spirâ acuminatâ, apice acuto, anfractibus planis, ultimo angulato, transversim tenuiter striatâ; aperturâ ovato-oblongâ; columellâ incurvatâ, anticè callosâ; labro margine subdilatato, extus incrassato, intus lirato.*

Hab. Swan River. Mus. Cuming.

Allied to *P. mollis*, Sowerby, but the last whorl is angulated.

24. Planaxis zonata, A. Adams. *P. testâ ovato-conicâ, rimatâ, glabrâ, nitidâ; spirâ acuminatâ; anfractibus convexiusculis, pallidè lutescente. zonulâ transversâ rufo-fuscâ cinctâ ad suturas, et, in anfractu ultimo, fasciis duabus transversis ornatâ, transversim tenuissimè striatâ; aperturâ ovatâ; columellâ incurvatâ; labro subdilatato, intus lirato.*

Hab. Calapan, Philippines. Mus. Cuming.

25. Planaxis cingulata, A. Adams. *P. testâ ovato-conicâ,*

solidâ, rimatâ; spirâ acutâ; anfractibus convexiusculis, fulvâ, zonulis rufo-fuscis transversis, prope suturas, duplicatis, ornatâ, longitudinaliter tenuissimè striatâ, transversim valde sulcatâ; aperturâ ovato-oblongâ, coarctatâ; columellâ incurvatâ; labro extus incrassato, intus dentato-lirato.

Hab. China Seas. Mus. Cuming.

Species collected by me during the voyage of H.M.S. Samarang.

26. Planaxis succincta, A. Adams. *P. testâ ovato-conicâ, spirâ acuminatâ, apice acuto, anfractibus convexiusculis, pallidè fuscâ, fasciis linearibus, transversis, multis, rufo-fuscis, ornatâ, longitudinaliter substriatâ; anfractu ultimo transversim sulcato; aperturâ ovato-oblongâ; columellâ fuscâ; labro intus sulcato.*

Hab. Peru, and the West Indies. Mus. Cuming.

Allied to *P. lineata* of Montagu, but of larger growth and different form.

27. Planaxis buccinea, A. Adams. *P. testâ ovatâ; spirâ brevi, acutâ, apice obtuso, rubro; anfractibus planis, plicato-granulosis; nigro-fuscâ, cingillis articulatis, transversis, ornatâ; longitudinaliter substriatâ, transversim valde sulcatâ; aperturâ ovato-oblongâ; columellâ excavatâ; labro intus creno-plicato, extus incrassato, varicoso.*

Hab. West Indies. Mus. Cuming.

28. Planaxis labiosa, A. Adams. *P. testâ ovato-conicâ, spirâ acutâ, anfractibus convexiusculis, atro-purpureâ, fasciis pallidis* (5–6) *transversis, in anfractu ultimo; transversim striatâ; aperturâ ovato-oblongâ; columellâ incurvatâ et dilutatâ; labro dilatato, margine reflexo et incrassato, intus lirato.*

Hab. Sandwich Islands. Mus. Cuming.

29. Lagena Californica, A. Adams. *L. testâ solidâ, ovato-fusiformi; spirâ, in medio, tumidâ, anfractibus planiusculis, infernè nodospinosis, albâ, cingulis transversis, elevatis, rufo-fuscis articulatis ornatâ, interstitiis obscuris, fuscis; anfractu ultimo longitudinaliter plicato, seriebus duobus tuberculorum subspinosorum instructo; aperturâ ovato-oblongâ; columellâ carneolâ, plicis quatuor, albis, obliquis; labro intus lirato.*

Hab. California. Mus. Cuming.

Allied to *L. picta*, Lamk., but of different form and markings.

30. Nassa Australis, A. Adams. *N. testâ ovato-fusiformi; spirâ acuminatâ, pallidè olivaceâ, fasciis tribus, transversis, fuscis, ornatâ, longitudinaliter valde plicatâ, interstitiis valde transversim sulcatis; anfractu ultimo anticè liris transversis subgranosis, posticè, prope suturam, tuberculis moniliformibus ornato; aperturâ ovato-rotundatâ, intus fuscâ, et dentato-liratâ; labro margine albo, posticè valde inflexo et dentato.*

Hab. Australia. Mus. Cuming.

MISCELLANEOUS.

Note on the Bird of Paradise (Paradisea apoda). By M. de Lafresnaye.

We understand from an old merchant at Rouen, a great amateur in Natural History, that one of his friends, a captain, had informed him, that being lately at Batavia and compelled to remain there for some time, he had made the acquaintance of a rich colonist who had a taste for keeping live birds, and possessed some which are very rare and valuable. Amongst others he noticed several pairs of the Bird of Paradise, and it was not without astonishment that he several times saw the males of this bird display themselves before the female, expanding the long plumes of their flanks. By means of a sort of vibration of their entire plumage, they raised all their feathers, including these long plumes, and surrounded themselves completely, so as to form a sort of halo, in the centre of which the bright green head formed a disc, which at the moment looked like a little emerald sun, with its rays formed by the feathers of the two plumes. He had no doubt that this action, which was frequently repeated, was intended to please the females, as is remarked in all birds the males of which are furnished with ornaments.—*Revue et Mag. de Zool.* 1853, p. 339.

New Observations on the Development of the Intestinal Worms. By Prof. Van Beneden.

In the intestines of *Rana temporaria* I have found in abundance specimens of *Tænia dispar*, which is usually observed only in the Tritons. In the adult Proglottis the eggs are distributed in threes in capsules placed in two longitudinal rows. The embryos can move in their shells, and their motions may be seen through the integuments of the mother; the hooks especially are constantly in motion. I succeeded in hatching these ova artificially, as I had done five years before, with the *Linguatulæ*, by crushing them between two plates of glass. Amongst a great number of ova and embryos which were completely destroyed, a few still retained life and motion, and I made the following observations upon them.

All their movements were the same; they were consequently the effect of a normal condition. The six hooks are disposed exactly in the same manner in all the individuals,—there are two in the middle in front, and four others placed in pairs to the right and left of these. These six hooks are not all alike, as has hitherto been supposed; they vary both in length and form. Those placed in the middle are not recurved at the apex like the others; they are straight, very tapering, a little longer than the others, and thinner throughout their length. The four lateral hooks are all alike; they consist of two parts—a rather long, straight stem, and a terminal portion, recurved so as to form a hook with the concavity behind. The two hooks in the middle are in contact at their base, but separate towards the apex, like a fan.

The following is the action of these organs, it being understood that the embryos are in the midst of the *débris* of the Proglottis. The six hooks are first of all united in a bundle, and plunged into the tissue before them; the two central straight styles remain stationary, but the two pairs of hooks move backwards, the base remaining stationary whilst the apex describes a quarter of a circle. They stop when they form a right angle with the central styles. After a moment's repose, the embryo contracts itself, and the hooks return to their original position. The same operation is continued for hours, and in this manner the worm penetrates into the tissues by means of the two central styles, and the two pairs taking their point of support in front, tear a passage for the entire embryo. If we bear in mind that these embryos scarcely exceed the size of the blood-discs of the frog, we may easily understand that they can perforate the intestine to encyst themselves under the peritoneum, or penetrate into the vessels, so as to be carried with the blood into the various viscera, not excepting either the brain or the eyes.

The question remaining for solution is that of the transformation of the embryo with six hooks into a *Cysticercus*; is this effected by metamorphosis, or by germination, as has recently been advanced? There are Cistoid worms, in which, according to my observations, this transition evidently takes place by metamorphosis, that is to say, the first embryo becomes a *Cysticercus*; in other cases, if Stein's statements be correct, the embryo produces the *Cysticercus*. In other words, the Scolex is born of a Proscolex.—*Comptes Rendus*, November 21st, 1853, p. 788.

Further Observations on the Animal Substance analogous to Vegetable Cellulose. By M. Virchow.

In a previous note*, I announced to the Academy the discovery of a peculiar substance in the brain and spinal cord of man, which gives rise to the same chemical reactions as vegetable cellulose.

Wishing to follow out this discovery, I sought for the new substance in most of the tissues of the human body, both in a healthy and morbid condition, but in vain, until it occurred to me again in a rare disease, an affection of the human spleen, which commences by a nearly pasty (*colloide*) degeneration of the follicles (white corpuscles of Malpighi). This disease, commonly known in Germany as *Wachsmilz* (waxy spleen), is considered by some pathologists as an albuminous or fibrinous effusion, by others as a fatty or pasty degeneration. In point of fact, the follicles of the spleen from their centre to their circumference are converted into an apparently homogeneous, transparent, grayish or yellowish mass, presenting a considerable resemblance to the grains of boiled sago. I have long known that these grains were composed of microscopic corpuscles, slightly irregular in form, but perfectly homogeneous, which might be considered as resulting from the transformation of the lymphatic cells, which constitute the contents of the follicles of the spleen. When the effects of chemical reagents upon these corpuscles are observed under the microscope, it is seen that they are rendered pale by acetic acid, and that a granular precipitate is produced in the interstices of the corpuscles when a little ferrocyanate of potash is added to the acidulated preparation. Hot nitric acid produces a yellow colour, which becomes brownish on the addition of caustic ammonia, owing

* Ann. Nat. Hist. vol. xii. p. 481.

evidently to xantho-proteic acid. For these reasons I formerly considered these corpuscles as composed of a solid albuminous substance; being struck, however, with the resemblance of the waxy corpuscles of the spleen to the amylaceous corpuscles of the brain, I took advantage of a recent case to try the effect of iodine and sulphuric acid upon them; the bright violet colour characteristic of cellulose made its appearance with surprising promptitude.

The correctness of the reaction was proved upon several old preparations in our pathological collection (Marburg), preserved in weak spirits of wine. This substance possesses so much fixity that it still remains unchanged in a spleen which has been macerated in running water for a fortnight.

I may add that this singular degeneration of the spleen occurs principally in general derangement of the system, and that it is most frequently met with in patients who have been subject to ulcerous affections for a very long time.—*Comptes Rendus*, Dec. 5, 1853, p. 860.

METEOROLOGICAL OBSERVATIONS FOR DEC. 1853.

Chiswick.—December 1. Overcast: fine: clear and frosty. 2—4. Dense fog. 5. Foggy: slight rain. 6, 7. Foggy: overcast. 8. Foggy: fine. 9. Fine: slight rain. 10, 11. Cloudy. 12. Hazy: uniformly overcast. 13. Foggy. 14. Overcast. 15. Snowing: clear and frosty. 16. Overcast: clear, with bright sun: severe frost at night. 17. Severe frost: overcast: frosty. 18. Clear: overcast. 19. Uniformly overcast: clear and fine: cloudy. 20. Hazy. 21. Densely clouded: boisterous at night. 22. Overcast. 23. Cloudy: clear. 24. Cloudy: clear and frosty. 25. Frosty: hazy: clear, with sharp frost at night. 26. Frosty: fine: frosty. 27. Clear and frosty: hazy: clear and frosty. 28. Clear and frosty: fine: severe frost at night. 29. Severe frost: clear and fine: frosty. 30. Snow-shower: frosty. 31. Very clear and frosty: partially overcast: sharp frost at night.

Mean temperature of the month	32°·49
Mean temperature of Dec. 1852	46 ·56
Mean temperature of Dec. for the last twenty-eight years .	39 ·64
Average amount of rain in Dec.	1·5 inch.

Boston.—Dec. 1. Cloudy: rain A.M. 2. Fine. 3. Cloudy. 4, 5. Foggy. 6. Cloudy: rain A.M. 7. Foggy. 8. Fine. 9. Fine: rain P.M. 10. Fine: rain early A.M. 11—13. Cloudy. 14. Fine. 15. Snow and rain A.M. and P.M. 16. Cloudy: snow A.M. 17. Cloudy. 18, 19. Fine. 20. Cloudy: rain P.M. 21. Cloudy: rain A.M. and P.M. 22, 23. Cloudy: rain A.M. 24. Cloudy. 25. Foggy. 26. Foggy: rain and snow P.M. 27. Fine: snow P.M. 28. Snow A.M. and P.M. 29. Fine. 30. Fine: snow A.M. 31. Fine.

Sandwick Manse, Orkney.—Dec. 1. Hazy A.M.: rain P.M. 2. Damp A.M.: drops P.M. 3. Bright A.M.: cloudy, aurora P.M. 4. Clear A.M. and P.M. 5. Bright A.M.: clear, aurora P.M. 6. Clear A.M.: clear, aurora S. P.M. 7. Bright A.M.: frost, showers P.M. 8. Showers A.M. and P.M. 9. Showers A.M.: clear P.M. 10. Bright A.M.: fine P.M. 11. Frost A.M.: damp P.M. 12. Damp A.M.: showers P.M. 13. Bright A.M.: clear, lunar halo P.M. 14. Damp A.M. and P.M. 15. Cloudy A.M.: clear P.M. 16. Damp A.M.: clear P.M. 17. Clear, frost A.M. and P.M. 18. Bright, frost A.M.: clear, frost P.M. 19. Showers A.M.: clear P.M. 20. Showers A.M.: clear, frost P.M. 21. Clear, frost A.M.: clear, frost, aurora P.M. 22. Cloudy, frost A.M.: showers P.M. 23. Showers A.M.: showers, aurora P.M. 24. Cloudy A.M. and P.M. 25. Cloudy A.M.: sleet-showers P.M. 26. Hail-showers A.M.: snow-showers P.M. 27. Snow drift A.M. and P.M. 28. Snow-showers A.M.: snow, cloudy P.M. 29. Thaw: showers A.M. and P.M. 30, 31. Snow-drift A.M.: snow-showers P.M.

Mean temperature of Dec. for twenty-six previous years ...	41°·18
Mean temperature of this month	38 ·97
Mean temperature of Dec. 1852	40 ·74
Average quantity of rain in Dec. for thirteen previous years	4·13 inches.

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. 1853. Dec.	Barometer. Chiswick. Max.	Barometer. Chiswick. Min.	Barometer. Boston. 8¾ 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.	30·096	29·971	29·77	29·82	29·87	48	24	48	43	44½	se.	s.	......	....	·07	·03
2.	29·937	29·899	29·70	29·92	29·82	42	21	37	45	47	e.	sse.	sw.	....	·03	·22
3.	29·959	29·951	29·70	29·86	29·81	41	36	32	40½	44	e.	calm	ssw.	·02	....	·04
4.	29·964	29·904	29·72	29·73	29·70	43	35	37	42½	45	e.	sw.	sw.	....	....	....
5.	29·907	29·892	29·65	29·76	29·91	46	34	36·5	44	39½	e.	calm	ne.	·01	....	....
6.	30·060	29·930	29·72	30·11	30·13	45	36	40	39	34	ne.	nw.	......	....	·03	·12
☽ 7.	30·099	30·088	29·83	29·94	29·85	44	28	35	37	44	ne.	nw.	w.	....	....	....
8.	30·236	30·164	29·90	30·00	30·16	43	29	31	41	45	n.	calm	sw.	·01	....	·09
9.	30·336	30·328	30·10	30·31	30·35	51	34	31	46	47	ne.	nnw.	sw.	·02	....	·09
10.	30·283	30·119	30·04	30·35	30·35	41	30	37·5	45	37	ne.	nnw.	s.	....	·08	....
11.	30·070	29·995	29·82	30·26	30·17	34	29	34·5	38	42	se.	se.	sw.	....	....	....
12.	29·934	29·782	29·70	29·96	29·84	35	28	32	41	40	se.	s.	se.	....	....	·06
13.	29·579	29·333	29·35	29·71	29·76	46	38	36·5	38	34	e.	e.	ne.	....	....	·01
14.	29·299	29·197	29·04	29·73	29·79	43	25	40	43	43	ne.	ene.	se.	....	....	·09
○ 15.	29·244	29·196	29·00	29·82	29·79	38	27	32	41	40	ne.	ne.	nne.	·20	....	....
16.	29·526	29·324	29·10	29·67	29·71	33	7	32	42	41	n.	calm	s.	....	·32	·04
17.	29·698	29·647	29·36	29·75	29·75	36	22	33	34	34	n.	s.	ne.	....	....	....
18.	29·661	29·546	29·40	29·69	29·71	34	26	32	38	37	se.	sse.	e.	....	....	....
19.	29·605	29·483	29·35	29·80	30·04	35	28	32	38½	36	e.	e.	e.	....	....	·14
20.	29·843	29·724	29·54	30·17	30·34	37	34	35	40½	40	ne.	ese.	se.	....	....	·11
21.	29·995	29·969	29·78	30·38	30·48	36	33	36	34	36	ne.	ne.	......	....	·03	....
22.	30·005	29·075	29·92	30·47	30·28	37	29	36	37	44	ne.	ene.	nw.	....	·14	....
☾ 23.	29·921	29·793	29·63	30·17	30·30	41	29	38	40	41	n.	n.	ne.	·04	·04	·15
24.	30·227	30·065	29·90	30·32	30·34	38	24	36	43½	44	ne.	ene.	n.	....	....	·05
25.	30·201	30·199	29·94	30·25	30·13	36	14	34	43½	42	ne.	calm	nw.	....	....	....
26.	30·128	30·013	29·87	30·21	30·04	36	19	33	31½	32	se.	calm	nw.	....	....	·07
27.	29·972	29·873	29·70	30·08	30·17	35	22	22	28	31	n.	calm	n.	....	·02	....
28.	30·083	29·902	29·75	30·36	30·37	34	8	27	30½	32	n.	n.	nnw.	....	·12	·02
29.	30·291	30·161	30·08	29·93	29·67	32	15	14	40	37½	ne.	n.	nw.	....	·20	·34
● 30.	29·670	29·550	29·37	29·59	29·62	37	22	33	31	29	w.	nnw.	n.	....	....	....
31.	29·679	29·501	29·40	29·46	29·39	33	19	22	27	31	nw.	nnw.	nw.	....	·09	....
Mean.	29·919	29·792	29·65	29·986	29·988	39·03	25·96	33·4	38·80	39·14				0·30	1·17	1·67

THE ANNALS

AND

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[SECOND SERIES.]

No. 75. MARCH 1854.

XVI.—*Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites.* By Thomas Wright, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School*.

[With two Plates.]

Cidaris Edwardsii, Wright. Pl. XI. fig. 1, *a–f*.

Test crushed, the form therefore unknown. Ambulacral areas narrow, with two rows of small perforated tubercles, and smaller perforated ones interspersed amongst them; interambulacral areas about four times the width of the ambulacral, having two rows of large tubercles with confluent areolas; the primary spines long, with a compound structure; the secondary spines short with blunt apices, the surfaces of both sculptured with delicate longitudinal lines; mouth armed with powerful jaws, each with three prominent tricarinated ridges. Upper part of the test and ovarial disc unknown.

Description.—It is much to be regretted that no other specimen of this noble Urchin but the one before us has been obtained from the Lias of Gloucestershire, and as the specimen exhibits only the lower half of the test, many points of its anatomy remain unknown; enough of its structure, however, is shown to enable us to point out some important affinities and differences in this rare species.

The narrow ambulacral areas are provided with two rows of small perforated tubercles, amongst which smaller tubercles are irregularly scattered; these tubercles all support short stout spines with a minutely sculptured surface, and which are abun-

* Read at a Meeting of the Cotteswold Naturalists' Club, held at Cheltenham, May 4th, 1852.

dantly preserved *in situ* on the specimen. The wide poriferous avenues are occupied with large oblong pedal pores with very thin partition-walls between them, a circumstance which forms a good diagnostic character between *C. Edwardsii* and *C. Fowleri*, which it very much resembles in many points of structure, the pores in *C. Fowleri* being small and separated by thick partition-walls. The interambulacral areas are four times the width of the ambulacral, and are occupied by two rows of large tubercles set closely together in a vertical direction, so that the areolas above and below are quite confluent throughout.

The imperfect condition of the shell prevents us from ascertaining the precise number of these tubercles there were in each row, but judging from the number (eight) contained in an imperfect column, we suppose there could not have been less than from twelve to fourteen; they increase gradually in size from the mouth upwards, and are of a moderate magnitude when compared with the shell they adorn. The areolas are small and not prominent, and the tubercles are deeply perforated. The space between the two rows of tubercles is wide and filled with close-set miliary tubercles, most of which are raised on elevations, and have their summits perforated; these all support small spines, which are well preserved *in situ* in our specimen.

The spines are of two kinds—those articulated with the large tubercles (the primaries), and those articulated with the small tubercles (the secondaries). The primary spines exhibit a peculiar structure: the head is large, increasing gradually in diameter from the articulating cavity to the circular band; the rim of the acetabulum is coarsely and deeply crenulated, and the raised band is prominent, narrow, and finely milled; the neck tapers gradually from the band to the point where it joins the stem, which has the same structure as the head, and its surface is delicately sculptured with fine longitudinal lines; the stem is united to the neck by an oblique harmonia suture. The structure of this part of the spine differs from that of the head and neck; in the spines denuded of their external layer, it has a horny semi-transparent appearance; in those in which this layer is present the surface is sculptured with longitudinal lines of microscopic delicacy, and there are numerous small processes, having their points directed forwards, arranged with some regularity in rows. The stem is circular or slightly compressed; but as none of the spines are complete, a part having been broken off, we are unable to ascertain their length. The secondary spines are very uniform in size and structure, and are abundantly preserved *in situ*; they measure from $\frac{6}{20}$ths to $\frac{7}{20}$ths of an inch in length and are round, and have their surface ornamented with fine longitudinal lines. The mouth is armed with a powerful dental apparatus: three of the jaws are very prominent; the external surface of each is strengthened by three prominent ridges; the teeth are large, but are fractured. As the under surface of the test only is shown, we are unable to describe the ovarial disc and the dorsal surface thereof.

Affinities and differences.—This Urchin belongs to the same group as *C. Fowleri* and *C. maxima*, Goldf. It resembles the former in the form and structure of both areas, and in the gradual development of the primary tubercles from the mouth upwards. It is distinguished from that species, however, by the greater size and uniform perforation of the miliary tubercles, but above all by the form and structure of the primary spines. Having ascertained that our conjecture * relative to the spines of *C. Fowleri* is correct, from having seen a specimen recently found with some spines attached to it, we can speak positively upon this point.

Locality and stratigraphical range.—Found by Mr. G. E. Gavey, C.E., in the upper shale beds of the Lower Lias at Mickleton Tunnel near Chipping Campden. It was associated with *Pentacrinus Goldfussii*, Wright, *Ophioderma Gaveyi*, Wright, *Uraster Gaveyi*, Forbes, and *Ammonites planicosta*, Sow.

History.—Isolated plates of this species have been found in beds of the same geological horizon in other localities of the county of Gloucester, but the specimen before us is the only one from which the anatomy of the Urchin could be made out. We dedicate this species to Prof. Milne-Edwards, of the Museum of Natural History at the Jardin des Plantes, Paris, as a tribute of gratitude for the pleasure and profit derived from the study of his admirable monograph on British Fossil Corals.

Cidaris Bouchardii, Wright. Pl. XI. fig. 2, *a–c*.

Test circular, depressed; ambulacral areas narrow and flexuous; interambulacral areas with two rows of primary tubercles, 5–6 in each row; the areolas of the small mammillary eminences deeply excavated, and surrounded by an elevated ridge, on which a distinct circle of granules for each areolar space is disposed.

Dimensions of the largest specimen. Height $\frac{13}{20}$ths of an inch, transverse diameter 1 inch and $\frac{7}{20}$ths.

Dimensions of a moderate-sized specimen. Height $\frac{11}{20}$ths of an inch, transverse diameter 1 inch and $\frac{2}{10}$ths.

Description.—It was for some time doubted whether the young forms of this Urchin were not the *C. elegans*, Goldf., but a com-

* Annals of Nat. Hist. Oct. 1851.

parison of several individuals of our fossil with a typical specimen of Goldfuss's species, kindly sent us by our friend Dr. Roemer of Bonn, which he had identified with the original *C. elegans* in the Bonn Museum now under his care, has convinced us of their distinctness. The test of our Urchin is circular and much depressed from the great flattening of both poles; the ambulacral areas are narrow and slightly flexuous, and have two rows of small marginal granules set nearly opposite to each other throughout the areas. The poriferous avenues are much depressed, and the pairs of pedal pores are disposed in a single file. The interambulacral areas are about five times the width of the ambulacral, and have two rows of primary tubercles of moderate size, with from five to six in each row. The mammillary eminences on which the tubercles are supported are surrounded by areolas deeply excavated out of the substance of the test plates; the margin bounding the areolas is raised into a ridge on which a distinct row of close-set granules is disposed, so that each tubercle is thereby separated from its fellow; the elevation of the marginal ridges produces a zigzag depression down the centre of the areas, which is covered with a small close-set granulation. The mouth-opening is small and circular, and lies in a slight depression; the apical disc is absent in all the specimens that have yet been found. The crenulations on the mammæ are small, but distinct, and the tubercles are of moderate size and not deeply perforated.

Affinities and differences.—This Urchin has many affinities with *C. coronata*, Goldf., and *C. propinqua*, Münst., and has been catalogued as the former by some authors; it is therefore important that we should point out the diagnostic characters by which it is distinguished from them. In both these corallian forms the ambulacral areas have four rows of granules, whilst in *C. Bouchardii* there are only two rows. From *C. propinqua* and *C. coronata* it is further distinguished by having more rows of primary tubercles in the interambulacral areas, in having the areolas smaller and more deeply sunk, the tubercles proportionately smaller, and the marginal circle of granules smaller and set closer together. With *C. marginata*, Goldf., it has some affinity in the excavated style of its areolar spaces, but it is distinguished from this beautiful form in having the tubercles smaller and more numerous. In *C. marginata* the ambulacral areas moreover are broader and more prominent, and they support four rows of small granules, whilst in *C. Bouchardii* there are only two. With *C. elegans*, Goldf., it has no resemblance whatever; it belongs therefore to a different group of Cidarites than these foreign corallian forms. From *C. Fowleri*, nobis, it is distinguished by having narrower and more deeply concealed poriferous avenues, fewer primary tubercles in the interambulacral areas, and deeper excavated areolar spaces with a more elevated marginal rim around them: these characters serve to distinguish *C. Fowleri* from *C. Bouchardii* at a glance, and the same diagnostic traits separate it from *C. Edwardsii,* nobis.

Locality and stratigraphical range.—We have found this species in the Pea-grit of the Inferior Oolite of Crickley, Leckhampton, and Birdlip Hills, Gloucestershire, but have never met with any traces of it in the Upper Ragstone beds so rich in Urchin forms. Some separate plates collected from the Bradford clay near the Tetbury Road Station, Great Western Railway, closely resemble this form; but as no entire specimen, that we are aware of, has been found, it is impossible to state whether it has a wider range in the higher beds of the lower division of the Oolites or not.

We dedicate this species to our friend M. Bouchard Chantereaux of Boulogne, to whom we are indebted for some beautiful and rare specimens of Echinoderms and other fossils from the rocks of the Boulonnais, most kindly contributed by him to aid us in the composition of these memoirs.

Hemicidaris minor, Agassiz. Pl. XI. fig. 3, *a–c*.

Syn. *Hemicidaris minor*, Agassiz, Catalogus Systematicus, p. 9; Agassiz and Desor's Catalogue raisonné des Echinides, Annales des Sci. Nat. tom. vi. p. 339.

Acrosalenia rarispina, M'Coy, Ann. of Nat. Hist. 2nd Series, vol. ii. p. 411.

Test hemispherical above, flat at the base; ambulacral areas slightly flexuous, not prominent, with six large tubercles at their base, and four rows of small unequal-sized granules in the middle, diminishing to two rows in the upper part of the areas; interambulacral areas three times the width of the ambulacral, with three primary tubercles on the upper surface and three smaller ones at the base; the wide intertubercular spaces are covered with small distinct nearly equal-sized granules, which form complete circles around the margins of the areolas of the primary tubercles; the apical disc is of moderate size, and its ovarial plates are covered with a delicate granulation; base flat, mouth-opening large and decagonal; pores arranged in the avenues in a single file throughout.

Height $\frac{6}{20}$ths of an inch, transverse diameter $\frac{9}{20}$ths of an inch.

Description.—This beautiful little Urchin was first discovered in the étage Bathonien of Langrune, Calvados, the true equivalent of the Great Oolite of English geologists; it was entered in M. Agassiz's 'Catalogus Systematicus*' as *Hemicidaris minor*, from specimens sent to him by M. Michelin; it afterwards found a place in the 'Catalogue raisonné des Echinides' of Agassiz and Desor, accompanied with this remark: "Se distingue entre tous les Hemicidaris par les tubercules très espacés, dont il n'y a que deux out rois dans une rangée.—Terrain Jurassique de France.—Michelin." Professor M'Coy, in his paper "On some new Mesozoic Radiata†," afterwards described this Urchin under the name *Acrosalenia rarispina*, giving the Great Oolite of Minchinhampton for its locality. As that gentleman has kindly favoured us with pen-and-ink sketches of the species described as new in that paper, we have no difficulty in deciding on the identity of his specimen. Moreover we have ascertained the collection from whence it originally came. The error committed by this learned author in the genus must have arisen from the disc in his specimen having been covered with "adhering siliceous matrix," and from his having overlooked the very remarkable character pointed out by Agassiz, "les tubercules très espacés." We have been fortunate to receive a typical specimen of the original species from the Great Oolite of Langrune, through the kindness of our friend Professor Deslongchamps; we have compared the French Urchin with specimens obtained from the same locality as that from whence Prof. M'Coy's was collected, and there is not a shadow of a doubt about their perfect identity. We have figured in detail this beautiful and singular form, to prevent the possibility of mistakes occurring about it in future.

This pretty little *Hemicidaris* is very distinct from all others of the group to which it belongs: the test is nearly hemispherical, and the few primary tubercles stand prominently at great distances apart from the surface of the test. The narrow ambulacral areas are slightly flexuous above, and have from four to six large perforated tubercles at their base only, the sides and upper part of the areas having first four, and then two rows of small imperforate granules upon their surface about equal in size to the granulation which covers other parts of the test. The poriferous avenues are depressed, and the pedal pores are disposed in pairs throughout. The interambulacral areas depart considerably from the typical structure of this portion of the test in other Echinidæ; they are three times the width of the ambulacra, and have at their base three large primary tubercles, two on one side and one on the other, with a smaller tubercle above the single large one; on the sides and upper part of the areas there are only three primary tubercles, two on one side and one on the other, making

* Catalogus Systematicus Ectyporum Echinoderm. Foss. Mus. Neocomensis, 1840.

† Annals of Natural History, 2nd Series, vol. ii. p. 411.

only three pairs of primary tubercles in the interambulacral areas, those of the base being closely set together, and those on the sides at great distances apart; the tubercles are large and hemispherical and only slightly perforated; the mammillary eminences which support them are small and ring-like with faintly marked crenulations, and the areolas are rather wide and only slightly grooved, so that the tubercles project prominently and abruptly from the surface of the test. The margin of the areolas is encircled by a row of granules rather larger than those which cover the rest of the intertubercular surface of the plates; here the granules are close-set and disposed without much regularity. The apical disc is of moderate size and slightly prominent; the five ovarial plates are large and of a heptagonal form, the ocular plates are small and heart-shaped, and the surface of both is covered with a close-set delicate granulation; the anal opening is nearly central and circular; the base is flat; the mouth-opening is large and widely decagonal from the great span of the ambulacral arches, and the comparative smallness of those of the interambulacra. The spines are as yet unknown.

Affinities and differences.—This remarkable little Urchin is so entirely different from its congeners, that it is impossible to mistake it for any other of the group to which it belongs. The presence of tubercles at the base of the ambulacral areas only, and of granules on the sides of these spaces, associate it with *H. diademata*, but the small number of the primary tubercles on the interambulacra, added to the great distance at which they are placed apart, serve to distinguish it from the young of that species; in fact, these characters alone are perfectly diagnostic of *H. minor* among all other forms of *Hemicidaris*.

Locality and stratigraphical range.—It was first found in the "Grand Oolite" of Langrune, Calvados, from whence the beautiful specimen before us was obtained, and kindly sent by Professor Deslongchamps of Caen. We take the present opportunity of recording our grateful acknowledgements to that eminent naturalist for his kindness and courtesy, not only in contributing specimens to our cabinet for comparison and reference, but likewise for communicating many rare species of oolitic Echinidæ which served as the types of several of M. Agassiz's species, and which specimens have been of much service in clearing up doubts as to the identity of some other English forms. *H. minor* was collected in this country by W. Walton, Esq., from the Great Oolite of Hampton near Bath.

History.—First named by M. Agassiz from specimens in M. Michelin's cabinet; afterwards described as *Acrosalenia rarispina* by Prof. M'Coy from specimens in the Cambridge Museum, which came from Mr. Walton's series collected near Bath; it has never yet been found either by Mr. Lycett or ourselves in the Great Oolite of Minchinhampton.

Acrosalenia Crinifera, Wright. Pl. XII. fig. 1, *a–d*.

Syn. *Echinus minutus*, Buckman, Geology of Cheltenham, 2nd ed. p. 95.

Cidarites criniferus, Quenstedt, Handbuch der Petrefactenkunde, tab. 49. fig. 32. p. 574.

Test circular, depressed; ambulacral areas narrow, with two rows of microscopic tubercles placed at some distance apart on each side of the areas, those of the right side alternating with those of the left; interambulacral areas with two rows of primary tubercles, 9–10 in each row, so disposed that the test appears to possess only ten rows of primary tubercles nearly equidistant from each other; spines long, numerous and hair-like.

Height $\frac{3}{20}$ths of an inch, transverse diameter $\frac{6}{20}$ths of an inch.

Description.—This singular little Urchin has been long known to collectors, and has been often a puzzle to them, for although a few specimens have been collected in a tolerable state of preservation, still for the most part the test is much injured by pyrites; under the most favourable circumstances, it requires a good lens and much patient study to make out the details of its structure. It was first found in the black shales of the lower Lias near this town, and recently, with its hair-like spines attached to the test, from the same bed near Gloucester, when excavating the new docks of that city; it was there associated with *Ammonites oxynotus*, Quenst. It is difficult to say whether this tiny Urchin is a *Hemicidaris* or an *Acrosalenia*, and the absence of the apical disc leaves the question unsolved; we incline to the opinion that it is an *Acrosalenia* from the structure of the ambulacral areas, the shape, length and development of the spines when compared with the diameter of the test, the spines being more than four times the diameter of the latter; be this however as it may, it is neither an *Echinus* nor a *Cidaris*, as previous authors have supposed. The ambulacral areas are narrow, with two rows of small marginal tubercles not much larger than the common granulation of the test; these tubercles are placed in each row at some distance apart, and the tubercles of the one side alternate with those of the opposite side; between these rows of tubercles the surface of the plates is adorned with a delicate granulation, which is arranged into a zigzag line; the tubercles are very uniform in size and distribution throughout the areas, and do not increase at the base thereof, as is the case in the genus *Hemicidaris*. The interambulacral areas are wide, and have two rows of primary tubercles, from 9–10 in each row; their mammillary eminences have well-defined areolas, the summits of the mammæ are deeply crenulated, and the tubercles are small and widely perforated; the areolas are confluent above and below; between the two rows of tubercles an elevated band extends from the mouth to the apical disc, composed of from 4–6 rows of unequal-sized granules. When viewed at the equator with the naked eye, this Urchin appears to possess only ten rows of tubercles placed nearly equidistant from each other; but when examined with an inch object-glass under the microscope its true structure is disclosed,—the narrowness of the ambulacral areas, the closeness and smallness of their rows of tubercles, the granular band down the centre of the interambulacra, and the unequal size of its component tubercles, alike contribute to make the deception almost complete.

The most remarkable parts of the structure of this tiny fossil are the spines, which in some crushed specimens are preserved *in situ*; they are long, delicate and hair-like, and have large articular heads; these spines look like so many bristles laid down in all directions upon some slabs of the Lias shales; in a crushed test of four-tenths of an inch in diameter the spines measured an inch and a half in length.

Affinities and differences.—The only *Cidarites* for which *A. crinifera* is likely to be mistaken are *Diadema Mooreii* and *Pedina Etheridgii*; from the former it is easily distinguished by the narrowness of the ambulacral areas and the smallness of the tubercles thereof; from the latter it differs in the comparative smallness of its ambulacral areas, and above all in having the mammillary eminences of its tubercles deeply crenulated, a character which is absent in all the Pedinas we know; at present we know of no other Urchin in the Lias for which it can be mistaken.

Locality and stratigraphical range.—*A. crinifera* has been found only in the lower shales of the lower Lias near Lansdowne, Cheltenham, and in the same stratum near Gloucester; it is associated wtth *Turrilites Valdani*, D'Orbig., and *Ammonites oxynotus*, Quenstedt. It has been collected by Prof. Quenstedt in the lowest schist of the "Posidonienschiefer von Pliensbach bei Boll" in Würtemberg. We have before us now two slabs of this curious bed; one surface of the slab is covered over with the long hair-like spines strewed about in all directions, with here and there the crushed test of one of these Urchins with its spines attached and *in situ*.

History.—Described by Mr. Buckman under the name *Echinus minutus*, but previously noticed by M. Quenstedt in his work on the Flœtzgebirge of Würtemberg; it has been recently figured by him in his 'Handbuch der Petrefactenkunde,' under the name *Cidarites criniferus*.

Diadema Davidsoni, Wright. Pl. XII. fig. 2, *a–e*.

Test depressed, circular; tubercles elevated upon prominent mammillary eminences; pores in a single file throughout; a few small secondary tubercles in the interambulacra; the primary ambulacral tubercles nearly as large as those of the interambulacra.

Height $\frac{9}{20}$ths of an inch, transverse diameter 1 inch and $\frac{6}{20}$ths.

Description.—This beautiful Urchin has a regular circular test, not at all inclined to the pentagonal form of many of its oolitic congeners. The ambulacral areas are three-fourths the width of the interambulacral areas, and are nearly of a uniform width throughout, tapering slightly and gracefully inwards towards their superior third; the contraction assumes the form of a gentle curve slightly inclined towards the centre. The double row of tubercles gradually increases in size from the mouth to the equator, where three pairs are about the same size; from this point upwards they gradually decrease, and terminate in two pairs of minute rudimentary tubercles at the disc. A single row of granules, arranged in a zigzag form, separates the primary tubercles from each other, a larger granule marking each of the angles. There is no granulation or other sculpture between the mammillary eminences of the tubercles and the poriferous avenues. There are from twelve to thirteen pairs of tubercles in each area. The interambulacral areas are nearly $\frac{4}{10}$ths of an inch in width, and $\frac{1}{4}$th wider than the ambulacral areas; they retain their width uniformly throughout, and are occupied by two rows of primary tubercles, nine to ten in a row, the mammillary eminences of which are large and prominent, and separated from each other by two rows of small granules which extend only a short distance beyond the equator; the remaining space between their termination and the disc being destitute of sculpture, where likewise the areas are slightly depressed; and a single row of granules rises on the external side of the tubercles, with here and there a secondary tubercle towards the basal portion of the test.

The poriferous avenues are very narrow: the pedal pores are arranged in a single file, only three or four additional pairs being introduced in the increased spaces around the circumference of the mouth. The tubercles of both areas are of moderate size, but exceedingly prominent, in consequence of being elevated upon large mammillary eminences, the apices of which are deeply crenulated. The tubercles of the ambulacral areas at the equator are not much less than those of the interambulacral areas, but upon the upper surface of the test they become much smaller and more numerous.

The mouth is decagonal and of moderate size: the arches over the bases of the ambulacral areas are about one-third greater in span than those across the interambulacra. The disc is absent in all the specimens, four in number, we have seen.

Affinities and differences.—This species resembles *Cidarites* (*Diadema*) *mamillanus*, Roemer, in the prominence of the tubercles and depression of the test; but Roemer's figure* is so indistinct and devoid of details, that it is impossible to institute a strict comparison between our Urchin and the one figured by him. The difference between *D. Davidsoni* and *D. subangulare* is so marked that it is impossible to mistake them—the pentagonal outline, large tubercles, wide granulated space between the primary tubercles of both areas, with the pores arranged in double files on the upper surface of the test, form a group of characters which distinguish *D. subangulare* from our Urchin. From *D. pseudodiadema* it is distinguished by the tubercles in *D. Davidsoni* of the ambulacral equalling in size those of the interambulacral areas, whilst in that species they are unequal. The rudimentary condition of the secondary tubercles in our species forms a striking contrast to the size they attain in *D. pseudodiadema*. The naked condition of the central parts of the interambulacral areas connects it with *D. subnudum*, Ag., of the Chalk, and the neatness of its outline allies it with other cretaceous forms.

Locality and stratigraphical range.—We have collected this species in the clays of the Coral rag near Calne, Wilts; it is a very rare Urchin, as we only know four specimens of it.

We dedicate this species to our friend Thomas Davidson, Esq., whose learned monographs on the Brachiopoda have earned him the gratitude of all palæontologists. We take this opportunity likewise of recording our deep obligations to Mr. Davidson for many friendly acts of assistance given during the preparation of these memoirs, by which we have been enabled to compare a considerable number of foreign Echinidæ with those of our own island, and thereby have been enabled to obtain a better knowledge of the affinities existing among the Echinoderms of the European Oolitic fauna.

Diadema Mooreii, Wright. Pl. XII. fig. 3, *a–d*.

Test circular, depressed; ambulacral tubercles smaller than those of the interambulacral areas; plates of the test covered with a small wide-set prominent granulation; mouth large and decagonal; anal opening large; apical disc of moderate size.

Height $\frac{5}{20}$ths of an inch, transverse diameter $\frac{12}{20}$ths of an inch.

* Die Versteinerungen des Norddeutschen Oolithen Gebirges, pl. 2. fig. 1.

Description.—There is much difficulty in distinguishing some of the smaller Diademas from each other, inasmuch as the young condition of many of the larger species so closely resembles the adult state of others, that it is only after one obtains a number of individuals of different species in their various phases of growth, that the naturalist feels himself upon sure ground when he endeavours to distinguish the affinities and differences that exist among them.

After a diligent search for Urchins in the Lias of Gloucestershire, we have succeeded in collecting only a very few examples of this group from these rocks. In addition to those found here, our friend Mr. Moore of Ilminster kindly presented us with a few specimens which he collected from the Upper Lias near Ilminster, and from these collective materials the species under consideration was discovered. *Diadema Mooreii* has a circular outline slightly inclining to a pentagonal contour; it is much depressed at the upper surface and is flattened at the base. The ambulacral areas are very narrow, being less than one-third the width of the interambulacral; their margins are occupied by two rows of tubercles about eight in each row, which, at the base and up to the equator, are nearly as large as those of the interambulacra; but from that region to the apex of the area they rapidly diminish in size, and are here very disproportionate in magnitude to them; a zigzag line of single granulation separates the two rows of tubercles from each other. The interambulacral areas are wide and well developed, and have two rows of tubercles, from 8–9 in each row, which occupy the centre of the plates; the areolas of the tubercles on the upper surface are surrounded with a circle of granules which separates them from each other, but those of the base are confluent above and below. The intertubercular surface at the base of the test has a number of granules scattered over it, whilst on the upper surface, the plates are destitute of any other ornament beyond the faint circles that surround the tubercles. The pedal pores are arranged in pairs in a single file; the avenues are, however, rather flexuous below; the basal tubercles of both areas are nearly alike in size, but on the dorsal surface those of the ambulacra dwindle into large granules, whilst those of the interambulacra maintain their size up to the last pair, which are small near the margin of the disc. The mouth-opening is large, and its margin is divided into ten nearly equal-sized lobes. The apical disc is partly preserved in the specimen here figured; it consists of five large ovarial plates of a heptagonal form; two of the sides unite with the interambulacral plates, two with the ocular, two with the adjoining ovarials, and the single surface contributes to form the boundary of the anal opening, which is of moderate size; the five ocular plates are small and heart-shaped, their apex is directed towards the anal opening, and their base to the area; the madreporiform tubercle is slightly elevated on the single ovarial plate, and the surface of the discal plates is almost destitute of sculpture or granulation.

Affinities and differences.— *D. Mooreii* resembles *D. depressum*, Ag., in the depression of its upper surface and the flatness of its base, likewise in having the tubercles of both areas of nearly a uniform size around the base; but it is readily distinguished from *D. depressum* by the number and greater development of the tubercles of the ambulacra, which maintain their size throughout; whilst in *D. Mooreii* the ambulacral tubercles are fewer in number and rudimentary in size in all the upper part of the areas. The contour of the test moreover does not assume the pentagonal outline of *D. depressum*, nor has the upper surface of the interambulacral areas the median depression seen on the test of the latter. The mouth-opening is larger, and the decagonal lobes are more equal in size in *D. Mooreii* than in *D. depressum*.

Locality and stratigraphical range.—We have collected *D. Mooreii* in the Upper Lias of Gloucestershire. Mr. Moore found it in the same stratum near Ilminster with *Ammonites communis* and *A. serpentinus*. Professor Deslongchamps has communicated a specimen of this Urchin which he found in the Lias supérieure of May, Calvados, associated with *Leptæna Davidsonii* and *Thecidea Bouchardii* and several other species.

We dedicate this species to Mr. Moore, of Ilminster, whose assiduous researches have brought to light so many interesting forms from the Upper Liassic beds of Somersetshire.

[To be continued.]

XVII.—*Descriptions of some newly discovered species of* Araneidea. By JOHN BLACKWALL, F.L.S.

Tribe OCTONOCULINA.

Family SALTICIDÆ.

Genus *Salticus*, Latr.

Salticus promptus.

Length of an immature female $\frac{3}{20}$ths of an inch; length of the cephalo-thorax $\frac{1}{16}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{20}$; length of a posterior leg $\frac{1}{10}$; length of a leg of the second pair $\frac{1}{12}$.

The cephalo-thorax is large, glossy, nearly quadrilateral, abruptly sloped behind, depressed and prominent before, projecting beyond the base of the falces; it is of a fulvous colour, with the entire space between the eyes, a line extending along the middle of its posterior half, several oblique ones on the sides of that part, and the margins of a black hue, the cephalic region having a slight tinge of brown, and the anterior eyes are surrounded with white hairs. The falces are small, conical, vertical, and have a few minute teeth on their inner surface; the maxillæ, which are straight, are enlarged and rounded at the extremity; the lip is moderately long and rounded at the apex; and the sternum has a regular oval form. The colour of these parts is pale yellowish brown, the sternum having a broad black border. The legs are robust, particularly those of the anterior pair, and are provided with hairs and sessile spines, two parallel rows of the latter occurring on the inferior surface of the tibiæ and metatarsi of the anterior legs; the fourth pair is the longest, the first pair rather surpasses the third, and the second pair is the shortest; their colour is pale yellowish brown, and there is an irregular black spot on the upper part of the coxæ of the posterior pair, and a curved one at the extremity of the femora of the anterior pair, on the under side; each tarsus is terminated by two curved, slightly pectinated claws, below which there is a small scopula. The palpi resemble the legs in colour, and have a few black spots on the cubital, radial, and digital joints, in front. The abdomen is oviform, convex above, projecting a little over the base of the cephalo-thorax; it is clothed with black and short hoary hairs, and is of a fulvous colour, with curved, transverse, oblique rows of black spots, more or less confluent, extending from the upper part to the sides; and on the under part numerous black spots are distributed without regularity; the branchial opercula have a pale yellowish tint; and there is a longitudinal black streak on the upper part of each superior spinner.

In October 1853 an immature female of this species, which is nearly allied to *Salticus frontalis* and *Salticus reticulatus*, was received from the Rev. Hamlet Clark, who took it near Northampton in the autumn of the same year.

Salticus Jenynsii.

Length of the female $\frac{5}{10}$ths of an inch; length of the cephalo-thorax $\frac{1}{8}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{1}{4}$; length of a leg of the third pair $\frac{3}{16}$.

The legs are robust, especially those of the first and second pairs, and are provided with hairs and strong black spines; their colour is yellowish brown, a longitudinal black line extending long the upper part of the femora, genua, and tibiæ; the anterior and posterior pairs, which are the longest, are equal in length, and the third pair is the shortest; each tarsus is terminated by two curved claws, below which there is a scopula. The palpi have a yellowish brown hue, the digital joint being the darkest. The cephalo-thorax is nearly quadrilateral, prominent in front, projecting beyond the base of the falces; it is covered with yellowish brown and black hairs intermixed, and has some long yellowish ones below the anterior row of eyes; a narrow black line occurs on the margins, immediately above which there is a longitudinal one of a yellowish brown hue. The falces are short, powerful, conical, and vertical; the maxillæ are straight, and enlarged and rounded at the extremity; and the lip is somewhat oval. These parts have a yellowish brown tint, with the exception of the bases of the maxillæ and lip, which have a dark brown hue. The sternum is small, oval, and of a brown colour, the margins being much the darkest. The abdomen is oviform, pointed at the spinners, convex above, projecting over the base of the cephalo-thorax; it is densely clothed with short yellowish brown hairs, interspersed with long black ones; a faint red-brown line passes from the spinners along the middle of the upper part, more than half of its length, and then separates into two diverging branches which extend to its anterior extremity and form a very acute angle; these red-brown lines have an obscure, narrow, whitish border, bounded by a faint red-brown parallel line, and an obscure whitish line bisects the angular space comprised between the diverging branches of the medial line; on the under part there is an obscure dark band, which tapers gradually from the sexual organs to the spinners; and the branchial opercula have a pale yellow hue.

It affords me much gratification to connect with this species of *Salticus* the name of so accomplished a naturalist as the Rev. Leonard Jenyns, M.A., F.L.S. &c., to whose liberality I am indebted for this opportunity of describing the adult female. It was comprised in a collection of spiders made in Cambridgeshire, and obligingly placed at my disposal by Mr. Jenyns in February 1853.

Family Drassidæ.

Genus *Drassus*, Walck.

Drassus propinquus.

Length of male $\frac{1}{9}$th of an inch; length of the cephalo-thorax $\frac{1}{16}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{24}$; length of a posterior leg $\frac{1}{5}$; length of a leg of the third pair $\frac{1}{8}$.

The eyes are disposed on the anterior part of the cephalo-thorax in two short, transverse, slightly curved, concentric rows, whose convexity is directed backwards, the intermediate ones of the anterior row being rather the smallest and darkest of the eight. The cephalo-thorax is oval, convex, glossy, with slight furrows on the sides converging towards a narrow indentation in the medial line; it is sparingly clothed with hoary hairs, some of which are disposed in three faint rows on each side, along the furrows; the falces are conical, vertical, and armed with a few minute teeth on the inner surface; the maxillæ are powerful, enlarged where the palpi are inserted, greatly dilated at the base, rounded at the extremity, and inclined towards the lip, which is longer than broad and rounded at the apex; the sternum is heart-shaped. These parts are of a brown colour, the margins of the cephalo-thorax and sternum, and the base of the lip being much the darkest. The legs are long, slender, provided with hairs and sessile spines, and are of a yellowish brown colour, with the exception of the femora of the first and second pairs which have a dark brown hue, those of the second pair being the paler; the fourth pair is rather longer than the first, which surpasses the second, and the third pair is the shortest; each tarsus is terminated by two plain curved claws, below which there is a small scopula. The palpi are robust; the humeral and cubital joints are somewhat darker coloured than the legs, and the radial and digital joints have a dark brown tint; the humeral joint has a gibbosity near its extremity on the under side, which is provided with short hairs, and the radial joint projects forwards, from its outer side, a very large curved apophysis, whose yellowish brown extremity is slightly bifid; the digital joint is of an elongated oval form, convex and hairy externally, concave within, comprising the palpal organs; these organs are highly developed, very protuberant at the base, which is convex and glossy, and have a small prominent process at the extremity; they are of a dark brown colour faintly tinged with red. The abdomen is oviform, glossy, thinly clothed with short hairs, convex above, projecting a little over the base of the cephalo-thorax, and is of a dark brown colour, the under part being the palest; there is a spot on each side of the anterior extremity, a fine line extending thence along the middle of the upper part nearly half of its length, and an oblique, transverse, curved line, whose extremities pass along the sides to the under part, and whose middle portion, abruptly curved forwards, is bisected by the point of the fine medial line; these marks are somewhat obscure, of a deep yellowish brown hue, and are sparingly covered with hoary hairs; a few white hairs form a minute spot immediately above the spinners, and the colour of the branchial opercula is brown.

Two adult males of *Drassus propinquus*, which is closely allied to *Drassus nitens*, were captured in the spring of 1853; one running on a public road near Llanrwst, and the other in a window of the sitting-room at Oakland. In the summer of the same year Mr. R. H. Meade took an adult male of this species in Norfolk.

Family Linyphiidæ.

Genus *Linyphia*, Latr.

Linyphia tenella.

Length of the female $\frac{1}{11}$th of an inch; length of the cephalo-thorax $\frac{1}{24}$; breadth $\frac{1}{32}$; breadth of the abdomen $\frac{1}{20}$; length of an anterior leg $\frac{1}{6}$; length of a leg of the third pair $\frac{1}{8}$.

The cephalo-thorax is oval, convex, glossy, with an indentation in the medial line; the falces are conical, vertical, and armed with minute teeth on the inner surface; the maxillæ are straight, with the exterior angle at the extremity curvilinear. These parts have a brown tint, with the exception of the lateral margins of the cephalo-thorax, which are black. The lip is semicircular and prominent at the apex; and the sternum is convex, glossy, and heart-shaped. Both these parts have a very dark brown hue. The eyes are seated on black spots; those of each lateral pair are placed obliquely on a small tubercle and are contiguous, and the anterior eyes of the four intermediate ones forming the trapezoid are seated on a slight protuberance and are the smallest and darkest of the eight. The legs are long, slender, provided with hairs and fine spines, and have a light yellowish red tint; the first pair is the longest, the second pair slightly surpasses the fourth, 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. The abdomen is oviform, pointed at the spinners, sparingly supplied with short hairs, glossy, convex above, and projects over the base of the cephalo-thorax; it is of a dull olive-green hue, the under part being the darkest, and along the middle of the upper part there extends a very obscure series of angular lines of a deeper shade having their vertices directed forwards; the sexual organs present two parallel, convex, glossy prominences of a red-brown colour.

An adult female of this *Linyphia* was received from Mr. R. H. Meade in September, and an immature one from the Rev. Hamlet Clark in October 1853.

Linyphia circumspecta.

Length of the male $\frac{1}{11}$th of an inch; length of the cephalo-thorax $\frac{1}{24}$; breadth $\frac{1}{36}$; breadth of the abdomen $\frac{1}{36}$; length of an anterior leg $\frac{3}{16}$; length of a leg of the third pair $\frac{1}{8}$.

The eyes are seated on black spots; the four intermediate ones form a trapezoid whose anterior side is the shortest, and those of each lateral pair are placed obliquely on a minute tubercle and are contiguous; the posterior eyes of the trapezoid are the largest and the anterior ones the smallest of the eight. The cephalo-thorax is oval, convex, glossy, with slight furrows on the sides converging towards an indentation in the medial line; the falces are conical, armed with a few small teeth on the inner surface, and somewhat inclined towards the sternum, which is broad and heart-shaped; the maxillæ are enlarged where the palpi are inserted, and slightly inclined towards the lip, which is semicircular and prominent at the apex; the legs are long, slender, and provided with hairs and fine spines; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and minutely pectinated, and the inferior one is inflected near its base. These parts are of a yellowish brown colour; the sternum, lip, and lateral margins of the cephalo-thorax are the darkest, the legs much the palest, and the falces and maxillæ are faintly tinged with red. The palpi resemble the legs in colour, with the exception of the digital joint which has a brown hue; the cubital and radial joints are short, the latter being the stronger; the digital joint is oval, with a depressed, curved process at the base, on the outer side; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, prominent, with a black filiform spine at the extremity curved in a circular form, and are of a red-brown colour. The convex sides of the digital joints are directed towards each other. The abdomen is oviform, pointed at the spinners, thinly clothed with hairs, glossy, convex above, and projects over the base of the cephalo-thorax; it is of a yellowish brown colour, the under part being much the darkest, and has an obscure series of dark angular lines, whose vertices are directed forwards, extending along the middle of the upper part: between the branchial opercula there is a rather prominent transverse fold.

In the autumn 1853, males of this species, having their palpal organs fully developed, were discovered among herbage growing in woods about Oakland.

Linyphia flavipes.

Length of the male $\frac{1}{12}$th of an inch; length of the cephalo-thorax $\frac{1}{24}$; breadth $\frac{1}{30}$; breadth of the abdomen $\frac{1}{28}$; length of an anterior leg $\frac{1}{3}$; length of a leg of the third pair $\frac{1}{8}$.

The legs are long, slender, provided with hairs and fine spines, and of a pale yellow colour faintly tinged with brown; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and minutely pectinated, and the inferior one is inflected near its base. The palpi have a brown-black tint; the radial joint is stronger than the cubital, and is somewhat produced in front; the digital joint is oval, with a lobe on the outer side; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, protuberant, complicated in structure, with a curved prominent process near the base, on the outer side, a few very short pointed ones at the extremity, and are of a reddish brown hue. The convex sides of the digital joints are directed towards each other. The cephalo-thorax is oval, convex, glossy, with slight furrows on the sides converging towards an indentation in the medial line; the falces are conical, armed with a few teeth on the inner surface, and inclined towards the sternum, which is broad, convex, and heart-shaped; the maxillæ are straight, with the exterior angle at the extremity curvilinear; and the lip is semicircular and prominent at the apex. These parts are of a brownish black hue, the falces and maxillæ being faintly tinged with red. The four intermediate eyes form a trapezoid whose anterior side is the shortest, and those of each lateral pair are seated obliquely on a tubercle and are nearly contiguous; the anterior eyes of the trapezoid are placed on a slight protuberance and are the smallest and darkest of the eight. The abdomen is oviform, glossy, thinly clothed with hairs, convex above, projecting over the base of the cephalo-thorax, and is of a brownish black colour. Some individuals have an obscure series of slightly angular lines of a pale brown colour, whose vertices are directed forwards, extending along the upper part of the abdomen.

Adult males of *Linyphia flavipes* were found among moss in woods at Oakland in the summer of 1853.

Genus *Neriëne*, Blackw.

Neriëne herbigrada.

Length of the female $\frac{1}{14}$th of an inch; length of the cephalo-thorax $\frac{1}{24}$; breadth $\frac{1}{32}$; breadth of the abdomen $\frac{1}{28}$; length of an anterior leg $\frac{1}{10}$; length of a leg of the third pair $\frac{1}{13}$.

The cephalo-thorax is oval, convex, glossy, with an indentation in the medial line; the falces are powerful, conical, vertical, divergent at the extremity, and armed with teeth on the inner surface; the maxillæ are enlarged where the palpi are inserted, and inclined towards the lip, which is semicircular and prominent at the apex; and the sternum is broad and heart-shaped. These parts have a brown hue; the sternum and lip are the darkest, and the falces and maxillæ, which are the palest, are faintly tinged with red. The eyes are seated on black spots; those of each lateral pair are placed obliquely on a small tubercle, and are contiguous, and the anterior eyes of the four intermediate ones forming the trapezoid, which are near to each other, are the smallest and darkest of the eight. The legs are provided with hairs, and have a yellowish brown hue; the anterior and posterior pairs, which are the longest, are equal in length, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and slightly pectinated, and the inferior one is inflected near its base. The palpi resemble the legs in colour. The abdomen is oviform, hairy, glossy, convex above, and projects over the base of the cephalo-thorax; it is of a pale brown colour, with obscure spots of a deeper shade, the under part being rather the darkest; the sexual organs have a reddish brown hue, and their anterior margin is prominent and semicircular.

The colours of the sexes are similar. The male has the humeral joint of its palpi curved towards the cephalo-thorax, which has a narrow indentation immediately behind each lateral pair of eyes; the radial is larger than the cubital joint and projects a strong obtuse apophysis from its extremity, in front, towards the inner side; the digital joint is somewhat oval, with a large lobe on the outer side; it is convex and hairy externally, concave within, comprising the palpal organs, which are highly developed, complicated in structure, with a curved prominent process at their base, on the outer side, another, situated underneath, which has its extremity enlarged and depressed, and two long, contiguous, filiform, black spines, originating near their base, on the outer side, which pass obliquely downwards, and curving round their extremity, extend considerably beyond the termination of the digital joint: the colour of these organs is red-brown.

Early in October 1853 both sexes of *Neriëne herbigrada*, in a mature state, were detected among coarse herbage and moss growing in woods on the northern slope of Gallt y Rhyg. Like *Neriëne sulcata*, this species makes a near approximation to the spiders of the genus *Walckenaëra.*

XVIII.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With two Plate.]

[Continued from p. 137.]

The orbit of the blood-proper in the Annelid is conducted in obedience to the simplest hydraulic principles. The Annelid is vermiform in figure. A dorsal vessel carries the blood from the tail to the head, a ventral in the reverse direction. The intermediate currents invariably, in every species, bear *from* the latter *into* the former vessel. This fact is perfectly patent to the eye of every observer. The blood enters *into* the dorsal vessel from the viscera, *from* the ventral trunk *into* the viscera. In simplicity of mechanical principles nothing can exceed such an arrangement. The annulose 'circulation' observes two leading directions, longitudinal and transverse. The dorsal trunk is propulsive, the ventral distributive, the œsophageal ring connective. Let the circulatory system of the *articulated* animal be studied with reference to this comparative standard.

Myriapoda, Insecta, Arachnida.

These three classes are distinguished by *one type* of organization. The blood-system, the nervous, and the respiratory are constructed upon one essential plan. A law, true of one, cannot therefore suffer aberration in the other. The unity of nature's constructive principles are observed with rigid inviolability. The lowest Myriapod is removed from the highest Annelid only by a short distance: the former in the adult state has no chylaqueous fluid, the latter no tracheal system. Is it mechanically reasonable that the introduction of 'tracheæ' into the organism should involve a radical change of plan in the orbital direction of the blood-current? It must be so, if Mr. Newport's exposition of this subject be founded in truth. In the Annelid the eye follows with clearness and certainty the currents in all the lateral vessels attached to the dorsal trunk moving *into* or *in the direction* of the latter. In what Mr. Newport has called the *systemic arteries* in Myriapods and Arachnids, the blood moves in a contrary direction, from the dorsal vessel towards the viscera. Those very vessels which in the Annelid can be proved indubitably, by the eye, to be *veins*, are suddenly in the very next class reversed into *arteries*! Which is the more probable,—that her observers have perpetrated a paradox, or that nature has reversed her course? The subject deserves a more accurate examination.

All English and continental anatomists have implicitly followed Mr. Newport; where he is in error they are wrong, where he is truthful they are right. It is *his* exposition of this subject therefore that must be measured by the standard of actual nature. Disciples will obey the master-teacher.

Mr. Newport's researches on the "Circulation of the Blood" in the Myriapods, Insects, and Arachnids, constituted a remarkable æra in the anatomical history of the Invertebrate animals*. His researches are masterpieces of minute and difficult anatomy; they deserve, as they have received, the admiration of all scientific men. The age of authority is gone by. Truth must now be reverenced at her native shrine, and Mr. Newport must submit to the criticism of his peers. Mr. Newport's anatomy is exact, but his reasoning is unintelligibly contradictory. His researches relate exclusively to the *central parts* of the circulating system of the tracheary Articulata; he has not attempted to investigate the peripheric. This is a natural division of this subject. Let these heads be discussed separately.

Central Parts of the Circulatory System in the Myriapoda, Insecta, and Arachnida.

The researches of Baker, Carus, Wagner †, Lyonet ‡, Cuvier §, Treviranus ||, Latreille ¶, Straus-Durkheim **, Mr. Bowerbank ††, Tyrrel ‡‡, Müller §§, Hunter, Lord ||||, Newport ¶¶, in connexion with this subject, should be historically signalized; they deserve the reverence, but not the servile acceptance, of the scientific scholar; they involve a vast mass of laboriously acquired knowledge; they constitute the foundation whereon all future additions must rest.

The myriapodal 'circulation' exists in its least complex form in the *Iulidæ*. Of this family the *Spirostrepti* and *Spiroboli* represent the lowest genera. Mr. Newport has proved that the chambers of the heart *decrease* in number as the articulate scale is followed upwards from the lowest Myriapod to the highest Arachnid. This principle is *not* observed in the larva of all insects. In several aquatic species, the great venous abdominal currents may be followed most perfectly with the eye, and seen to enter the dorsal vessel *only* at its posterior extremity, where alone auricular orifices exist (Pl. IX. fig. 4, *b*). The dorsal vessel (*a*) of

* On the nervous and circulatory systems, and on the existence of a complete circulation of blood in vessels, in Myriapoda and Macrourous Arachnida, Phil. Trans. 1843. Also Art. *Insecta*, Cyclop. Anat. and Phys.; and various papers in the 'Linnæan Transactions,' by George Newport, Esq.

† Isis, 1832.

‡ Traité Anatomique de la Chénille, &c., 1760.

§ Leçons d'Anat. Comp.

|| Die Arachniden, 1812; and also his Vermischte Schriften Anatomischen und Physiologischen Inhalts. Göttingen, 1816 (Die Spinne), p. 5.

¶ Cours d'Entomologie, &c., Paris, 1831.

** Considérations générales sur l'Anat. Comp. des An. Art., 4to, Paris, 1828.

†† Entom. Mag. vol. i. April 1833.

‡‡ Proceedings of the Royal Society, 1835.

§§ Nova Acta Nat. xii. 2.

|||| Medical Gazette, 1838.

¶¶ *Op. cit.*

the larva of the Insect therefore bears a closer typal analogy to that of the Annelid than that which is presented by that of the lowest Myriapod. The dorsal vessel of certain transparent aquatic larvæ may be readily defined under the microscope; its pulsations and currents may be perfectly observed. The corpuscles floating in the blood mark with great clearness the direction of the current. It is certain that in some species the *systemic arteries* (fig. 1, *f*, & fig. 3, *n*, *n*.) (of Mr. Newport) do not exist. In those in which these vessels are detectable, the current which they convey tends *towards*, not *from*, the dorsal vessel. Repeated observations have convinced the author upon this point. They are venous, not arterial; they return the blood from the viscera into the dorsal vessel; these vessels are described everywhere, in all his writings, by Mr. Newport, as visceral *arteries*; his dissections have notwithstanding traced them into anastomosis with branches coming from the *supraspinal artery* (fig. 1, *c*, fig. 3, *c*, *e*, fig. 2, *b*). In *this* vessel the blood moves from the head in the direction of the tail; it follows therefore that the currents conveyed by the anastomosing branches must meet each other in the *same* vessel! action and reaction are equal and contrary! stagnation results! The *subspinal* venous trunk (fig. 3, *e*, *l*) discovered by Mr. Newport in Insects and Arachnids does not exist in the Myriapod. In the latter, therefore, the *primary* channels of the system of the blood do not exceed two in number, the dorsal and the ventral. This is the case in the Annelid; the ventral vessel of the Annelid *undulates* much *less* obviously than the dorsal. It receives *all* its blood from the dorsal by means of the œsophageal collar-branches: it distributes it chiefly to the integumentary structures. Trunks of secondary size proceed backwards, in some species from the heart, in others from the œsophageal vessels, expressly to supply the walls of the alimentary canal*. Now the *veins* which return this blood from the glandular parietes of the intestinal canal in the Annelid enter into the dorsal vessel precisely in the same manner as the systemic *arteries* are described by Mr. Newport to *proceed from* this vessel in the Myriapod, Insect, and the Arachnid. In classes so contiguous, why should the functions of the same vessels be reversed? Mr. Newport's views are drawn from anatomical structures; he has never *seen* the blood moving in these so-called systemic *arteries*; he ignores the argument of analogy drawn from the *living* circulation of the Annelid; he does not perceive the *mechanical* difficulty with which the blood would enter these vessels from the segmental heart, on the supposition of their arterial character. They arise from the latter at its extreme *posterior*

* See the Author's Report on the British Annelida in the Transactions of the British Association for 1851.

end (Pl. IX. fig. 3, *n*, *n*)—at that very point at which they should enter if they were veins.

A large wave of blood rushing forwards may be clearly *seen* in the dorsal vessel of larvæ (fig. 4, *b*, *a*): the chambered dorsal vessel contracts from behind forward; it observes the law of the Annelidan; the hindmost chamber contracts first, that next to it in advance next, and so on. The systolic movement does not occur throughout the whole length of the vessel at the same time, but in parts from behind forwards as the wave of blood travels. In two adjacent chambers the actions of systole and diastole are alternate.

There is in fact no functional difference whatever between the dorsal vessel of the Annelid and that of the articulated animal; they are distinguished only in structure. In the Myriapod, the tubular vessel of the Annelid is reinforced with propelling power at successive points = the chambered hearts. In the articulated animal this *extra* power in the central vessel is absolutely required. In the Annelid every vessel in the body is an elastic tube *tightly embracing* the fluid contents. The *channels* through which the blood moves in the Articulata do not closely grasp the contained fluid (fig. 2, *g*); they are indeed bounded by definitive membranes, but they are not elastic contractile structures fitted mechanically to favour the circulation of the fluids (Pl. X. fig. 10, *b*, *c*). This circumstance ought not to involve an alteration in the *type* of the circulation. But if the systemic arteries of Mr. Newport be really arteries, then the plan and principle of the circulatory systems of the Annelid and the Myriapod must be diametrically dissimilar. If they be arteries, the circuit of the fluids cannot be explained without involving physical contradictions. The author is however convinced that Mr. Newport has committed the mistake of imputing to vessels an arterial character, which observation and analogy prove to be venous.

The orbit of the blood-current in the Myriapod conforms in every particular with the Annelidan type. *All* vessels attached to the dorsal vessel *behind the œsophageal collar* (fig. 1, *b*) are *afferent* with respect to that trunk. *All* branches connected with the great ventral or supraspinal vessel posterior to the same limit are *efferent* with respect to this vessel. The currents in these latter branches are divisible into two orders—that first which supplies the viscera, that secondly which is distributed to the integuments: the current from the first, after having traversed the viscera *en route*, returns into the dorsal vessel under a *venous* character by means of the *systemic arteries* (sic) of Mr. Newport. That from the second is poured from various sources into the great splanchnic sinuses which enter the dorsal vessel at the auricular orifices.

In the *dorsal* vessel, from the extreme tail to the extreme head, the blood moves *forwards*, in the ventral backwards: in *all* branches whether integumentary or visceral, *from* the latter *into* the former. The dorsal vessel is afferent only with respect to those parts which are situated anteriorly to the œsophageal ring; the ventral is efferent only to the same parts—it is distributive to all others.

The preceding account of the course of the blood in the Myriapoda embraces conclusions suggested by careful study and numerous observations; it is recommended by its mechanical simplicity; it entangles the physiologist in no hydraulic contradictions.

That of the *Insect* (fig. 2) is regulated in exact conformity to the myriapodal type. The dorsal vessel (*a*) in the Insect exhibits signs of concentration; it is only the *abdominal* portion that is multiplied into chambers; through the thorax the vessel is continued in form of a simple tube. The auricular orifice of these chambers is furnished with a more perfect valvular apparatus. The same observations apply to the so-called *systemic arteries* of Insects as to those of Myriapoda. To the presence of these vessels in this class, however, no allusion is made by Mr. Newport*. If they exist in the Myriapod, they must also exist in the adult Insect.

The *supra-spinal* trunk (fig. 2, *b*) in Insects, as in Myriapods, is the great centre of the ventral circulation. It receives all its blood from the dorsal vessel by means of the anterior branches into which the latter divides; it supplies chiefly the external structures and the nervous chords. Either from the descending aortic branches or from the anterior part of the supraspinal artery, there proceed backwards along the ventral aspect of the viscera, one or more secondary trunks which correspond with those which in the Annelids are exclusively distributed over the parietes of the alimentary canal; in these, the direction of the blood corresponds with that in the great ventral artery; like the latter, they are afferent and distributive. All the blood, thus, by means of these trunks, entering the viscera from below, reaches again the dorsal vessel, conducted by the so-called "systemic arteries." In Insects the vessels connected with the abdominal circulation are more perfect, mechanically, as conduits, than those traversing the exterior structures of the body. This explains the difference of structure which exists between the systemic arteries (sic) and the *loose membranous channels* (fig. 2, *g*, *f*, *e*) opening into the auricles of the heart. The former belong to a distinct segment (the visceral) of the circulation, the latter to the integumentary or peri-

* See article *Insecta*, Cyclop. Anat. and Phys.

pheral. In the Insect, as in the Myriapod and the Annelid, the circulatory current acknowledges two main directions; in *all* dorsal trunks, from the extreme tail to the antennæ, the movement of the blood is *forwards*, in all ventral trunks it assumes an opposite course.

In all branches connecting more or less transversely these two systems of longitudinal trunks, the blood travels from below upwards, from the ventral in the direction of the dorsal trunks. On the supposition that the "systemic arteries" are distributive neither in Insects nor in Myriapods, is it possible to solve the mechanical problem of the circulation? As now explained, the principle of the system is intelligible and consistent. It is asserted with great confidence by the physiologist, that in Insects no distinction into venous and arterial blood can prevail. The ubiquity of the tracheæ renders such a distinction impossible.

Such are the doctrines now taught; they are not necessarily true; at present neither the extreme peripheric parts of the blood-system, nor those of the tracheæ are known. New questions, to be presently propounded, will prove that the material conditions of the processes of nutrition and respiration in the air-breathing Articulata are as yet by no means clearly defined. But let the central parts of the circulation in Arachnids be first defined.

To Mr. Newport is due the credit of first solving the problem of the 'circulation' in the Arachnid; but his solution is neither clear nor complete*. On his interpretation, conceding the merit of correctness to his descriptive anatomy, the circuit of the blood cannot be consistently described. Like that of the Myriapod and the Insect, the dorsal vessel (fig. 3, *p, a*) of the Arachnid extends from the tail to the head, along the dorsal median line. With its sides, along its entire course, there are connected two orders of branches; first, the pneumo- or brancho-cardiac canals (fig. 3, *k, k, k*), which return the blood from the pulmonary or branchial sacs (*g*); secondly, the systemic *arteries* (*n, n*) of Mr. Newport†. At its anterior extremity it breaks forth into a great number of branches destined for the supply of the appendages. To the dorsal vessel in the Arachnid Mr. Newport assigns an extraordinary duplicity of action. According

* See his papers in the Phil. Trans. Part ii. 1843.

† I am very desirous in this place to invite the attention of the student in comparative anatomy to the beautiful work now being published by M. Emile Blanchard; it is entitled 'L'Organisation du Règne Animal,' à Paris, chez Victor Masson et J. B. Baillière. The delineations which adorn this work are executed in the first style of French art. M. Blanchard implicitly follows the interpretation of the circulatory system of the Arachnids, rendered by Mr. Newport.

to him, the same straight vessel (*p*, *a*), and furnished too with valves opening in *one* direction, sends the blood in two diametrically opposed currents! forwards towards the head, and directly backwards towards the tail at the same moment*. He thus wantonly violates the unity of principle which presides over the distribution of the blood in the whole annulose and articulated series.

Directly contrary to the views of Mr. Newport, the blood in truth, in the *caudal artery* (fig. 3, *p*) of the Arachnid, moves *forwards*, not *backwards*. It follows therefore, that in the ventral trunk (*l*) of the tail of the Scorpion the direction of the current is backwards, not forwards as stated by Mr. Newport. The pneumo-cardiac channels (*k*, *k*, *k*) *enter* the auricles of the heart; the systemic arteries *arise* (Newport) from almost the same point in the walls of the chambers. The author has already argued in favour of the *venous* character of these vessels in Myriapods and Insects: if in the latter classes they be venous, they cannot be arterial in the Scorpion; they are the same vessels—they present the same relations—they are connected with the viscera in the same manner. They anastomose with the branches which proceed upwards from the supraspinal visceral arteries. Henceforth they will be called systemic *veins*.

At its cephalic extremity in the Scorpion, the dorsal vessel divides into three groups of secondary trunks (fig. 3, *b*, *c*, *d*),—those first which supply the brain, head and tentacles,—those secondly which proceed to the claws and legs,—and lastly those which form the great ventral longitudinal trunks of the body. In the Scorpion they consist of two orders, those first which Mr. Newport in this instance has called the visceral arteries (*b*), and secondly the *supraspinal artery* (*c*). If the visceral arteries exist as separate trunks in Arachnids, they must be present

* This is his language:—"Having traced the distribution of the arterial vessels from the anterior extremity of the heart, it remains now to follow those of the posterior, which *afford some curious peculiarities*. The last two chambers of the heart, which are situated in the seventh segment of the abdomen, are greatly reduced in size, and constitute the *origin* of the caudal artery (fig. 3, *p*, of the author's plate), and seem to be the means by which part of the current of the blood is *directed backwards to the tail*." See page 292 of his paper on the Myriapods and Arachnids, in the Phil. Trans. 1843. There are eight valves to the heart. The anterior six act forwards. The two posterior act directly backwards (Newport)!—Is this probable, physiologically or mechanically? Does it not involve a hydraulic absurdity? Can the *same linear* tube, whose contractions *begin* behind and travel undulatorily *forwards*, drive the contained fluid simultaneously backwards and forwards? (!) *Why* should this reversal of the blood-current take place in the same homologous vessel in the Arachnid, and *not* in the Insect and the Myriapod? The mere addition of a *tail* to the Scorpion does not necessitate such a mechanical paradox.

under some form in the Myriapod and the Insect. They constitute a conspicuous class of distributive vessels in the Annelids. Mr. Newport does not suspect even their existence in the Myriapod and the Insect. He replaces them by his incomprehensible *systemic arteries*. In the pulmonary Arachnids a great *venous* abdominal trunk (fig. 3, *e, l*) is superadded to the system of the circulation. It conveys *forwards* the blood (according to Mr. Newport) from the caudal region. This again is undoubtedly an error. In this vessel in the Arachnid, as in the Insect, the course of the blood is *backwards*; it distributes it over the branchiæ, from which it is returned by the pneumo-cardiac channels to the heart again to repeat the same course.

The corresponding central parts of the *tracheary apparatus* require but few preparatory words:—

In the Myriapods the large tracheæ communicate externally with the spiracles. In the *Scolopendridæ, e. g.* the *Lithobius*, they exist on alternate rings to the number of eight or ten. The tracheæ proceed thence in longitudinal trunks to be distributed over every part of the body.

In Insects the *spiracles* are usually nine in number on each side; each spiracle consists of a horny ring of an oval form, within which is a valve formed of a series of converging fibres, and which opens perpendicularly on its long axis guarding the external entrance*. In the perfect Insect the spiracles of the abdomen are small, those of the larva large. In the latter, abdominal respiration is most active; in the former, the thoracic is predominant. In Insects as in Myriapods, the tracheæ, arising at the spiracles, are distributed over every part of the body (Plate X. fig. 8). The tracheæ of *all* larvæ are simply tubular, those of all volant perfect insects are dilated at various parts into *vesicles*.

In some tribes, as in most of the Hymenoptera, Lepidoptera, and Diptera, these sacs are present in almost every species and occupy a large portion of the interior of the body, more especially of the abdominal region. They exist only in the volant species of the Coleoptera. They are present in the winged Carabidæ, but not in the apterous. The tracheæ, in those species of Orthoptera which are merely saltatorial in habits, never dilate into vesicles. M. Emile Blanchard declares that the *substance* of the walls of these vesicles is channelled into plexiform passages for the blood. This is most certainly incorrect. These sacs have no reference to the respiratory process; they subserve only a mechanical use; without them the insect could not fly. They exist in the male of the common Glow-worm, but not in the female (Newport).

* Art. *Insecta*, Cyclop. Anat. and Phys.

The relation of the tracheæ to the blood-currents will be studied under the next head.

Peripheral extremes of the respiratory and circulatory systems in Myriapoda, Insecta, and Arachnida.

In their extreme distributions these two great systems will be most advantageously studied in connexion. There prevails between them an extensive parallelism; they are not, however, everywhere in coincidence. Though much has been accomplished by the ingenuity of minute anatomists during the last few years to dispel the difficulties of this subject, much still remains to be unravelled. Swammerdam, Malpighi, Lyonet, and Cuvier*, did really no more than discover the existence of the dorsal vessel. It was at this time that Cuvier first made the felicitous observation, "Le fluide nourricier, ne pouvant aller chercher l'air, c'est l'air qui vient le chercher pour se combiner avec lui." Cuvier believed the fluids in the Insect to be stagnant, except in the dorsal vessel, in which they only oscillated to and fro. In the year 1827 Carus *saw* the movement of the blood in the transparent larvæ of the *Ephemeridæ* and *Agrionidæ*†. Carus could not trace the currents to their remote courses. Wagner in 1832‡ confirmed the observations of Carus. Straus added his authority upon the same point. Mr. Bowerbank§ has published admirable observations on the circulation of the blood in the wings of *Chrysopa perla* and *Phlogophora meticulosa* in the order Lepidoptera. Mr. Bowerbank has in no instance, however, followed the blood beyond the larger nervures of the wings, in which he saw the current (accompanied always by a trachea) turning back at certain points. He nowhere states that these currents followed the tracheæ to their extreme ramifications. Mr. Newport corroborates these observations in his article "Insecta," in the Cyclopædia of Anatomy and Physiology. In the year 1848, M. E. Blanchard|| published a celebrated essay, in which he first announced the ingenious experiments which led him to conclude that the blood *travelled* everywhere in the *sheaths* of the tracheæ:—"il est démontré que le fluide nourricier pénètre entre les deux membranes qui les constituent." M. Emile Blanchard does not attempt to show how the blood can describe a *circuit* in such a manner and in such a situa-

* Sur la Nutrition dans les Insectes, Mém. de la Société d'Hist. Nat. de Paris, 1797.

† Nova Acta Physica, vol. xv. 1834.

‡ Beobachtungen über den Kreislauf des Blutes, &c. bei den Insecten, Isis 1832.

§ Entomological Magazine, 1833.

|| Annales des Sciences Nat., 3me série, Sur la Circulation dans les Insectes, &c.

tion. But his conclusions have by no means received the undivided assent of subsequent observers*. It is easy to prove that the coverings of the tracheæ are very unlike those implied in the inferences of M. Blanchard. This will be afterwards done.

Agassiz† declares that he has repeated the injections of M. Blanchard with confirmatory results. At this period M. Charles Bassi and M. Filippi‡ undertook especially to examine this question. They fed the *larvæ* of *Sphinx atropos* and *Bombyx mori* on indigo, cochineal and other coloured substances; they found on dissection that the tracheæ were everywhere coloured; they satisfied themselves that the colour was limited to the tunics of the aëriferous tubes; it never entered into the interior. Prof. Alessandrini§, varying the preceding observations, concludes from similar experiments that the coloured matter actually enters into the *interior* of the *tracheal tube*:—"Le Prof. Alessandrini crut remarquer que la matière colorée était contenue dans l'intérieur même des trachées, et que la coloration dépendait ainsi d'une véritable injection de vaisseaux trachéens." The famed observations of Mr. Bowerbank lend support to the views of the French and Italian observers just explained. He remarks, "the course of the blood is almost invariably in immediate connexion with that of the tracheæ." Mr. Newport, in his article "Insecta," teaches precisely the same doctrine. In a paper very recently‖ read before the Linnæan Society on the *Ichneumon atropos*, Mr. Newport states, "that the ramifications of the tracheæ which penetrate the structure of the alimentary canal and of every other organ, *become denuded of their external covering*, and then seem to form only two tissues, the *spiral* and the mucous; if indeed there be not also, as he has some reason to think, an extremely delicate serous or basement, closely adherent to and uniting the coils of the fibrous tissue on its external

* With reference to the remarkable relation which, according to M. Blanchard, subsists between the tracheæ and the blood, it is important that his views should be clearly apprehended. He says again,—"Mais n'est-ce pas plus encore sous le rapport de la *nutrition* que ces tubes respiratoires, dont nous connaissons la nature actuellement, doivent arrêter notre attention. En portant de l'air dans leur intérieur ils portent le sang dans leur périphérie. Ces trachées divisées et ramifiées à l'infini dans la profondeur de l'éconômie conduisent ainsi le fluide nourricier à tous les organes, à tous les muscles au moment même, où il vient de subir le contact de l'air. C'est le sang nouvellement artérialisé, le sang propre à vivifier, à nourrir tous les organes."—*Op. cit.* p. 380.

† Annal. des Sc. Nat. 1851, and Proceedings of the American Association for the Advancement of Science, Cambridge, U.S., &c.

‡ Ann. des Sc. Nat. 1851.

§ At the Scientific Congress held at Geneva, Sept. 1851.

‖ See Annals and Magazine of Nat. Hist. for July 1853.

surface. The *ultimate divisions of the tracheæ are always distributed separately and do not anastomose*, ending, as noticed by Mr. Bowerbank, in *extremely minute, filiform, blind extremities, and this Mr. Newport finds to be their condition in all structures*, in the nervous and integumentary, in the glandular and muscular*". M. Blanchard† has very recently proved the existence in the Arachnids of a *true capillary network*? at the extremes of the circulation. "This network," he remarks, "which has not yet been pointed out in the Articulata, exists under the integuments and between the various layers of the muscles, in the connective tissue; it consists of *distinctly circumscribed canals lined with a thin epithelium.* Thence the blood is received by the venous canals‡." Thus is presented in bibliographic but faithful outline the sum of existing knowledge on the distribution of the air-tubes and the blood-channels in the air-breathing Articulata: who can say that it exhibits a consistent history? The physiologist rises from the scene confounded by its manifold contradictions. The assertions of one observer are opposed and outweighed by those of another. Mr. Newport, the most recent and laborious investigator, leaves the subject utterly unintelligible; his observations cannot be verified in nature.

The author does not, for one moment, pretend to affirm that his researches (now first published) have as yet destroyed the possibility of all controversy upon *every part* of this subject. He does, however, believe that he has *finally* settled *one* part,—that which relates to the extreme distribution of the tracheæ. He has not definitively established, by actual demonstration, the manner in which the blood is related to the *extreme* tracheæ. On this subject he will state at present only what he has clearly and confidently observed.

It should first be affirmed as an absolute principle, from which there can be no departure, that a tracheal tube is an *air*-tube in *every part* of its course. It is not, as supposed by Agassiz and M. Léon Dufour§, an air-tube in its proximal moiety, and a

* I have given in the text at length the views of Mr. Newport, as reported in the abstract published in the 'Annals'; I have indicated the points in controversy by italics. They express the results of Mr. Newport's last and very recent observations. It will be afterwards seen by the text, that the conclusions at which I have arrived, from numerous and scrupulous examinations of the very same points, differ in a remarkable degree from those just communicated by Mr. Newport to the Linnæan Society.

† Comptes Rendus, June 20, 1853, p. 1079. See also the beautiful figures in his work 'Sur l'Organisation du Règne Animal.'

‡ See translated abstract in the Annals and Mag. of Nat. Hist. for Sept. 1853.

§ "Elles se divisent, comme dans les Insectes en général, en *trachées-artères* ou grand *canaux aérifères*, et en *trachées nutritives*, qui naisent des premières, et vont épanouir leurs subtiles ramifications dans tous les tissus."—Ann. des Sc. Nat. tome xv. no. 2. p. 76, 1852.

blood or circulatory conduit in its distal; the microscope everywhere proves such a view to be an unmitigated error. It is quite another and more rational supposition to maintain that the *passages* which bear the tracheæ may probably serve also to convey the nutritive fluids. Even this opinion requires the evidence of new demonstration. The author will now proceed to consider the results of his own recent investigation, distributed under the following heads:—1. The structure of the tracheæ. 2. Their distribution; (*a.*) in the adult and larval internal structures; (*b.*) in the branchiæ, in connexion with the question of insect aquatic respiration. 3. The anatomical relation in which the tracheæ stand to the nutritive fluids. 4. The mechanism of respiration in air-breathing Articulata.

Structure of the Tracheæ.

The air-tubes in Myriapods, Insects, and Arachnids, admit of division into two distinctly different parts: 1. the *spiral trachea*, and 2. its capillary continuation, the *membranous*. The former is a continuously tapering tube, branching arborescently, the branches never re-entering. It is always and everywhere furnished with an elastic spiral by which its bore is maintained in an open state. It is composed, as stated originally by Sprengel, of three anatomical elements (Pl. X. fig. 13); the outermost (*a*) consists of a dense membrane which swells under the agency of acetic acid, and *separates* from the spiral on which it normally rests and to which it forms *a close investment*. When raised by acetic acid it retains the impress of the spiral. This would not be the case if the membrane did not naturally *closely embrace the spiral*. And if it did closely embrace the spiral, it required no further persuasive to satisfy the physiologist that between it and the spiral there can by possibility travel no current of blood. This simple experiment is quite enough to effect the demolition of M. Blanchard's theory. All structures *external* to this membrane belong to the blood-channels (fig. 10, *b*, *c*) and not to the trachea. From the coverings of the latter they are quite dissimilar in anatomical structure; they are really the *loose* delicate membranes which constitute the walls-proper of the blood-channels. They are attached to the tracheæ only by loose adhesions. If now, while the tube is under the reagency of acetic acid, the eye search for the internal lining membrane (fig. 13, *c*), which lies on a plane to the inside of the spiral, it will appear with as perfect clearness as the external. It swells and separates from the *spiral* like the external. It is impossible to *prove* the existence of much difference of structure between this and the external membrane; it is more delicate and less refractive. The spiral lies in the space between these two membranes. On close inspection it seems as if a membrane distinct from the two former united together tubularly the coils of the spiral, and that the spiral itself consisted of a *hollow tube* formed out of cells arranged spirally in the substance of this membrane. In a short time the *fibre* of the spiral, after immersion in acetic acid or turpentine, loses its dark, highly refractive *solid* character. It appears distinctly as though its substance were permeated by the fluid and that air was displaced. In this state the spiral looks like a pellucid diaphanous coil wound around the axis formed by the internal membrane. This description applies to every *spiral* trachea in the body. But there is a limit, different in different structures, at which the *spiral ceases*. It is at this point that the second division of these tubes or *membranous tracheæ* begins. It is not the *external covering*, as stated by Mr. Newport, which ceases, but the *spiral* (Pl. IX. fig. 5, C, *e*). This fact admits of various and unquestionable proofs. The spiral grows less and less visible until it graduates insensibly into a *continuous* tube (*f*, *g*). It still however retains the peculiar optical character of a *trachea*. Its edges are faint *reddish*, from the iridescent decomposition of the light. This appearance was observed by MM. Alessandrini, Filippi and Bassi. The latter of these observers believed that the tint was due to the colour of the hollow cylinder of coloured blood which embraced the air-tube, corroborative of the views of M. Blanchard. It should rarely be ascribed first to the high refractive index of the air contained in the tube, and next to the density of the external fibrous membrane. It is a character by which a membranous air-tube, though of capillary diameter, can be distinguished with certainty from a blood-channel or a capillary blood-vessel. The direct continuity of the *bore*, as well as of the walls of this membranous capillary air-tube, with the larger and spiral trachea, can be proved in several modes beyond the possibility of dispute. By pressure, skilfully managed, while the specimen is under the microscope, air may be forced from the 'spiral' into the membranous tube; but the continuity of the walls of the latter with those of the former is so clear and convincing under the microscope, that no other evidence is required to prove that the capillary membranous tube is to the 'spiral' as a capillary is to an artery. The diameter of the 'spiral' trachea constantly decreases as it divides; that of the membranous observes throughout its entire course, whether it multiply into a network (Pl. X. fig. 9, *d*, *e*), or wavy brushes (fig. 12, *c*, *d*, *f*), or into the muriform plexus which exists in the substance of muscles (Pl. X. fig. 15), a uniformity which can compare only with that of true blood-capillaries of the vertebrated animal.

A tracheal tube, in many instances at the point of penetrating into the substance of a solid organ provided with a membranous investment, will *appear*, from the close and tubular manner in which it is embraced by this membranous investment, to throw off, as supposed by Mr. Newport, its external coat at the point of entrance. Acetic acid however proves this appearance to be false. The tube still preserves its three constituent elements *after* entering the substance of the organ, whatever it be, and until it assumes the capillary or membranous character.

It is important to observe, because it reconciles the accurate observations of Mr. Bowerbank with those of the author, that on the *wings* (fig. 10, *f*), especially on the scaly intervals between the nervures, the *spiral* tracheæ, as correctly stated by Mr. Bowerbank, do *not* for the most part degenerate into the *membranous* tracheæ. In these situations the *spiral* continues to the extreme termination of the tube (fig. 11, *b*). There is something anatomically characteristic in the walls of the membranous tracheæ. They denote a difference between those 'parietes' through which a *gas* has to pass, and those (of the vessels) which *fluids* transude. The smallest trachea differs from the largest only in the absence of the spiral, just as the largest artery differs from the capillary only in the presence of a thick elastic coat. The tracheæ terminate differently, and form different plexuses, in different organs, according to the varying mechanical arrangements of the ultimate parts of the latter.

The conclusion must be emphatically reiterated, that however, wherever, and in whatever structure the tracheæ may peripherically terminate, they are *air*-tubes throughout all changes to their final extremes.

Distribution and Subdivision of the Tracheæ.

The primary, secondary and tertiary tubes divide and subdivide arborescently, the branches never reuniting (fig. 14). In the *spiral* tracheæ no plexiform union of the branches ever, anywhere, occurs; so far the observations of Mr. Bowerbank and Mr. Newport are exact to nature. It is because these distinguished observers could not succeed in tracing the air-tubes beyond this limit, and because they drew a general inference intended to be applied to *all* structures, from the distribution and termination observed by the tracheæ in the wings, that they were both seduced into the error of supposing first these points to be the distributive *ultimata* of the tubes, and secondly, that the tracheæ nowhere inosculate. As already stated, this is true only of the scaly intervals which separate the nervures of the wings—*of no other structures*. In nearly *every other* structure in the body of the Insect the air-tubes divide and subdivide in the same profuse retiform manner as the blood-capillaries of the vertebrated animal. In the *muscles* the ultimate membranous tracheæ divide and unite plexiformly (figs. 14, 15). The meshes are large and oblong (fig. 15). Some tubes run parallel with the ultimate muscle-fibre; others cross the latter at right angles, connecting the former. In the glands the capillary tubes *enclose* the space occupied by the gland-cells (fig. 9): they unquestionably *reticulate,* and in their ultimate form preserve a remarkable uniformity of diameter. In many parts of the mucous membranes they observe a peculiar *wavy* method of distribution (fig. 12). They elaborately reticulate in the loose structure beneath the integuments. It is by no means improbable that M. E. Blanchard has mistaken the plexus formed by the *tracheæ* in the integuments of the Arachnids for a *rete* consisting of true blood-vessels. In the nervous tissue they follow two modes of subdivision. The brain substance is actually *penetrated* by the plexiform capillary tubes. The nerves are accompanied by long undulating filaments.

In some of the voluntary muscles the tracheæ are profusely numerous. The larger spiral branches enter the sheaths of the muscle=fascicles at right angles (fig. 14); the *membranous* tracheæ into which in the substance of the muscle they subdivide, coincide generally in direction with the fibres of the muscles (fig. 15). In other muscles the primary entering tracheæ are few in number. As a rule it seems at present probable, that the volume of air (oxygen) which by means of the tracheæ enters into the substance of a *solid* organ in the tracheary Articulata is *directly* as the *vital importance* of that organ. The reticulation of the tracheæ is most dense and profuse in the glandular and nervous structures. The large spiral air-tubes which travel along the axes of the spacious blood-channels, detach from their sides here and there *minute wavy* branches (fig. 10, *j*, *b*) which *float in the fluid,* and which appear to be expressly intended to aërate the *fluids.* These floating air-tubes are everywhere seen where the blood-stream comes into contact with the main trachea. The main tracheæ are simply convective. It will afterwards appear that the function of these *floating tracheæ* is distinct from that of those plexiform extremes of the system which penetrate and traverse the substance of the solid organs. *These aërate immediately the solids, those the fluids.*

The distribution and subdivision of the tracheæ in the branchiæ of the aquatic larvæ of Insects involve the consideration of the mechanism and significance of aquatic respiration as it occurs in the young of the air-breathing Articulata. Is it *real* aquatic breathing, or is it only apparently so?

In the larvæ and pupæ of gnats, the branchiæ exist in the form of slender hair-like organs arranged in tufts. Each filament is penetrated by a single trachea and an advancing and returning current of blood. In the *Agrionidæ* (fig. 5, *a*) they assume the character of lancet-shaped processes attached to the sides of the abdomen at the points of the future spiracles. Examined carefully as transparent objects, the tracheæ of these branchiæ divide and subdivide much more elaborately than is commonly supposed (fig. 5, B, *b*). It is only the *larger* tracheæ that are accompanied by a current of blood (fig. 9, *i*, *b*, fig. 12, *e*). The latter is much *less* profusely subdivided than the former. This fact seems incontestably to prove that the tracheæ, *not* the blood-channels, extract the air from the surrounding water. In the anal branchiæ of the *Libellulidæ*, M. Léon Dufour exhibits the tracheæ (fig. 7) as terminating in *bulged* extremities (fig. 7, B, *a*). The author will only state that he has never, in the course of his numerous researches, in any instance met with this mode of termination. In the filiform branchiæ of the larva of gnats each trachea tapers to the finest extreme.

In *Pteronarcys regalis* Mr. Newport describes the branchial filaments as consisting "each of a simple, unarticulated, uniform structure, slightly tapering and closed at its extremity, and in the interior of which there is an extremely minute tracheal vessel* terminating in delicate cæca." In no one of his writings is it evident that Mr. Newport is aware to what an extreme degree of *capillary* subdivision the tracheæ are carried in the *flat branchiæ* (fig. 6, B, *c*), if not in the filiform, of the larvæ of Insects. In those of the *Agrionidæ*, cut off and examined separately under the microscope, they cannot be followed by the highest powers of the microscope. The blood-current turns back at the larger branches: it does not ramify in network streams. It is obviously not designed to fulfil the office of breathing: this function falls upon the tracheæ. This conclusion is opposed to the views of Mr. Newport. "The blood-corpuscles of the whole body circulate through the branchiæ for the purposes of respiration. The current of the blood is always in the vicinity of the tracheæ, absorbing oxygen by endosmose and giving out carbonic acid. *This takes place in every form of branchiæ* †." The author is fully satisfied that this is an erroneous interpretation of the respiratory process as it occurs in the branchiæ of Insects. The ramifications of the tracheæ in these organs are far more elaborate than Mr. Newport and other observers have ever yet supposed. They render the inference irresistible that the branchial respiration of the Insect is really atmospheric in type. The air does not, as in fish-breathing, enter immediately into the blood.

In the vessels of Insects in every phase of life, there seems to

* Linnæan Transactions, 1851. † *Op. cit.* p. 432.

be some structural peculiarity which *unfits* them for the interchange of *gases*. There resides on the contrary in the walls of the tracheæ a marvellous endosmotic property, which enables them to give passage in any direction to *gaseous* elements with extraordinary facility. There occurs then in reality no example of true branchial breathing in the larvæ of Insects. It is only the extracting of air from the water instead of directly from the atmosphere*. The aquatic life of the Insect therefore is only apparent, not real. The *principle* of the respiratory process is the same whether in or out of the water, whether in the larva or imago state, whether with internal tracheæ or external branchiæ. There is no example of *real* aquatic breathing.

What light then do these anatomical minutiæ reflect on the question which involves the *mechanism of nutrition and respiration in the tracheary Articulata*? That is the question now to be considered. It is surpassingly interesting. If the conclusions which the author is about to present should prove to be exact, the physiologist will have approached nearer to a solution of the ultimate problem of respiration. He will see this function under a new phase—under strikingly novel conditions.

In all the transparent structures of Insects, such as the wings, antennæ, branchiæ, &c., every observer may prove for himself that the blood-currents travel in the same passages as the tracheæ (fig. 10, *b*, *k*, *c*). On closer scutiny it will be seen that a channel, such as the nervure of the wings, bearing in its centre a large tracheal tube (*k*), exhibits on *one* side of this tube a current going in one direction (*b*); on the other, another bearing in an opposite course (*c*). These are afferent and efferent, arterial and venous blood-streams. They are bounded by separate walls. The afferent current is circumscribed by its own proper coats, the efferent by *its* own; and the trachea is placed intermediately, having parietes quite distinct from, though contiguous to, those of the blood-channels. This coincidence between the tracheæ and the blood-currents can be traced in the wings nowhere beyond the limits of the nervures into the scaly spaces which they circumscribe. The returning of the corpuscles at a certain point renders this fact quite unquestionable. Beyond this limit *only the fluid elements*, not the corpuscles of the blood, extend. In this extra-vascular region it is *cyclosis*, not circulation, which

* M. Léon Dufour contends for the same principle: "Le dernier terme de la composition organique serait donc ici, comme dans les branchies des Poissons, une trame *vasculaire*, en ne donnant à ce dernier mot que sa valeur rigoureusement étymologique, c'est-à-dire anatomique. Seulement dans les Poissons c'est du *sang*, et dans les Insectes de l'*air*, qui est renfermé dans les vaisseaux de cette trame." Ann. des Sc. Nat. 1852, tom. xvii.

governs the movements of the nutritive fluid. If the same passages served everywhere for the blood and for the tracheæ, and if their parallelism was unexceptional and universal, wherever the tracheæ could be seen, there also should be observed the corpuscles of the blood. This is the case only in the primary and secondary, *never* in the capillary tracheæ (fig. 11, *b*). The blood-corpuscles (fig. 10, *g*) in the Myriapod, Insect, and Arachnid exceed by several times in diameter that of the extreme capillary membranous tracheæ. It is perfectly marvellous to what inconceivable minuteness the *air*-current is reduced in travelling along these tubes. It affords a captivating example of the illimitable divisibleness of matter.

If *everywhere* the blood and the air travelled together, branched together, *capillated* in concert,—if *everywhere* a *double* blood-current to *one* air-tube could meet the eye, the inference could not be resisted, that the sole, entire and exclusive design of the tracheal apparatus of the Insect consisted in aërating *the fluids*.

Since, however, the blood *returns far before* the tracheæ reach their remote *penetralia*;—since the comitance between the blood and the air is broken abruptly at a limit *proximal* to the extremes of the organism, *it is certain* that the tracheal system in the Insect fulfils some other function—answers some other end—than that merely of aërating the *fluids*. What can be the meaning of those incomparable *pneumatic plexuses*—veritable *retia mirabilia*—which embrace immediately the *very ultimate elements* of the *solid* organs of the body;—those microscopic air-tubes, which carry oxygen *in its gaseous form*, unfluidified by any intervening liquid, to the very seats of the fixed solids which constitute the fabric of the organism? There is an immeasurable difference between oxygen dissolved and oxygen free. In the former case, all the *forces* liberated during the moment of condensation from the elastic to the fluid form are expended upon the *blood*, and that, too, remote from the scene at which that blood is to be utilized; in the latter case, free, gaseous and uncombined, it is delivered immediately at the spot where the oxygen is to be employed; it electrizes by direct combination the last sedentary elements of the organism; by such an arrangement those forces attendant on chemical action vivify undissipated the very ultimate components of the body at the very moment of their disengagement. This then is the real difference between an insect and every other living animal. This is the unequalled mechanism which renders the insect a *multum in parvo*, the unsolved riddle of creation. In *all* other animals the quickening action of oxygen is first *exclusively* exhausted upon the *fluids*; in the insect, the fluids are only partially influenced as the vitalizing element travels forwards to operate *immediately*, in its *un*exhausted form, on the final elements which conspire to maintain the nutrition of the living body.

The intense electrical and chemical effects developed by the immediate presence of oxygen, *in the gaseous form*, at the actual scene of *all* the nutritive operations of the body, fluid and solid, give to the insect its vivid and brilliant life, its matchless nervous activity, its extreme muscularity, its *voluntary* power to augment the animal heat; such contrivance, subtle and unexampled, reconciles the paradox of a being microscopic in corporeal dimensions and remarkable for the relative minuteness of the *bulk* of its blood, sustaining a frame graceful in its littleness, yet capable of prodigious mechanical results.

EXPLANATION OF PLATES IX. AND X.

PLATE IX.

Fig. 1. Plan of the central parts of the circulatory system of the Myriapod, constructed in part from Mr. Newport's figures and in part from the author's dissections: *a*, *d*, the dorsal vessel; the arrows mark the direction of the blood; *b*, the œsophageal collar; *c* & *e*, supraspinal artery; *f*, the systemic arteries (sic) of Mr. Newport.

Fig. 2. Plan of the central parts of the circulatory system of the Insect: *a*, dorsal vessel. The anterior or thoracic half is a smooth tube, the abdominal chambered by valves; *b*, the supraspinal artery, having on either side venous currents (*c*), as shown by the arrows; *d*, branches, distributive, from the supraspinal artery; *e*, large, loose-walled venous channels entering the capacious abdominal sinuses *g*, *g*; *f*, the membranous channels which pour their blood into the dorsal vessel at the auricular orifices. The blood in the dorsal vessel moves forwards, that in the supraspinal artery moves backwards.

Fig. 3. *a*, *p*, Dorsal artery; *p*, its caudal continuation; *d*, its cephalic; *b*, visceral artery, sending distributive branches (*i*) into the viscera, the blood of which is returned into the dorsal artery by *n*, *n*, the systemic arteries of Mr. Newport; *c*, the supraspinal artery, conveying blood to the nervous and integumentary structures; *e*, subspinal vein; *f*, branches going to the pneumo-branchiæ (*g*); *h*, origin of the pneumo-cardiac channels (*k*, *k*, *k*); *l*, continuation of the subspinal vein into the tail; *m*, branches communicating with the dorsal artery (*p*).

Fig. 4. Glassy, jelly-like aquatic larva of an Insect, common in the pools about Swansea: *a* (*c*), kidney-shaped tracheal vesicles, without any ramifying tubes; *b*, dorsal vessel; *d*, arrows denoting the returning into the dorsal vessel at the posterior auricles (*b*).

Fig. 5. Aquatic larva of *Sialis Lutarius*: *a*, branchial appendages; B, one of the branchiæ enlarged; *b*, tracheæ; *c*, cell-tissue.

Fig. 6. Aquatic larva of one of the *Libellulidæ*: *a*, branchial appendages; B, the same further enlarged; *b*, trachea; *c*, secondary arborescent branches; C, extreme end of one of the tracheal branches traced under a high power to its membranous capillary termination *f*, *g*.

PLATE X.

Fig. 7. Rectal branchiæ of *Æshna grandis*, after M. Léon Dufour: C, *a*, orifices in the rectum of the branchial folds (A); *a*, dilated extremities of the tracheæ.

Fig. 8. Head, tail, digestive system (*d*), tracheal (*h*) and branchial (*g*) systems, hepatic vessel (*e*), of *Agrion Puella*, after M. Dufour.

Fig. 9. A small piece from the parietes of the intestine of the Cockroach, showing the extreme distribution of the trachea (*a*). The blood-current accompanies the tube only as far as *i*. The trachea then describes a true network (*e*, *c*, *d*) of *membranous* tubes. In the meshes the glandular cells (*f*, *g*) are placed. A clear space intervenes between the trachea and glandular cells in which the nutritive fluids, without the corpuscles, may probably move.

Fig. 10. A small piece of the wing of the Cricket drawn under a high power: *a*, a large trachea in the centre of the nervure or channel, surrounded by two opposed currents of blood (*b*, *c*); *i*, larger branches; *d*, *e*, *f*, small terminal tracheæ, entering alone, *without* coincident, blood-currents into the *scaly* interval; *j*, long, slender, wavy tracheæ floating in the fluid; *g*, blood-corpuscles, travelling in the channel *b*.

Fig. 11. One of the tracheæ from the scaly intervals between the nervures of the wing of the Cricket, showing the mode in which it terminates (*b*) between the scales *d*.

Fig. 12. A minute portion of walls of the stomach of the Cockroach, showing the wavy manner (*c*, *f*) in which the *membranous* capillary tracheæ are distributed around and between the ultimate glandular elements; at *e*, the current of the blood, as traced through the blood-corpuscles, turns back: *a*, large spiral tracheæ.

Fig. 13. A small portion of a spiral trachea, exhibiting the coats under the action of acetic acid: *a*, outer coat raised, indented like the spiral (*b*); *c*, the internal or mucous coat.

Fig. 14. A piece of voluntary muscle, representing the manner in which the tracheæ enter the substance of the muscle.

Fig. 15. One of the above tracheæ traced *into* the substance of the muscle; *a*, *b*, *c*, network of ultimate membranous tracheæ as they are distributed between the ultimate muscle-fibres—the latter being omitted.

[To be continued.]

XIX.—*Description of a new genus and species of Seal* (Heliophoca Atlantica) *from Madeira*. By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

Some months ago Mr. MacAndrew most kindly procured for me the skin of a Seal from the island of Madeira. A careful examination of it convinced me that it was a new species, most allied to *Phoca barbata* of the North Sea, but yet quite distinct from it. Mr. MacAndrew after considerable trouble at length obtained for me another skin of an older animal with its skull, which proves that it is not only a new species, but presents a new combination of characters such as I believe entitle it to be considered a new genus. It is the only species of Seal which I believe has yet been found so near the tropic on the African coast.

Both the specimens in the Museum came from the same cave in the *Deserta Grande Island*; the larger skin is full-grown, the other younger. Knight, in his 'Once on a Time,' speaks of the seals as common near Funchal; he observes, "A multitude of seals rush out from that hollow with a sudden cry and plunge into the waves; that point shall be *Camara das Lobos*, the cave of seals." (i. 60.)

Mr. MacAndrew observes, that there is an island called *Isle Lobos* near the Canaries, on account of the number of seals formerly found there. It is very difficult of access, and Mr. MacAndrew could not hear of any existing there now, nor of any remains of them.

The following are the characters of the genus :—

Heliophoca.

Muzzle rather elongate, broad, hairy, with a slight groove between the nostrils; whiskers small, quite smooth, flat, tapering. Fore-feet short; fingers gradually shorter to the inner one; claws 5, flat, truncate. Hind-feet hairy between the toes; claws very small; hair short, adpressed, with very little or no under fur. *Skull* depressed; nose rather depressed, rather elongate, longer than the length of the zygomatic arch; palate angularly notched behind. Cutting teeth $\frac{6}{4}$, large, notched within, the middle upper much smaller, placed behind the intermediate ones. Canines large, conical, sharp-edged. Grinders $\frac{5 \cdot 5}{5 \cdot 5}$, large, crowded, placed obliquely with regard to the central palatine line, crown large, conical, with several small conic rhombic tubercles. Lower jaw angulated in front below with diverging branches, the lower edge of the branches rounded, simple.

The feet, palate and teeth resemble those of the genus *Callocephalus* (*communis*), but the grinders are larger and less deeply lobed; but it has the smooth whiskers of the restricted genus *Phoca* (*P. barbata*). It differs from the latter genus in the depressed form of the skull, the large tubercular grinders, and the angular termination to the palate.

As the other subtropical Seal, *Phoca tropicalis* (Gray, Cat. Seals B.M. 28), from Jamaica, described from an imperfect skin without a skull, has similar small smooth whiskers, it may very probably when its skull has been examined belong to this genus, and the genus thus prove a subtropical form of the family.

Heliophoca Atlantica.

Fur short, adpressed, olive-gray, very obscurely grisled at the tips of the hairs. Chin and under parts of the body rather paler.

Length 5 feet 5 inches.

Hab. Madeira. R. MacAndrew, F.R.S. &c.

While on the subject of Seals, I may draw the attention of naturalists on the coast of the Pacific to the account of the *Sea Horses* said to be found in abundance on the seaward part of the island of St. Lorenza near Callao, mentioned in M. Bonelli's Travels in Bolivia, i. 90 & 128.

I have never heard of that genus living out of the Arctic Ocean, and should have believed that the author had mistaken the *Sea Bear* (*Otaria Leonina*) for the *Sea Horse*, if he did not describe "the two great white tusks projecting from the mouth on either side," and further observe, that "the tusks are of great value and form an important article of commerce" (see i. 90), which cannot apply to the tusks of the Sea Bear.

It is to be observed that the Peruvian continuation of the Antarctic current runs up the shores of Chili and Peru (see Journ. Roy. Geog. Soc. 1853) and chills that coast. This may explain why seals are found so near the tropics in those seas. I fear that M. Bonelli is not to be relied on for his natural-history observations, for he states that the cedar, mahogany and banyan tree (i. 79), and the date-palm (i. 146) grow on the coast of Peru.

XX.—*Monograph of the British* Graphideæ.

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

[Continued from p. 97.]

8. *Opegrapha Turneri.* Thallus very thin, pale dirty-yellow, bordered with black; lirellæ very prominent, sessile, mostly simple, slender and linear; disk very narrow, uniform; proper margins plump, rounded and incurved; sporidia in asci, eight, linear-obovate, 3-septate, pale yellow.

Opegrapha betulina, Sm. E. Bot. t. 2281. excl. syn. (1811) (good, the magnified figure excellent); Hook. Br. Fl. 2. 145. excl. syn.

On birch. Hurst Pierpoint, Sussex! Bradwell! Burgh! Suffolk! *Mr. Borrer.* New Forest, Hants! *Mr. Lyell in herb. Borrer.* Ireland! *Miss Hutchins in herb. Borrer.* Loppington! Shropshire.

Thallus very thin, membranous, pale dirty-yellow, more or less shining, in small patches with a pale margin, or where in contact with other plants throwing up a narrow brown watery line or margin. *Lirellæ* scattered, more or less numerous, somewhat inclining to a parallel arrangement, but very irregular and variable in this respect, peculiarly prominent, lying on the surface of the thallus, often apparently without any visible connexion, variable in length, but never very long, simple, seldom branched, straightish, or slightly curved and waved, very slender and narrow, of the same width throughout though tapering at the extremities, which are obtuse or slightly pointed, of a full shining black, more or less sprinkled with dingy yellow powder, which is not unfrequently altogether absent. *Disk* a narrow chink, uniform in its width throughout, in older states expanding, particularly in the middle. *Proper margins* peculiarly plump, rounded and incurved, uniformly parallel, in an older state becoming more erect and narrower, and wavy or crisped around the flattened expanded disk.

The thin membrane of the thallus is sometimes very slightly raised here and there around the very base of the lirellæ, but scarcely to be noticed without a lens, certainly not in the decided manner so as to form a considerable thallodal margin as represented in Persoon's figure of his *betuligna* in Ust. Ann. Bot. st. 7. p. 31. t. 3. f. 5. A. *a*. Without the comparison of an authentic specimen we ought to hesitate to consider it identical. Our plant is a true *Opegrapha*, whilst the *Graphis betuligna* of Acharius is from his description as certainly a true *Graphis*. Moreover he questions whether his plant may not be regarded as a variety of *Graphis scripta*, with which ours has not one feature in common.

I greatly doubt whether this is anything more than a state of *Opegrapha rimalis*, Ach.

PLATE V. fig. 10. *a, a*, Vertical sections of thallus and lirellæ; *b*, sporidium: all magnified.

9. *Opegrapha atra*, Pers. Thallus very thin, forming smooth, pale yellow or whitish ocellate patches; lirellæ densely crowded towards the centre of the thallodal spot, sessile, depressed, lying in all directions or subparallel, linear, generally simple or confluent, flexuose; disk narrow, uniform; proper margins thick, elevated, wavy; sporidia in asci, eight? very minute, obovate, somewhat pointed at the extremities, 3-septate, pale yellow.

Lichen scriptus, Hoffm. Enum. p. 12. t. 3. f. 2. *c* (1784).
Opegrapha atra, Pers. in Ust. Ann. Bot. st. 7. p. 30. t. 1. f. 2. C. *c*. (1794); DeCand. Fl. Franç. 2. 310. n. 840; Chev. Hist. Graphid. p. 21. t. 3. f. 1, 2; Johnst! Fl. Berw. 2. 100; Hook. Br. Fl. 2. 145 (in part).
—— *atra*, *α*. *denigrata*, Schær. Spicil. 48. 324 (1823–1836); Enum. 153; Exsicc. 461!

Opegrapha atra, a. *stenocarpa* (in part), Fries, L. Ref. 367 (1831); Summa Fl. Scand. 118.
—— *atra*, *β. syngrapta*, Wallr. Crypt. Germ. 1. 326 (1831).
Lichen denigrata, Ach. Prodr. 24 (1798).
Opegrapha denigrata, Ach. Meth. 27 (1803); Sm. E. Bot. 1753. (The upper left-hand figure may perhaps belong to this, but the other figures are doubtful having a black marginal line, and one of the magnified sections having the structure of a *Graphis*, the other of an *Opegrapha*.) Mart. Fl. Erlang. 280; Wahl. Fl. Suec. 860; Fingerhuth, Fl. Eiffl. 23.
—— *denigrata*, *α. & β. atra*, Ach. L. Univ. 259 (1810); Moug. & Nestl. Stirpes, 469!
—— *stenocarpa*, *β. denigrata*, Ach. Syn. 75 (1814).
"—— *reticulata*, DeCand. Fl. Franç. 6. 170" (1815), fide Schær.; Chev. Hist. Graphid. 28. t. 5. f. 1, 2, 3, 4. *a*.
—— *prominula*, Chev. Hist. Graphid. 31. t. 6. f. 2, 3, 4 (1824).
—— *implexa*, Chev. Hist. Graphid. 34. t. 7. f. 1, 2 (1824).
Graphis macularis, Mart. Fl. Brasil. 1. 85 (1833), in part.

On ash, oak, ivy, hazel, currant. Sussex! *Mr. Borrer*. Netley Abbey, Hants! (on ivy and mortar!), *Mr. Lyell in herb. Borrer*. (On currant), Henfield! Sussex, *Mr. Borrer*. Knocknagoney!; Colin Glen! Belfast; Massareene Park, Co. Antrim! *Mr. Wm. Thompson*. Near Edinburgh! *Dr. R. K. Greville*. Gopsall Wood, Leicestershire! *Rev. A. Bloxam*. Chelmsford, Essex! *Mr. H. Piggot*. Yorkshire! *Mr. G. Dixon*. Castle Bernard Park, Bandon, Ireland! *Rev. Prof. Hincks*. Fermoy, Ireland! *Mr. T. Chandler*. Berwick-upon-Tweed! *Dr. G. Johnston*. Shropshire generally!

Thallus forming pale roundish or oblong irregular spots or patches of about half an inch or more in diameter, on the smooth bark of trees, not bounded by any brown or black line or margin, but fading away in a watery manner ("crusta determinata sed non limitata," Ach. L. Univ. 260), thin, membranous, continuous, smooth, very slightly tartareous; in colour generally pale dirty-yellow or olive, not unfrequently also of a pure white, and then decidedly pulverulent. *Lirellæ* very numerous and crowded, densely congregated towards the centre of the thallodal spot, so as to appear at a little distance almost one black mass, more scattered and often smaller in size towards the circumference, prominent but at the same time depressed so as to form a uniform level surface, sessile, immersed only and slightly at the base, somewhat shining, of a full black, lying in all directions and positions, curved and flexuose; on some barks however becoming more or less parallel to each other, moderate in length, linear, and of nearly the same width throughout, more or less obtuse at the extremities, though sometimes slightly tapered there, generally simple, but by confluence and lying over one another divided. *Disk* narrow, uniform, rimæform, in age more open and canaliculate, surrounded by the elevated, thick, uniform or wavy proper margins.

Owing to the great thickness of the substance of the lirella compared with the small lamina proligera, the sporidia have been seen with difficulty and with some uncertainty. They are very minute, and as represented in

PLATE V. fig. 11. *a*, Vertical section of thallus and lirellæ; *b*, sporidia.

10. *Opegrapha herpetica*, Ach. Thallus thin, subtartareous, more or less cracked or slightly rugged, dusky olive, limited; lirellæ small, innate, round, oval, oblong or linear-oblong, obtuse, simple and divided, straight or curved; disk rimæform, expanded in age; proper margins thick, rounded and inflexed; sporidia in asci, eight, fusiform, 3-septate, pale yellow.

α. vera. Thallus tuberculate, pulverulent; lirellæ imbedded, small, simple, naked.

Lichen herpeticus, Ach. Prodr. 20 (1798), sec. specim. ab Achario seipso in herb. Borrer!
Opegrapha herpetica, Ach. Meth. 23 (1803); Sm. E. Bot. t. 1789?; Cheval. Graph. 82. t. 19. fig. 1. *α. brunnea*, 2, and *ε. linearis*, 6 *b*; Heppe, Fl. Wurzburg. 73 (excellent); Fingerh. Tent. Fl. Lich. Eiffl. 21; Fries, L. Ref. 368 (in part, excl. syn.); Tuckermann, Lich. N. Amer. 75 (in part).
—— *herpetica α*, Ach. L. Univ. 248 (1810); Syn. 72.
—— *herpetica*, *γ. fuscata*, Schær. Enum. 156 (1850).
—— *rimalis*, *β. fuscata*, Ach. L. Univ. 261 (1810).
—— *rubella*, Sm. E. Bot. t. 2347 (good), excl. syn. (1811); Hook. Br. Fl. 2. 144. excl. all the syn. (except E. Bot. 2347), which belong to our *δ. rubella*.
—— *rufescens*, Hook. Br. Fl. 2. 144. in part (excl. syn.).
—— *rufescens*, *γ. fuscata*, Schær. Spic. 327 (1836).
—— *atra*, *β. siderella*, Fries, L. Ref. 368 (1831), apparently from the synonyms and specimen quoted, in part.
Graphis herpetica, Mart. Fl. Brasil. 1. 88 (1833).

On oak, ash, and beech. Bradwell, Suffolk! *Mr. Borrer.* Twycross, Leicestershire! *Rev. A. Bloxam.* Lasswade! and near Dundee! *Dr. Greville.* Oxfordshire! *Mr. Baxter in herb. Dr. Greville.* Orton Wood near Twycross, Leicestershire! *Rev. A. Bloxam.* Chelmsford, Essex! *Mr. H. Piggot.* Charnwood Forest! *Rev. A. Bloxam.* Haughmond Hill, Shropshire!

Thallus thin, subtartareous, somewhat pulverulent, coarsely cracked, of a dark dusky olive, forming irregular patches limited by a thickened brown wavy line or margin. *Lirellæ* numerous, congregated close together but distinct, not crowded, immersed, and imbedded in the thallus, and only slightly raised, small but very variable in size and shape, roundish, oval, oblong, linear-oblong, obtuse at the extremities, simple, straight, sometimes slightly curved. *Proper margins* thick, rounded and inflexed, encompassing a narrow rimæform disk, which however varies in its expansion, apparently according to age. *Sporidia* the same in all the varieties, eight in asci, fusiform, 3-septate, pale yellow, easily separable from the ascus, straight when seen on their back or front, curved when lying on their sides. Fries's remark (*l. c.*) respecting the thallus is admirably characteristic: "Crusta vera sub epidermide latens albissima, mox vero in verrucis granulosis albis erumpentibus collecta, unde crusta extus albo-guttata. In minus evolutis speciminibus tamen lævigata est." According to the specimens in herb. Borrer ! ! ! "*Op. rubella* and *rufescens*, Brit. Fl." are confounded together, and are distributed into this and the following varieties. The sporidia in Schærer's *Opeg. herpetica, α. rubella,* Enum. 155, Exs. 95 ! and *δ. subocellata,* Exs. 281 ! are identical with those of our plants; but his *var. β. siderella,* Exs. 96 ! is a distinct species having sporidia elongato-fusiform, 13-septate.

PLATE V. fig. 12. *a*, Vertical section of thallus and lirella; *b*, sporidia—all magnified.

β. subocellata, Ach. Thallus tuberculate, pulverulent; lirellæ imbedded, ocellate.

Opegrapha siderella, β. ænea, Ach. Meth. 26 (1803), sec. specim. ab Achario seipso in herb. Borrer !
—— *rubella, δ. ænea,* Ach. L. Univ. 250 (1810).
—— *rubella, ε. subocellata,* Ach. L. Univ. 250 (1810).
—— *herpetica, γ. subocellata,* Ach. Syn. 73 (1814).
—— *subocellata,* Heppe, Fl. Wurzburg. 73 (1814) (excellent); Fingerh. Tent. Fl. Lich. Eiffl. 22 (1829).
—— *herpetica,* Fries, L. Reform. 368. in part (1831); Tuckermann, N. Amer. Lich. 75 (in part).

a. *simplex.* Lirellæ small, simple. *Opegrapha subocellata, γ. ænea,* Cheval. Hist. Graphid. 82. t. 19. f. 4, as to colour and general appearance; *α. brunnea,* fig. 1 *a,* as to detail.

On ash and willow trees. Hurst, Cuckfield and Ardingley, Sussex ! *Mr. Borrer.* Bovingar, Essex ! *Mr. Lyell in herb. Borrer.* Near Thirsk, Yorkshire ! *Mr. J. G. Baker.*

Thallus thin, subtartareous, somewhat pulverulent, continuous, scarcely if at all cracked, rough or rugose, with innumerable minute raised irregularly-shaped pale-coloured or whitish elevations or projections, pale dirty tawny olive, raised around the lirellæ into a sort of spurious thallodal margin, narrow, whitish and pulverulent, forming extensive patches either limited by a brown wavy margin, or diffuse and without such being visible. *Lirellæ* simple, of the same size, shape and number, and immersed, as in the last.

b. *divisa.* Lirellæ larger, substellate. *Opegrapha subocellata, β. grisea,* Cheval. Hist. Graphid. 82. t. 19. f. 3.

On ash trees. Hurst, Sussex ! *Mr. Borrer.*

Similar to the last, but the immersed lirellæ are larger and longer, confluent into irregular substellate figures, with simple ones interspersed, all surrounded with the peculiar whitish spurious thallodal margin.

γ. *elegans*, Borrer MSS. Thallus pulverulent; lirellæ larger, simple and divided, prominent, wavy.

On ash trees. Ardingley, Sussex! *Mr. Borrer.*

Thallus subtartareous, pulverulent, cracked, uneven but not so rugged as in the preceding varieties, of a pale tawny hue, spreading in extensive patches. *Lirellæ* very numerous, more prominent, without the ocellate border, which however is occasionally seen imperfectly at the very base, longer and larger, linear, variable in size and length, simple or branched, elegantly curved and wavy. *Disk* variable in expansion, but generally broader, the proper margin, though still thick and rounded, frequently more erect and visible.

δ. *rubella*. Thallus smooth; lirellæ prominent, immersed only at the base.

"*Opegrapha rubella*, Pers. Ust. Ann. Bot. st. 7. t. 1. f. 2. A. *a.*" (fide Ach.); Schrader, Spicil. 77; Heppe, Fl. Wurzburg. 73 (excellent); Fingerh. Fl. Eiffl. 22.
—— *rubella α*, Ach. Meth. 21 (1803); L. Univ. 249.
Lichen rubellus, Ach. Prodr. 22 (1798).
Opegrapha herpetica, β. disparata, Ach. Syn. 73 (1814), sec. specim. a Schærero in herb. Borrer!
—— *rufescens, α. rubella*, Schær. Spicil. 50. 327 (1836); Exs. 95!
—— *atra, β. siderella*, Fries, L. Reform. 368. in part, according to the synonyms and Schær. Spec. Exs. 95. quoted (1831).
—— *herpetica, α. rubella*, Schær. Enum. 155 (1850).
"—— *rufescens*, Pers.," Bohler's Lich. Brit. no. 74.

a. *simplex*. Lirellæ simple. *Opegrapha rubella*, Cheval. Hist. Graphid. p. 74. t. 17. fig. 1 *a*; *β. decorticata*, 74. t. 17. f. 2; *δ. albicans*, 75. t. 17. f. 4.

On ash trees. St. Leonard's Forest and Charlton Forest, Sussex! *Mr. Borrer.* Berrow, south end of Malvern Hills, Worcestershire! *Mr. E. Lees.* Yorkshire! *Mr. G. Dixon.*

b. *divisa*. Lirellæ substellate. *Opegrapha rubida*, Cheval. Hist. Graphid. 80. t. 18. f. 1 *a*, f. 2 *b*. *Opegrapha crucianella*, 80. t. 18. f. 3 *c*.

On ash and birch trees. Sussex! *Mr. Borrer.* Gopsall Wood, Leicestershire! *Rev. A. Bloxam.*

Thallus thin, membranous, smooth, continuous, somewhat shining, of a dark dingy olive, forming irregular patches bounded by a thickened wavy brown margin. *Lirellæ* scattered, prominent, immersed only at the very base, linear, moderately long, variable in size and shape, simple or branched in an irregular substellate manner. *Proper margins* rounded, thickened and inflexed, enclosing the *disk*, which is variable in its expansion, either rimæform or broader and canaliculate.

11. *Opegrapha vulgata*, Ach. Thallus effuse, cartilagineo-membranaceous, cracked and scaly, greenish white; lirellæ prominent and sessile, variable in size, shorter ones roundish or oblong, longer ones slender and linear, simple, wavy and shining or greasy; disk rimæform, uniform; proper margins thick, very round and inflexed; sporidia in asci, eight, fusiform, 5-septate, pale yellow.

α. vulgata. Lirellæ small, numerous, but regularly scattered; disk rimæform, more or less expanded.

Lichen vulgatus, Ach. Prodr. 21 (excl. syn.) (1798).
Opegrapha vulgata, Ach. Meth. 20 (1803); L. Univ. 255; Syn. 73 (secundum specimina Cel. Swartzii "cum Achario seipso collecta" in herb. Borrer!; Sm. E. Bot. t. 1811; Mart. Fl. Erlang. 279; Hook. Fl. Scot. 2. 43, Brit. Fl. 2. 145; Grev. Fl. Edin. 352; Chevallier, Graphid. 32. t. 6. f. 5 *c*; Wahl. Fl. Suec. 860; Fingerh. Fl. Eiffl. 22; Tayl. Fl. Hib. 2. 106; Bohler, Lich. Brit. no. 127!
Graphis atra (in part), Meyer in Spreng. Syst. Veg. 4. 1. 251 (1827).
Opegrapha notha, Johnst.! Fl. Berw. 2. 100 (1831).
—— *atra, ζ. vulgata*, Schær. Spicil. 325 (1836); Enum. 154; Exsic. 516!
—— *atra*, a. *stenocarpa* (in part), Fries, L. Ref. 367 (1831); Summa V. S. 118; Tuckermann, N. Amer. Lich. 75.
Graphis vulgata, β. periblastetica, Wallr. Crypt. Germ. 327 (1831).

On fir, ash, beech, apple, holly. Hurst and St. Leonard's Forest, Sussex! *Mr. Borrer*. Lasswade! and near Edinburgh! *Dr. Greville*. Malvern Hills, Worcestershire! *Mr. E. Lees*. Portslade, Sussex! *Mr. Borrer*. Berwick-on-Tweed! *Dr. G. Johnston*. Haughmond Hill, Shropshire! near Shrewsbury! Pen Maen Mawr, Caernarvonshire!

Thallus effuse, thin, membranous, cracked and scaly, subpulverulent and scurfy, of a pale dirty white tinged slightly with green, sometimes quite smooth and continuous; and in other specimens white, canescent, entirely pulverulent. *Lirellæ* numerous but regularly scattered, sessile and prominent, variable in size, though chiefly small and short, roundish, oblong and linear, of a plump turgid appearance, black and shining, straight or curved. Not unfrequently there are longer lirellæ intermixed and approaching in size and flexuosity to those of *stenocarpa*, so that it is difficult to say to which variety such specimens should be correctly referred. On these specimens, and more especially in the variety *stenocarpa*, the lirellæ are exceedingly similar in appearance to those of *Opeg. Chevallieri. Disk* in a perfect state a mere chink, uniform in width throughout, in an older state becoming wider, more open and expanded. *Proper margins* very round, thick, plump and inflexed.

PLATE V. fig. 13. *a*, Vertical section of thallus and lirellæ; *b*, sporidia.

β. stenocarpa. Lirellæ long, slender and wavy, densely crowded; disk rimæform, very narrow, closed.

Opegrapha stenocarpa α, Ach. L. Univ. 257 (1810); Syn. 75; Chevallier, Graphid. 37. t. 7. f. 5 *c*; Heppe, Fl. Wurzburg. 74; Fingerh. Fl. Eiffl. 23.
—— *atra, β. stenocarpa*, Schær. Spicil. 48. 324 (1823–1836); Enum. 153; Exsicc. 93! (in part); Fries, L. Ref. 367; Summa V. S. 118; Tuckermann, North. Lich. 75.
—— *atra, γ. gyrograpta*, Wallr. Crypt. Germ. 326 (1831).
—— *rimicola*, Cheval. Graphid. 41. t. 9. f. 1 (1824).
Graphis stenocarpa, Meyer in Spreng. Syst. Veg. 4. 1. 250 (1827).

On oak, beech, elm. Sussex! *Mr. Borrer.* New Forest, Hants! *Mr. Lyell in herb. Borrer.* Lasswade! *Dr. Greville.* Twycross, Leicestershire! *Rev. A. Bloxam.* Near Cork, Ireland! *Mr. I. Carroll.* Near Shrewsbury! Gloddaeth, Caernarvonshire!

Thallus effuse, thin, membranous, somewhat scaly or scurfy, continuous, pale dirty yellow, scarcely if at all cracked, though in old specimens very considerably cracked, and of a scurfy pulverulent appearance. *Lirellæ* very numerous and crowded, nevertheless quite distinct, forming a sort of black netlike work over the thallus, sessile, prominent, variable in size, the smaller ones short and oblong, the larger ones more considerable in number and frequently no others are present, very long and slender, narrow, linear, curved, flexuose, and wavy in all degrees and directions, of nearly the same width throughout but narrower at the extremities, of a full black, more or less shining, often with a greasy aspect. *Disk* a very narrow chink of the same uniform width throughout, even in old age when it becomes a little more open. *Proper margins* very thick in proportion to the disk, rounded, prominent, and inflexed.

There are specimens in which the transition between the varieties *vulgata* and *stenocarpa* are clearly traceable.

PLATE V. fig. 13. *a* 1, Vertical section of thallus and lirellæ; *b*, sporidia.

12. *Opegrapha siderella*, Ach.? Thallus thin, subtartareous, cracked, pale dusky yellow, limited; lirellæ small, innate, various in size, rounded, oblong or linear, straight or curved, chiefly simple; disk rimæform, uniform; proper margins rounded and

inflexed; sporidia in asci, eight, elongato-fusiform or aciculate, 13-septate, pale yellow.

Lichen siderellus, Ach. Prod. 24? excl. syn. (1798).
Opegrapha siderella, Ach. Meth. 25? (1803); Syn. 79?
—— *siderella* α. & β, Ach. L. Univ. 256?
—— *rubella*, Moug. & Nestl. Stirpes, 648! (1820).
—— *rufescens*, β. *siderella*, Schærer, Spicil. 50. 327 (1823–1836); Enum. 155; Exsicc. 96!
—— *rufescens*, Hook. Br. Fl. 2. 144 (excl. syn. *O. phæa* and *O. herpetica*, and E. Bot.) in part (1833).
—— *atra*, β. *siderella*, Fries, L. Reform. 368. in part (1836).

On beech in New Forest, Hants! *Mr. Lyell in herb. Borrer* (a single specimen).

Thallus thin, subtartareous, cracked, somewhat pulverulent and leprose, forming irregular patches of greater or smaller extent, with a wavy margin but not bounded by any line, of a pale dusky dirty yellow. *Lirellæ* numerous, pretty regularly scattered over the whole thallus, minute, innate or immersed at the base, the upper half only prominent, very various in size, punctiform, rounded, subtriquetrous, oblong or linear, straight or crowded, simple or sometimes with a short branch, very plump in general appearance and obtuse at the extremities, dull black, somewhat greasy-looking. *Proper margins* rounded and inflexed. *Disk* a mere chink, uniform in width throughout or more open in age.

Our plant and Schærer's are identical, but I doubt whether they be the same as Acharius's plant, judging from the description, which states the lirellæ to be stellate, and also from his reference to Persoon's figure, and it is almost impossible to decide without comparison with an authentic Acharian specimen. If it should prove to be really different from the *siderella* of Acharius, then it is a "nova species," and will appropriately be named *Opegrapha Schæreri*.

The appearance of this plant at first sight is a good deal like that of *O. herpetica*, but the sporidia keep them distinct.

Plate VI. fig. 14. *a*, Vertical section of thallus and lirella; *b*, sporidium.

13. *Opegrapha taxicola*. Thallus very thin, tartareous, pulverulent, cracked, pale yellowish gray, effuse; lirellæ large, excessively prominent and sessile, oblong, linear or linear-elongate, straight or curved, chiefly simple; disk broadly rimæform; proper margins rounded and inflexed, rugged; sporidia in asci, eight, elongato-fusiform or acicular, 13-septate, pale yellow.

On yew. Funtington churchyard! Hunston churchyard! and Aldingbourne churchyard! Sussex, *Mr. Borrer*.

Thallus effuse, very thin, tartareous, somewhat pulverulent, partially cracked where it is thicker in substance amidst the groups of lirellæ, where and around the very bases of the lirellæ it is chiefly to be distinguished; in other and opener portions being only a pulverulent film, of a very pale yellowish gray. *Lirellæ* numerous, scattered and diffuse, or closely congregated in larger or smaller groups, excessively prominent and sessile, of a dull black colour, more or less sprinkled with the powder of the thallus, lying in all directions, straight or variously curved, chiefly simple, but here and there with a simple branch, variable in size, oblong or linear, or linear-elongate, of the same width throughout, obtuse at the extremities, very plump in appearance from the rounded inflexed *proper margins*, which are rugged and broken. *Disk* of the same width throughout, distinctly and broadly rimæform.

The size, appearance and habit of the denuded lirellæ induce me to present this as a new species, though doubtfully, for the sporidia would lead me to regard it as a variety of *siderella*. The denuded state of the thallus may arise from local circumstances connected with the nature of the matrix, and the otherwise immersed lirellæ be thus rendered accidentally prominent. Nor is the difference in size of the lirellæ between this and the preceding greater than prevails in other species, *e. gr. O. rupestris* and *O. varia*.

PLATE VI. fig. 15. *c*, Plant, nat. size; *a*, vertical section of thallus and lirella; *b*, sporidium.

14. *Opegrapha lentiginosa*, Lyell MS. Thallus thin, tartareous, smooth, cream-coloured, limited; lirellæ excessively prominent and sessile, very minute, punctiform, oblong or linear, straight, simple; disk a mere chink; proper margins tumid and incurved; sporidia in asci, eight, irregularly obovate, uniseptate, pale brown.

On beech and holly in New Forest, Hants! *Mr. Lyell in herb. Borrer*. On beech in St. Leonard's Forest, Sussex, sparingly! *Mr. Borrer*.

Thallus thin, tartareous, continuous, even and smooth, here and there slightly and delicately cracked, cream-coloured, forming irregularly rounded or oblong or more extended patches, one or two inches in size, bounded by a tolerably broad, irregular, wavy, brownish-black margin. *Lirellæ* numerous and very minute, appearing to the naked eye as mere black specks, under a lens like a multitude of minute black grains of wheat scattered over the thallus and lying in all directions, either singly or confluent and crowded, variable in size, the smaller or younger ones punctiform and more or less imbedded in the thallus, the larger and perfect ones of a narrow linear-oblong form, slightly tapered towards each extremity, which is rounded, very prominent and sessile and plump in appearance. *Proper margins* full, rounded and incurved. *Disk* a mere chink. The sporidia are very singular and different from any other known British species.

Plate VI. fig. 16. *c*, Plant, nat. size; *d*, vertical section of thallus and lirella; *b*, sporidia.

Opegrapha macularis, Ach., and *O. epiphega*, Ach. & E. Bot., seem to be merely states of the same plant. Their structure will be seen from our Plate VIII. fig. 34, which consists of a black carbonaceous perithecium (*a*) which bursts at intervals through the epidermis of the bark, and finally when the whole epidermis is thrown off by it is found to be continuous. It is raised and elevated here and there over the nucleus, and at those points has frequently a longitudinal depression like the rimæform disk of an *Opegrapha* or *Hysterium*. The base of the nucleus is quite naked or destitute of perithecium. The nucleus consists of pale hyaline oblong sporidia (*b*) of considerable size, margined and elevated on simple pedicels, with others of various sizes in different stages of maturity. This structure clearly distinguishes it from *Opegrapha*, and refers it to the genus *Hysterium*, subgenus *Dichæna* of the Fungi.

[To be continued.]

XXI.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, F.Z.S., C.M.E.S.

[Continued from p. 131.]

146. *Zoothera* (n. s.?) *imbricata*, Layard.

Among the birds received from Mr. Thwaites is one which I cannot identify with any Indian species, and which may perhaps prove new. I have therefore provisionally named it *imbricata* from its scaled appearance.

Length about 9 inches; of closed wing $4\frac{3}{4}$ in.; tail 3 in.; bill to end of gape $1\frac{1}{4}$ in.; tarsi $1\frac{1}{12}$ in.

General colour of back and upper tail-coverts darkish olive-brown, darker on the head; each feather pales off to the edge, where a black border one line in breadth succeeds. Tail-feathers wholly brown, shafts black. Shafts of wing-feathers dark brown, outer webs reddish brown, inner webs dark brown. On the breast the same style of marking prevails, the colours being pale rufous yellow darkening into deep rufous with very dark brown edge. Vent and under tail-coverts rufous. Bill corneous. Legs brown.

I am indebted to the kindness of the Zoological officers of the British Museum for the opportunity of examining and describing this and other species.

147. Cissa puella, Blyth & Layard, J. A. S. xviii. *Kahibella,* Cing.

This, the most lovely of all our Ceylon birds, was discovered by me along the course of a mountain stream in the jungle near Ambegamoa, and described by Mr. Blyth, *loc. cit.* Dr. Kelaart writes that it is "common in Nuwera Elia, and frequents the fields there, generally in small flocks, in search of worms." In such situations I never saw it; all I have noticed were in the most dense and lonely jungles. The last I procured fell a victim to that curiosity so characteristic of all the jays. I was creeping through some thick jungle to get a shot at a large wood-pigeon, when the Cissa flew down from some lofty trees, and coming close to me peered into my face. It came so near that I refrained from firing, lest I should blow it to pieces; neither did I wish to frighten it, lest I should drive it away altogether; I therefore waited till the bird had leisurely surveyed me and flown to a little distance, still watching my movements. This enabled me to shoot it.

Nothing can exceed the beauty of this bird when in full plumage, and with the cere of the eyes and legs still fresh; the contrast between the blue of the former and the crimson of the latter being very striking. It has a loud harsh note, not unlike that of the European jay.

Mr. Thwaites has forwarded several specimens procured in the central province.

148. Corvus culminatus, Sykes. *Andang,* Mal.; lit. Grave Crow. *Goyegamma-caca,* Cing.; lit. High-caste, or Vellally Crow.

The carrion crow is everywhere common in Ceylon, being found inland as well as on the sea-coast, the great resort of the next species. It is found in the deep forests where *C. splendens* never appears, and such is its acuteness of sight and scent, that though the wounded deer may retire to the most tangled brake to die, its covert is invariably revealed to the hunter by these crows, who, congregating in small parties on the surrounding trees, patiently wait till life is extinct to begin their repast in company with the jackals and wild hogs.

As soon as the carrion crow detects an animal lying on the ground, it utters a curious soft modulated "caw," wheeling in circles round the object of its curiosity, beating the air with heavy strokes, and then joining the wings over the back, it sails down and alights within a few feet of its hoped-for prey. These motions are known and understood by all the crows in the vicinity, who immediately flock to the expected banquet. One bolder than the rest now approaches and hops upon the animal's body: as this is not an unusual practice with them whilst searching for ticks, the animal lies still, till the crow peers into its eyes, when, should it be in a state to defend itself, a shake of the head rids it of its dangerous friend, who then, instead of feasting on its eyeballs, performs the grateful office of ridding it of its vermin. Far different, however, is the fate of the wretched animal dying of disease or of the deadly rifle-ball; full well the carrion crow knows the dim eye over which the shadows of death are stealing, and, like the wretches who rob the dying on the field of battle, he hastens its last moments. Plunging its powerful bill into the eyeball of his victim, it tugs at it, despite the feeble struggles which oppose it, and is soon joined by its now bolder companions, some pecking at the eyes, some at the fatal wound or sore, but all select those points where the thinness of the skin, or an abrasion in it, offer an easy access to the entrails: these once reached are torn out and swallowed, but the eye is invariably the first point of attack.

About the villages the carrion crow builds in the cocoa-nut trees: in the jungles it selects a tall tree, amid the upper branches of which it fixes a framework of sticks, and on this constructs a nest of twigs and grasses. The eggs, from three to five in number, are usually of a dull greenish brown colour, thickly mottled with brown; these markings being most prevalent at the small end. Axis $1\frac{1}{2}$ inch, diam. $1\frac{1}{4}$ inch. They are usually laid in January or February.

149. Corvus splendens, Vieill. *Cagum*, Mal. *Caravy-caca*, Cing.; lit. Low-caste or Fisher Crow, from its frequenting the sea-coast.

The common hooded crow is essentially a "cit," he is never found away from towns, and the denser the population the more frequent is he. He builds his nest in the hibiscus-trees in the court-yard of the Government House, or of the merchant's store, and while in these situations the windows of his white fellow-citizens often overlook his domestic arrangements; he in turn, from his eyrie on the top of the rocking palm, looks down on the lowly huts of the black ones. He levies contributions on all alike: leave but your breakfast-table for a moment, and as you return, the rustling of hurrying wings, the marks of many feet on the white table-cloth, the gashes in the pat of butter, and the disappearance of plantains and small viands, proclaim who have been the robbers. The old "hopper woman" sits frying her cakes under the lowly "pandal" of her cadjan hut, and over her with head inclined, taking a bird's-eye view of her cookery, sits the "caca;" and now the "*appah,*" anglice "hopper," is done, lifted from the pan, and laid on the little circular basket ready for a customer. With a grunt of satisfaction the aged crone surveys her handiwork, and drops her spoon to feel for her beloved betel-pouch; a tiresome little bit of "areca-nut" has got into a corner and the old dame bends over it, unmindful of her charge; a dark figure drops from the roof, and though she is instantly on the alert, and aims an ineffectual blow at the thief, the nice white "appah" is borne off. Sometimes however the robber has but a poor hold on it and drops it on the red cabook road; down pounce a host of crows that have been looking on from many a tree, and a scuffle ensues; but anxious at least to cheat them of their booty, if not to retain the damaged article for her own eating, the old woman hurries to the rescue; but this makes matters worse, the castle is defenceless, and unseen foes drop down from beam and rafter or fly in through open doors. The rice-basket is invaded, the chilli box overturned, the dried fish stolen, and lucky is the dame if the crash of most of her little store of crockery and glass, swept to the ground and scattered in shining fragments, does not hastily recall her to her hut.

But in spite of these annoying thefts, the amount of good done by the vast numbers of these birds which frequent our towns is very great; they are the great street scavengers; nothing escapes their quick eyes, everything that can be eaten is devoured as soon as discovered, and early and late they are on the watch for whatever is thrown out; and so nimble are they, that I have frequently seen them catch small bits of carrion, or other matters, before they fell to the ground. They have not the least fear of the natives, and even European children are unheeded by them, and I have seen my boy's hand bitten and bleeding from their attempting to snatch his bread from him. But of the white man and his gun they entertain the most wholesome dread. Point but a stick at one and away it flies, while yet two or three hundred yards distant, and alarms the whole winged fraternity with his cries. Crows flock from all quarters, and sailing high in air, caw in concert till the object of their dread has disappeared. However, should one unwary bird fall before the gun, his companions hasten to assist him, and will often raise him up, and fly so heedlessly round the head of the fowler, that a dozen perhaps may be shot before the remainder, conscious of their danger, seek safety in flight.

Their nests are loose structures of sticks lined with hair, built in cocoa-nut or other trees, and the eggs are 1 in. 7 lines long by 1 in. 1 line broad. The general colour is a light bluish green, mottled more sparingly than those of the carrion crow with dark brown, the markings also being at the obtuse end; but in these particulars considerable variation occurs in both species, and I have some eggs in which the markings are almost obsolete.

150. Gracula religiosa, Linn. *Hallaleynia*, Cing.

Common along the western coast of the island. Mr. Brodie procured numerous specimens at Putlam; it extends sparingly into the Kandian provinces, where it is replaced by

151. Gracula ptilogenys, Blyth, J. A. S. xv. 285.

This is the "Hill Maina," the largest and most beautiful of our species; the yellow lappets of the ears contrasting elegantly with the purple-black of the velvety feathers on the head and neck.

In habits these two species are similar, generally flying in flocks varying in numbers according to the families who join in them; they perch on the topmost branches of trees, and feed on fruits and berries. They also frequent pasture lands, and attend the grazing cattle, on whose backs they often alight in search of ticks and other insects; they likewise scratch in ordure for the coleoptera which burrow therein. They breed, so the natives tell me (I have never been fortunate enough to obtain their nests), in the palm-trees about villages, placing their nests on the broad ends of the old fronds which lie horizontally. The same authority informed me that the structure was sticks lined with hair of cattle and the fibres of cocoa-nut, and that the eggs were bluish. Both the species are highly prized by the natives for the facility with which they acquire the power of imitating certain sounds of the human voice. A highly educated bird will often sell for 20 rupees or more; they are kept in cages made entirely of bamboo, in the manufacture of which the natives are very skilful. In captivity they are cheerful, active and prying, exhibiting very much the characteristics of our English magpie, and feeding upon almost all the substances, raw or cooked, eaten by their masters. Their natural note is a hoarse cackling or loud whistle, uttered in the same clamorous manner as that of our English starling. An egg said to belong to this species is—axis 13 lines, diam. 10 lines; colour a beautiful darkish blue; in shape it is much more rounded than that of *Acridotheres tristis*.

152. Pastor roseus, Linn.

I found large flocks of these birds at Pt. Pedro in July, but not one specimen, out of the many which fell at several discharges from a large gun into the huge flocks which for several days frequented one locality, proved an adult bird. They were very wary, and I could only approach them by creeping up behind hedges and then raking them as they rose with my largest gun. At the end of about a week they disappeared and I saw no more of them. They were entirely unknown to the natives. Mr. Brodie, my esteemed friend and fellow-worker in Ceylon zoology, found a few at Putlam and noticed their extreme wildness; they perched on the summit of the low bushes which dotted the open plains, and he only succeeded in obtaining a single specimen, although he followed them for several days.

153. Hetærornis Pagodarum, Gmel.

This species is not uncommon in the north of the island, but I have never met with it in the south. Dr. Kelaart found it in Fort Frederic, at Trincomalie. I think it breeds at Pt. Pedro, as I shot several young birds in September with the cere still on the base of the bill. They frequented the ploughed lands in small flocks of four, five or six individuals, and fed on small insects and grubs. Dr. Kelaart includes

154. Hetærornis Malabarica, Gmel.

and

155. Hetærornis cristatella, Linn.

Sed non vidi.

156. Hetærornis albofrontata, Layard, n. s.

Another of the new species in Mr. Thwaites's collection, if new it really is. It may be *Pastor Senex*, Temm., as it agrees tolerably well with the short description given in Prince Bonaparte's Consp. Avium, p. 419, but that description is so concise that I cannot be sure of it; I therefore name it provisionally *H. albofrontata*.

Length about 8 inches, of closed wing $4\frac{1}{4}$ in., tail 3 in., bill to end of gape $1\frac{1}{6}$ in., tarsi 1 in. General colour of back, tail and wings black, with a green gloss. Forehead albescent; hinder feathers of crest brownish black, with albescent shafts. General colour of breast, throat, vent and under tail-coverts albescent, the shafts of the feathers on the throat shining white.

Specimens are in the British Museum.

157. Acridotheres tristis, Linn. *Gong cowdea*, Cing. *Nacanam patchy*, Mal.

This is the common Maina of the country; they frequent meadows in search of worms and grubs of insects, not refusing perfect coleoptera when they come in their way; they scratch among the ordure of cattle (whence their native appellation), and scatter it far and wide over the fields, thus assisting the lazy native husbandman; and the amount of labour they perform is considerable, as they generally go in parties of six or eight, and often in flocks of forty or fifty. Like the other mainas also they often perch on the backs of cattle in search of ticks.

They breed in hollow trees, making a nest of fibres and dry grasses, and deposit from three to five light blue eggs much resembling those of the European starling in shape, but rather darker in colour. Axis 13 lines, diam. 10 lines. Young birds hatched in March or April.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Symbolæ ad Monographiam Marseniadarum. Auctore Rudulph Bergh. 4to. 1853. Plates. Copenhagen.

This work is a most interesting contribution to malacological science by a young and ardent Danish naturalist, giving a very complete detailed account of the scientific history, the anatomy, and the zoological classification of these hitherto little-known Mollusca, illustrated with excellent plates of the animal, their anatomy, including the teeth and the prehensile organs of the mouth, (which I believe have only hitherto been observed by Messrs. Alder and Hancock in this country,) and of the shells of the different species. Unfortunately the history and anatomy is in Danish, but the characters of the genera and species are in the Latin language.

The author divides the family *Marseniadæ* into three genera:— 1. *Marsenia*, containing two subgenera; *Marsenia* with eighteen species, and *Chelynotus* with four species, having three series of teeth and an earshaped spiral shell. 2. *Onchidiopsis*, Beck (=*Oncophora*, Bergh), with seven series of teeth, and a horny oblong non-spiral shell, with two species, confined to the North Sea. 3. *Marsenina*, Gray, also with seven rows of teeth, but with partly exposed earshaped spiral shell, containing only two species, from the North Sea. It is probable that the two latter genera may eventually form a separate family, or form a part of *Velutinidæ*.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

December 15, 1853.—Thomas Bell, Esq., V.P., in the Chair.

"On a New Method of propagating Plants." By E. J. Lowe, Esq., F.R.A.S., F.G.S. &c.

The author states that it had occurred to him, that if a cutting of a plant were sealed at the base, so as to exclude the moisture of the soil from ascending the stem in injurious quantities, the method of striking cuttings of most species of plants would not be so precarious a process as at present; and accordingly some collodion was obtained in order to make the experiment.

With respect to this new process, he states, that immediately upon the cutting being severed from the parent stem, the collodion was applied to the wound, and then left a few seconds to dry, after which the cuttings were potted in the ordinary manner.

To test the value of this new process more effectually, duplicates of all the species experimented upon were at the same time similarly planted, without the collodion being applied to them.

Experiments were carried on in two different ways; one batch of cuttings being placed on a hot-bed, whilst a second batch was planted in the open ground, without even the protection of glass.

First Batch.—All of which were placed on a hot-bed on the 1st of September, and examined on the 1st of October:—

Stove Plants.

Number of cuttings with collodion applied.	Name of plant.	Number of cuttings which took root.	Number of cuttings without the application of collodion.	Number of cuttings which took root.
1	Ixora coccinea	1	1	0
1	Tacsonia manicata	1	1	1
3	Franciscea Hopeana	3	3	0
3	Franciscea Pohliana	3	3	0
2	Gloxinia Maria van Houtte	0	2	1
2	Begonia incarnata	2	2	1
8	Achimenes patens	7	8	6
2	Hoya bella	2	2	1
2	Rondeletia speciosa	2	2	1
2	Allamanda nerifolia	2	2	1
	Greenhouse Plants.			
6	Boronia serrulata	5	6	0
3	Polygala dalmaisiana	1	3	0
6	Polygala grandiflora	3	6	2
6	Verbena luna	6	6	6
1	Chorozema cordata	1	1	0
1	Epacris pallida	0	1	0
2	Leschenaultia formosa	2	2	1
1	Swainsonia astragalifolia	1	1	0
1	Swainsonia galegifolia	0	1	0
2	Abelia rupestris	2	2	0
4	Plectranthus concolor, picta	2	4	2

Second Batch.—Planted in the open ground on the 1st of September, and examined on the 1st of October:—

Hardy Plants.

Number of cuttings with collodion applied.	Name of plant.	Number of cuttings which took root.	Number of cuttings without the application of collodion.	Number of cuttings which took root.
12	Garrya elliptica	5	12	1
12	Erica vagans...........................	7	12	4
18	Bupleurum longifolium	6	18	0
12	Laurus fœtens	10	12	7
6	Rose, Souvenir de la Malmaison...	4	6	3
12	Taxus baccata, golden-leaved var.	8	12	4

	Total number of cuttings to which collodion was applied.	Number of cuttings which took root.	Total number of cuttings without the application of collodion.	Number of cuttings which took root.
First batch	59	46	59	23
Second batch ...	72	40	72	19

The experiment, the author considers, speaks for itself. Notwithstanding the season being too far advanced for the full benefit of the process to be thoroughly observed, still twice as many cuttings took root treated by the new method as had rooted by the old. The mortality in the open ground was increased by slugs having eaten off above the soil some of the cuttings; those thus damaged were examined after they had been in the ground a month, and it was found that the collodion was quite as sound as when first applied. It would therefore appear that the collodion seals the wound of the cutting, and protects it from the fatal effects of damp, until roots are prepared to force through the covering of gun-cotton. It is further stated, that the application of this solution has been found to be exceedingly beneficial in the pruning of such plants as *Euphorbia speciosa, Impatiens latifolia, Impatiens latifolia-alba, Hoya bella, Hoya imperialis,* &c., the cut branches being prevented from bleeding.

It is the author's intention next spring to follow out this experiment, in budding and grafting, as he considers that it will also be useful in this branch of horticulture.

Gutta-percha, dissolved in æther, was in some instances substituted to heal the wounds caused by pruning; yet owing to this solution not drying as rapidly as collodion, the first, and sometimes the second application was not sufficient.

The effect of these solutions upon cut flowers was very marked. Two branches were gathered as nearly alike as possible; to the flower-stalks of the one, collodion was applied. These flowers were placed in vases filled with water; those coated over with collodion began to fade in thirty-six hours, and many were quite dead in three days; whilst the flowers merely placed in water in the ordinary manner remained fresh and healthy. Those that faded soonest were *Reseda odorata* and *Tropæolum majus*, and those which were least affected were *Tagetes erecta* and *Senecio erubescens*.

ZOOLOGICAL SOCIETY.

January 13, 1852.—W. Yarrell, Esq., in the Chair.

The following papers were read:—

1. MONOGRAPH OF THE FAMILY APODIDÆ, A FAMILY OF CRUSTACEANS BELONGING TO THE DIVISION ENTOMOSTRACA; WITH A DESCRIPTION OF A NEW SPECIES OF APUS, AND TWO SPECIES OF OSTRACODA BELONGING TO THE GENUS CYPRIS. BY W. BAIRD, M.D., F.L.S. ETC.

IN drawing up this communication, one of the objects I had in view was to call the attention of the members of this Society to a group of animals which must be very numerous, especially in warm climates, but which nevertheless have been but little attended to. The animals to which I propose directing your attention belong to that very interesting division of the great class CRUSTACEA, called ENTOMOSTRACA. The chief interest attached to these creatures, most of which are very small, is derived from watching their gambols in their native element, and examining by the aid of the microscope the wonderful beauty of their various organs, especially their organs of motion and breathing. Unfortunately few naturalists, comparatively speaking, have paid much attention to them, and collectors of objects of Natural History have generally, perhaps from their minuteness, overlooked them almost entirely. Those however who have watched these little creatures, whether sporting in the freshwater ponds and lakes of the interior, or illuming the bosom of the ocean with their brilliant phosphorescent light, have not failed to be struck with the beauty and elegance of their forms,—a beauty and elegance which it is difficult to describe, and the attempt to do which has caused the grave naturalist Otho Fredericus Müller involuntarily to rise into the language of poetry.

The largest species of *Entomostraca* belong to the order *Phyllopoda*, and the beauty of their movements through the water and the symmetry of their various organs of motion are truly exquisite. The family *Apodidæ* contains the largest individuals, though as yet the number of species described is not great. One species of the family was known to Linnæus, who mentions, in the first edition of his 'Fauna Suecica' (1746), having seen a specimen in 1728 at the house of a naturalist in London, who told him he had received it from Prussia. Jacob Frisch * had, previously to the publication of the 'Fauna Suecica,' made known and figured a species, specimens of which he had received from Klein, then at Dantzic, who had found it in East Prussia. Specimens of this species were sent soon afterwards

* Insecten in Deutschland, 1732.

by Klein to London to Sir Hans Sloane, and at the very same time (1738) this species was found also in England in a pond on Bexley Heath by the Rev. Lyttleton Brown. Klein's notice, previously sent to Sir Hans Sloane, and Mr. Brown's description, were published simultaneously in the 'Philosophical Transactions' of that year. Several species have since then been discovered, natives of various parts of the globe and having a wide geographical range. They have been found in different parts of Europe, in North Africa, in North America, even as high as the borders of the Arctic Ocean, in the West Indies, and in Australia.

The Family *Apodidæ* (belonging to the Order *Phyllopoda*) may be thus characterized:—

Pedes branchiales, paribus sexaginta. Antennæ breves, styliformes, pari singulo. Oculi duo, sessiles. Corpus numerose articulatum, parte majore clypeo magno obtectum.

The feet, consisting of 60 pairs, are all formed for the purpose of breathing with, and not for locomotion, the first pair alone being provided, in addition to the branchial plates, with organs adapted for assisting the animal in swimming. The first pair are the largest, and after the second pair they become gradually smaller as they descend, until the last few pairs become almost obsolete. The animals generally swim on their back, and these branchial feet are in constant motion even when the animal is at rest. The body is cylindrical, elongated, consisting of numerous segments, and the upper half, or more in some species, is covered by a large shield-shaped carapace or buckler. This carapace protects the vital parts, and is furnished with a peculiar structure in its substance for increasing the extent of its branchial apparatus. The antennæ are small organs and in number only one pair, short and styliform. The eyes are two in number, compound, lunate-shaped, and are sessile, being placed on the upper and central portion of the carapace. The young have only one eye, which gradually disappears as moulting goes on, until the mark merely remains. This is generally described as a third eye, but according to Zaddach the two compound eyes only are provided with optic nerve, pigment and cornea. The caudal segment of the body gives off two long and very numerously articulated cylindrical setæ or filaments which are more or less provided with short hairs from each side.

Only one genus of this family is recognized by M. Milne-Edwards in his work on the Crustacea, though Dr. Leach had many years ago established a second; the character upon which that genus was founded by Leach is not considered by M. Edwards as of generic importance; but having observed another character equally remarkable, which occurs in all the known species of the group which that genus represents, I consider Leach's genus ought to be adopted, and I now propose giving the characters of the two genera at greater length than they have yet been done.

Genus Apus, Scopoli.

Clypeus corneo-coriaceus. Corpus molle, cylindricum. Segmentum caudale lamina producta non instructum. Pedum primi paris appendices, aut rami, longissimi, flexibiles.

In the genus *Apus*, the tail-segment of the body is rounded, and has no plate or prolongated appendage between the two long setæ or filaments. The first pair of feet are very long, dividing into three cylindrical branches, the external one of which is very long, in some species equalling in length the whole body with the tail filaments included: they are very flexible, possess much motion, and are very conspicuous. These organs at once distinguish the genus, and they possess the same general character in all the species hitherto known. Four species have only as yet been described, and I now propose to add to that number a fifth.

1. Apus cancriformis, Schæffer. *Clypeo corporis plusquam dimidiam partem tegente, ovato, olivaceo, corneo; ramo externo pedum primi paris longitudine clypeum æquante.*

Long. toti corporis $2\frac{1}{2}$ poll.; lat. clypei $1\frac{1}{2}$ poll.

Pro Synonymis vide "Baird's Nat. Hist. of the British Entomostraca, Ray Society's Publications, 1850."

Hab. In Europa; detecta in Anglia, Gallia, Borussa, &c. In Africa Septentrionali; detecta in Tunisia, collegit Dominus L. Frazer; in Algeria, collegit M. Lucas. Museum Britannicum.

The colour of this species is brownish yellow or olive clouded with marks of a deeper hue. The carapace is oval and extends over nearly two-thirds of the body of the animal. The keel which runs down the centre of the carapace is pretty strong, and the deep notch at the posterior extremity is lunated in shape and has its edges finely toothed. The external branch of the first pair of feet is about the length of the carapace, while the caudal setæ are nearly as long as the whole body, and are covered with numerous short hairs. The abdominal portion of the body not covered by the carapace is studded all over with circular rows of stout hooked spines of a dark brown colour.

2. Apus Guildingii, Thompson. *Clypeo corporis vix dimidiam partem tegente, quadrato, membranaceo, nigrescente; ramo externo pedum primi paris longissimo, totum corpus, filamentis caudalibus inclusis, excedente.*

Apus Guildingi, Thompson, Zoological Researches, Fasc. v. 108. t. 6. f. 3; M. Edwards's Hist. Nat. Crust. iii. 561.

Hab. In Insula "St. Vincent's," India Occidentali; *Rev. Lansdowne Guilding.*

Mr. Thompson in his 'Zoological Researches' remarks: "I received this species of *Apus* together with the *Artemis Guildingi* from the West Indies, and having as yet no details, must leave its history in the hands of its distinguished discoverer. It is of a light blackish colour, the clypeus translucent, almost membranous, and shorter in proportion than in any of the known species, with the extreme branch of the anterior member extremely long." Unfortunately we have no further history of this species from its discoverer the Rev. Lansdowne Guilding, but the short square-shaped carapace and the extreme length of the external branch of the first pair of feet sufficiently distinguish it.

3. Apus longicaudatus, Le Conte. *Clypeo corporis tertiam partem non multo magis tegente, rotundato, subfusco; ramo*

externo pedum primi paris longitudine clypeum excedente; corporis postica parte longissima, cylindrica.

Long. toti corporis 1·5 poll., clypei ·65 poll.; lat. clypei ·7 poll.

Apus longicaudatus, Le Conte, Ann. Lyc. Nat. Hist. iv. 155. t. 9.

Hab. In America boreali. "In a shallow lake on the high plateau between Lodgepole Creek and Crow Creek, N.E. of Long's Peak" (*Le Conte*).

This species is readily distinguished by the extraordinary length of the abdominal portion of the body. The carapace is rounded, somewhat truncated at the anterior extremity, and having the two extremities of the fork terminating in a very sharp point. It does not cover much more than one-third of the body, and is thin in substance. The external branch of the first pair of feet is long, exceeding considerably the length of the carapace. The caudal filaments are about the length of the abdomen. Mr. Le Conte says that the species was found in immense numbers in a small shallow lake on the high plateau between Lodgepole Creek and Crow Creek, N.E. of Long's Peak, near the Rocky Mountains. "They were swimming about with great activity, plunging to the bottom and rising to the surface."

4. Apus obtusus, James. *Species hæc reperta a Domino James in* "Major Long's Expedition to the Rocky Mountains," *non satis bene descripta necnon delineata est.*

Long. clypei ·3 poll.; lat. clypei ·4 ? poll.

Apus obtusus, James, Expedition to the Rocky Mountains, ii. 336.

Hab. In America boreali. "Rain-water puddles on the Platte river, near the Rocky Mountains" (*James*).

This species is very briefly described by Mr. James. "In rain-water puddles," he says, "we remarked a new species of Branchiopode belonging to the genus *Apus*; small crustaceous animals, which exhibit a miniature resemblance to the King or Horse-shoe Crab (*Limulus polyphemus*) of our own sea-coast, but which are furnished with about 60 pairs of feet, and swim upon their back. The basins of water which contained them had been very much diminished by evaporation and infiltration, and were now crowded to excess, principally with the *Apus,* great numbers of which were dying upon the surrounding mud, whence the water had receded. This species is distinguished from the *productus* of Bosc and *Montagui* of Leach, by not having the dorsal carina prolonged in a point behind; and from *cancriformis* by the greater proportional width of the thorax, and more obtuse emargination behind. The length of the thorax along the middle is three-tenths of an inch and its greatest breadth somewhat more. It may be named *Apus obtusus.*"—Note 7. p. 336.

5. Apus Domingensis, Baird, sp. nov. *Clypeo corporis dimidiam partem tegente, rotundo, tenui, corneo; ramo externo pedum primi paris corpus æquante.*

Long. toti corporis 1 poll.; lat. clypei $\frac{3}{4}$ poll.

Hab. In Insula St. Domingo, India Occidentali. Collegit M. Sallé. Museum Britannicum.

Though a native of the West Indies, this species may be easily distinguished from *A. Guildingii* by its round-shaped carapace of a horny colour covering half the body of the animal, and its external branch of the first pair of feet only the length of the body, while in *A. Guildingii* it exceeds the whole body and caudal filaments included. The carina down the centre of the carapace, and the fork which it takes at the anterior extremity where the division into cephalic and thoracic portions takes place, are marked throughout their length with a deep brown colour, as are also the short stout spines on the abdominal portion of the body. These are straight, not hooked as in some of the other species. The caudal filaments are nearly the length of the body, and are covered with very numerous, extremely short setæ. The oviferous feet are present in all the specimens I have examined, but none contain any ova.

Genus Lepidurus, Leach.

Clypeus corneo-coriaceus. Corpus molle, cylindricum. Segmentum caudale lamina producta instructum. Pedum primi paris appendices, aut rami, brevissimi.

In the genus *Lepidurus* the tail-segment of the body, which in *Apus* is rounded, is furnished with a flap or plate of considerable size extending to some distance between the long setæ or filaments. The first pair of feet, compared with those of *Apus*, are extremely short and comparatively inconspicuous. These two characters at once distinguish the genus, of which only three species have as yet been described. In other respects it resembles perfectly the genus *Apus*.

Schæffer is the first author who has distinctly described any species belonging to the genus *Lepidurus*. Linnæus's description of the "*Monoculus cauda biseta*" in the first edition of the 'Fauna Suecica,' will apply to either the *Apus* or *Lepidurus*. He quotes Frisch's figure, and states, as I have mentioned above, that he had seen a specimen in London. We might conclude from this that it was the *Apus cancriformis* he had in view; but in the second edition of the 'Fauna' (1761), he distinctly mentions, in his brief description, that the tail was furnished with two long setæ, with *a flap interposed between them*. As in this edition he continues to refer to Frisch's figure, and adds that of Klein, in the 'Philosophical Transactions,' it is evident he confounded two species together; and as the *Lepidurus productus* (the *Apus productus* of authors) is perhaps the more common species of the two on the Continent, it is most probable that he had it in view when he wrote, but erroneously referred to the species figured by Frisch and Klein as identical with it.

The three species which have been described are—

1. Lepidurus productus, Bosc. *Clypeo corporis magis quam tres partes tegente, ovato, elongato, olivaceo-viridi; setis caudæ pennatis; lamina caudali elongato-ovata, carinata, setis brevibus numerosis obsita.*

Long. toti corporis $2\frac{1}{2}$ poll.; lat. clypei 1 poll.

Pro Synonymis vide M. Edwards, Hist. Nat. Crust. iii. 560.

Hab. In Europa; detecta in Gallia, Suecia, Borussa, &c. Museum Britannicum.

This species is of an olive-green hue, and is smaller than the *Apus cancriformis*. The carapace is of an oval form and covers more than two-thirds of the body. The notch at its posterior part is less deeply lunated than in *Apus cancriformis*, and the keel which runs down its centre is well-marked. The flap of the caudal segment is of an elongated oval shape and has a keel running down its centre, which, as well as its edges, are finely serrated, or beset with numerous short setæ. The tail-setæ are also furnished on each side with numerous short hairs, which, when magnified, present a fine plumose appearance. The first pair of feet or rami are very small, and when the animal lies prone are indistinctly visible.

2. Lepidurus glacialis, Kroyer. *Clypeo corporis tres partes tegente, rotundato, viridi; setis caudæ plumosis; lamina caudali abbreviata, subquadrata, denticulata.*

Long. toti corporis 1 poll.; lat. clypei ·5 poll.

Apus glacialis, Kroyer, Voy. en Scandinavie, Lapponie, &c. t. 40. f. 1.

Hab. In America boreali; detecta ad "Cape Krusenstern" mense Augusti 1849. Collegit Dominus J. Rae. Museum Britannicum.

This species is smaller than the preceding, and of a green colour, having the carapace of a rounded form with a sharp keel running down the centre. It covers rather more than two-thirds of the body, and has the notch at its posterior extremity small and finely toothed on its edges. The spines on the body are small and of the same colour as the body itself. The first pair of feet or rami are very short, scarcely visible when the animal is in a prone position beyond the edge of the carapace. The tail-setæ are finely plumose, and the flap between them is of a somewhat square shape, short and toothed on its edges.

3. Lepidurus viridis, Baird. *Clypeo corporis magis quam dimidiam partem tegente, rotundato-ovali, viridi, valide carinata; setis caudæ brevi-pilosis; lamina caudali ovali-lanceolata, carinata, denticulata.*

Long. toti corporis 2 poll.; lat. clypei 1 poll.

Lepidurus viridis, Baird, Proceedings of Zool. Soc. 1850, t. 17. f. 1.

Hab. "Van Diemen's Land." Museum Britannicum.

This species resembles considerably the *Lepidurus productus*. It is two inches long, and has the tail-setæ nearly as long as the body. The carapace and whole body are of a fine green colour; the carapace of a rounded oval form and covering about two-thirds of the body. The edges of the notch in the posterior part of the carapace are strongly toothed, and those of the inferior half of the carapace are very finely serrated. The keel running down the centre is well marked and projects a short way beyond the edge of the notch. The tail-setæ are beset with very numerous short hairs, and the flap between them is of an oval lanceolate form, and has the keel beset with short sharp spines and the edges finely serrated. The first pair of feet or rami only slightly extend beyond the edge of the carapace.

Spurious Species.

Apus caudatus, De Kay, Nat. Hist. New York, Part 6, Crustacea, p. 61.

In the Journal of the Academy of Sciences of Philadelphia for 1818, vol. i., Mr. Say describes a parasitic Crustacean living on the *Calianassa major* (a malacostracous Crustacean), found on the coasts of the Southern States of N. America and of East Florida. He names it the *Binoculus caudatus*; and in the Nat. Hist. of New York, Mr. De Kay refers this species to the order *Phyllopoda* and to the genus *Apus*, though he says, "I place it here with some hesitation." This animal being parasitic is no doubt referred by Say to the genus *Binoculus* of Geoffroy, (equivalent to the genus *Argulus*, and which must be placed in the order *Pœcilopoda*,) and not to the genus *Binoculus* of Leach, as De Kay supposes, which is the *Apus* of authors.

Order Ostracoda.

Family Cyprididæ.

Genus Cypris.

1. Cypris Belcheri, Baird. *Testa lucente, albida, elongata, stricta, supra arcuata, infra sinuata; extremitate anteriore latiore, margine compressa, rugata; extremitate posteriore mucronata.*

Long. $\frac{1}{10}$ poll.; lat. 1 lin.

Hab. ——? "From Sir E. Belcher's Collection, along with some freshwater shells from the islands of the Eastern seas." Museum Britannicum.

The carapace valves or shell is of an elongate and narrow form, having the anterior extremity considerably broader than the posterior, and flattened on the margin, which is marked with a good many raised-looking striæ, which give it a puckered appearance. The posterior extremity is pointed and acute. The upper margin of the carapace is arched, while the under margin is sinuated. The valves of the carapace are convex in the centre and are of a shining white colour.

In form this species resembles considerably the *C. clavata*, Baird, Brit. Entomostraca, but is less club-shaped and more sharply pointed at posterior extremity.

2. Cypris Schomburgkii*, Baird. *Testa subviridi, hirsuta, puncturata, ovali; extremitate anteriore rotundata, margine subcompressa; extremitate inferiore oblique-truncata et mucronata, antennis pedibusque brevibus, setis plumosis.*

Long. $\frac{1}{6}$ poll.; lat. $\frac{1}{10}$ poll.

Hab. In insula St. Domingo, India Occidentali. Collegit M. Sallé. Museum Britannicum.

The carapace valves or shell is of an oval form, with the anterior extremity rounded in front and having its margin rather flattened or compressed, the posterior extremity being obliquely truncated above

* Named after Sir R. Schomburgk, British Consul in St. Domingo.

and terminating in a sharp point. The carapace is of a whitish green colour and covered all round the edges with rough coarse hairs. The valves are convex on the centre and have their surface dotted all over with small dots or punctures. The antennæ and legs are apparently very short, and the setæ of both are shortly plumose.

This is the largest species of the genus I have yet met with, being about $\frac{1}{6}$th of an inch in length. Mr. James, in his account of the Expedition to the Rocky Mountains, mentions his finding a *Cypris* along with the *Apus obtusus* rather more than one-fifth of an inch in length.

2. On the Genus Thalurania. By John Gould, F.R.S.

It is now some years since I proposed the generic name of *Thalurania* for the *Trochilus furcatus* and its near allies. This generic term having been adopted by the Prince of Canino and others, tends to show that the division is a good one, and hence a list of the species known up to the present time, with their native habitats, may not be uninteresting to the members at the present meeting. I would also take the present opportunity of laying before the Society a new and very beautiful species, which, as far as I am aware, is only to be seen in my own collection.

The species of this well-defined genus are—

Thalurania furcata.

Hab. Cayenne, Demerara, and Brazil.

Thal. nigrofasciata.

Hab. Woods on the banks of the Upper Amazon.

Thal. Columbiana.

Hab. Temperate region in the neighbourhood of Bogota in Columbia.

Thal. venusta.

Inhabits Costa Rica and the southern portion of Mexico. The only species of the genus yet discovered to the north of Panama.

Thal. viridipectus.

A beautiful species lately sent to Europe from the Caraccas near to the Andes.

Thal. verticeps.

A species found only in my own collection. It frequents the wooded regions on the west side of Pichincha in Ecuador. Sent to me by Mr. Jameson.

Thal. glaucopis.

Hab. South Brazil.

Thal. Watertoni.

This is the largest species of the genus and a very beautiful bird.

Hab. Demerara.

THAL. WAGLERI.

Hab. The hilly regions of Brazil, particularly Minas Geraes.

THAL. ERIPHILE.

This species also inhabits Brazil, and is generally sent in collections from Rio.

THAL. REFULGENS, n. sp.

A species very like *furcatus* in colour, but nearly as large as *Watertoni*. The under tail-coverts are steel-black; crown of the head velvety black; breast and shoulders beautiful purplish blue; tail black and considerably forked; wings purplish brown; throat rich metallic green.

Hab. ——?

January 27, 1852.—Professor Bell, F.R.S., in the Chair.

1. NOTES ON THE EGGS AND YOUNG OF THE APTERYX, AND ON THE CASTS OF THE EGGS AND CERTAIN BONES OF ÆPYORNIS. BY PROFESSOR OWEN, F.R.S., F.G.S., F.Z.S.

The Secretary placed upon the table casts of two eggs and of portions of the leg-bones of a gigantic bird of the Island of Madagascar, which had been presented by the Administration of the Garden of Plants in Paris to the Zoological Society of London, and on these Professor Owen made the following observations.

The casts were beautifully made and coloured, and were exact representations of the originals, which the Professor had examined during a visit to Paris in July last. These were received at the Garden of Plants in January last, and were described this day twelvemonth (January 27th) in a communication made by M. Isidore Geoffroy-St.-Hilaire to the Academy of Sciences *. They had been obtained by the master of a merchantman at the Island of Madagascar in 1850, from the natives, who stated that one of the eggs had been found, entire, in the bed of a torrent, amongst the debris of a land-slip: a second egg, with some fragments of bone, was subsequently found in a formation which is stated to be alluvial: a third egg, which the natives had perforated at one end, and used as a vessel, was also obtained. This egg was fractured in the carriage; the other two eggs arrived entire.

They are nearly of the same size, but differ in shape, one being shorter but a little thicker, and with more equal ends than the other. The following are admeasurements of these eggs and of an Ostrich's egg:—

	Æpyornis.		*Ostrich.*
	Ovoid egg.	Ellipsoid egg.	
Greatest circumference:	ft. in. lin.	ft. in. lin.	ft. in. lin.
Lengthwise	2 10 9	2 9 6	1 6 0
Breadthwise	2 4 3	2 5 6	1 4 6
Extreme length in a straight line	1 0 8	1 0 5	0 6 4

M. Isidore Geoffroy estimates the larger of the two eggs to con-

* A translation of this communication appeared in the Annals for March 1851.

tain $10\frac{1}{8}$ quarts, or the contents of nearly 6 eggs of the Ostrich, or 16 of the Cassowary, or 148 of the Hen, or 50,000 of the Humming Bird. The portions of bones of which casts were exhibited consist of the lower end of the right and left metatarsal bones and the upper end of the right fibula. These are nearly equal in size to the corresponding parts of the skeleton of the *Dinornis*, as the following dimensions demonstrate:—

	Æpyornis.		*Dinornis giganteus.*		*Casuarius.*	
	in.	lin.	in.	lin.	in.	lin.
Extreme breadth across the trochlear condyles......	5	0	5	6	2	3
Transverse diameter of shaft 6 in. above lower end* ..	2	9	2	3	0	$11\frac{1}{2}$
Antero-posterior diameter of shaft 6 inches above lower end	1	3	1	5	0	7

In neither *Dinornis* nor *Æpyornis* is the metatarsus perforated, as in *Casuarius* and many other birds, above the interspace between the two outer condyles: that interspace is simply deeper, or curved higher in both. The outer trochlea, which is entire in both portions of the metatarsi in *Æpyornis*, is, in a marked degree, smaller than in *Dinornis*, as is also the inner trochlea, as far as one may judge from the posterior part which is preserved. The interspaces of the trochleæ are wider posteriorly in *Æpyornis*, and the outer one is more angular at its upper end. The middle portion of the posterior surface of the lower third of the shaft of the metatarse in *Æpyornis* is more produced than in *Dinornis*, and a ridge is continued from it to each lateral trochlea, dividing the back part of the shaft above them into three surfaces; whereas the corresponding surface in *Dinornis* is simply flat from side to side. Above this part in *Æpyornis* the posterior surface on each side of the middle prominence is concave and meets the anterior surface at a ridge, which is narrowest at the outer border of the bone. In *Dinornis* both borders of the lower third of the shaft are thick and rounded.

The *Æpyornis* does not show any trace of the rough tract for attachment of a back toe, as in the *Palapteryx robustus*; in this respect it resembles the *Dinornis*.

At 6 inches from the lower end, the shaft begins to be concave along the middle of the fore part, the concavity deepening as it ascends; whereas in *Dinornis* the anterior median concavity of the shaft does not begin to appear until above the upper half of the bone. In this character the *Æpyornis* resembles the Cassowary; but it differs from the Cassowary in the much narrower or sharper lateral margins of the shaft of the metatarsus. Like the Cassowary, however, the breadth of the shaft is greater in proportion to that of the trochleæ than in the *Dinornis* or *Palapteryx*.

It would be hazardous to conclude as to the length of the entire metatarse from the breadth of the distal end; for this is equal in *Dinornis giganteus* and *Palapteryx robustus*, whilst the length of

* One-third the length of the entire bone in *Dinornis giganteus*.

the metatarse is 1 foot 6 in. in the one and 1 foot 4 in. in the other. I think it more probable, however, that *Æpyornis* had a shorter than that it had a longer metatarse than the *Dinornis giganteus*.

That its leg-bones were smaller is significantly indicated by the difference of size in the fibulæ.

	Dinornis.		*Æpyornis.*	
	in.	lin.	in.	lin.
The longest diameter of the upper end ..	2	11	2	9
The shortest diameter of the upper end..	1	4	1	0

This bone in *Æpyornis* shows a flat, full, oval articular facet on its tibial side, of which there is no trace in *Dinornis*.

Upon the whole, therefore, Prof. Owen concluded that the *Æpyornis maximus* did not surpass in height or size the *Dinornis giganteus*, and that it was more probably a somewhat smaller bird.

From the obvious differences which M. Geoffroy found on comparing these fragments with the casts of the metatarsus of the *Dinornis giganteus*, he has inferred with much probability not only its specific but generic distribution, and has proposed for it the name of *Æpyornis maximus**. This distinction is illustrated not only by the metatarsal bones, but by the eggs themselves. Mr. Walter Mantell, of Wellington, New Zealand, has recorded his observation of an egg of a *Dinornis* found in the volcanic sand, of the magnitude of which he endeavours to give an idea by stating that his hat would have been but large enough to have served as an egg-cup for it.

The fragments of the egg of *Dinornis* or *Palapteryx*—of what species, of course, cannot be determined—show, after arriving approximatively at their size by the curve of the fragments, that the shell was not only absolutely thinner, but relatively much thinner than in the Ostrich, and *à fortiori* than in the *Æpyornis*. The air-pores, also, have a different form, being linear, not rounded; and the external surface is smoother.

In the smoothness and thinness of the shell, the egg of the *Dinornis* resembles that of the *Apteryx*: in the thickness of the shell and the comparative roughness of its exterior, the egg of the *Æpyornis* more resembles that of the Ostrich and Cassowary.

Such colour—a dull greyish yellow, as the *originals* of the eggs of the *Æpyornis* now at Paris show—may well have been derived from the recent alluvial soil in which it is stated that they were discovered: the darker stain on one part of the circumference of the larger egg seems to have been due to some accidental circumstance. Most probably they were originally white, like the eggs of the Ostrich, and like the fragments of the eggs of the *Dinornis*: whether an original green tint, like that of the egg of the Emu and Cassowary, would be wholly discharged by long continuance in the soil, may be a question.

It is most probable that the entire eggs of the *Æpyornis* were excluded in the usual fertile state, but had suffered such want or interruption of the heat requisite for their incubation as to have become addled.

* From *αἰπὺς* alta, *ὄρνις* avis. The trivial epithet is hazardous, to say the least, with the results of the comparison with the above recorded.

How hazardous it is to judge of the size of a bird by that of its egg would appear, Prof. Owen observed, by the remarks which he should next proceed to offer on the eggs of the *Apteryx*. Of these the Professor exhibited one entire specimen, and a nearly fully incubated chick from a second egg, both of which had been most liberally transmitted to him by the Rev. Wm. Cotton, M.A., from the North Island of New Zealand.

Had it not been for the demonstration afforded by the chick itself, it might well have been doubted whether so small a bird could have excluded so large an egg. The following are the dimensions of the egg:—

	Egg of *Apteryx*. ft.	in.	lin.
Greatest longitudinal circumference	1	0	9
Greatest transverse circumference	0	10	0
Length	0	4	10
Breadth	0	3	2

The egg presents the usual long oval form, the colour a dull dirty greyish white; but this is partly due to grease stains from the de composition of an incompletely hatched chick, with its yolk, within.

Viewed under a moderately magnifying power the surface presents a very fine fibrous, or spicular character; the raised lines, like spiculæ, crossing in opposite directions, with air-pores scattered here and there and barely perceptible to the naked eye. The shell is not more than $\frac{1}{8}$th of a line in thickness. Supposing, as is most probable, from the size of the bones of the *Æpyornis*, that it did not exceed the *Dinornis giganteus* in size, the egg of the *Æpyornis* is smaller in proportion to the bird itself than the egg of the *Apteryx* is in proportion to that bird.

The embryo *Apteryx*, which had been removed from its shell, had nearly reached the term of its incubation, the yolk-bag being reduced to a hernia-like appendage of an inch in length and half an inch in breadth, protruding about two lines in advance of the cloma, and covered by a continuation of the ordinary integument of the abdomen: the free end of the hernia was open, and exposed the ruptured ends of the allantoic vessels.

The whole body was clothed by down-fascicles, presenting the appearance of moderately thick cylindrical hairs, $1\frac{1}{2}$ inch in length, with a smooth, unbroken exterior, gradually tapering to a fine point. This smooth surface is due to an extremely delicate capsule, which when torn open exposes the down-tuft, consisting of a central stem with slender smooth barbs from 3 to 5 lines in length, diverging loosely from each side of the stem.

	in.	lin.
Length of the body from the base of the beak to the tail	4	0
Length of the beak	1	7
Length of the leg from the knee-joint	4	3
Length of the freely projecting part of the fore-limb from the elbow-joint	0	6

From these dimensions it will be seen that, with the characteristic large size of the unhatched young, in the genus *Apteryx*, the chief peculiarities of the remarkable external form of the bird had been acquired. The feet were very completely formed with well-developed claws, the small back claw presenting its characteristic proportions, and the integument of the naked part of the foot its well-marked dentations. The little wing-rudiments had their terminal hook. The tail presented the form of a short bifid prominence. The beak being comparatively soft, had become distorted and bent in the bottle of spirits in which the specimen was transmitted to the Professor, but it showed its characteristic shape, the terminal nostrils, and the slight terminal expansion, which forms the end of the crutch in the mature bird. The eyelids, with their cilia, and the orifice of the ear opening obliquely upwards, were rather larger in proportion than in the adult, according to the usual law of the precocious development of those organs of sense; and the same remark applies to the entire cranium. The neck is relatively shorter and thicker.

The young bird must be excluded unusually well developed, with a complete clothing very like that of the parent, and capable of using its limbs and beak for its own safety and support.

BOTANICAL SOCIETY OF EDINBURGH.

January 12, 1854.—Professor Balfour, President, in the Chair.

Mr. G. Lawson exhibited specimens of *Bryum warneum* from the Tents Muir Sands, on the east coast of Fife, where it was discovered by Mr. W. M. Ogilvie, on the 27th of August last. It was associated with *Bryum cæspititium*, to which it bears a resemblance. The species is new to Britain, and appears to be rare on the Continent. It is described and figured by Bruch and Schimper in the 'Bryologia Europæa,' fasc. vi. t. 5.

The following papers were read:—

1. "On Diatomaceæ found in the Mull Deposit," by Professor Gregory.

Having continued the study of this deposit for more than a year, Professor Gregory detected in it more than 150 species, a number three times as large as has hitherto been observed in any other deposit. Of these, he mentioned on the present occasion about 140, of which about 120 were known and admitted already as British species.

The following species were new to Britain, but figured by continental authors:—

Epithemia gibberula.	Himantidium exigerum, *Bréb.*
Eunotia depressa, *Kütz.*	Navicula Trochus, *Ehr.*
E. Camelus.	N. lævissima.
E. bigibba, *Kütz.*	Cocconema gibbum.

The following species were described as new:—

Eunotia incisa.	Pinnularia latestriata.
Pinnularia undulata.	P. exigera.

Pinnularia tenuis.	Cymbella tumens.
P. parva.	Gomphonema Brebissonii?
Stauroneis rectangularis.	G. Hebridense.
Navicula apiculata, *Smith*.	

Professor Gregory then directed attention to the remarkable variations of a form which had been referred by Mr. Smith to his *Pinnularia divergens*, but, as found in the Mull earth, had more than double the number of striæ which belong to that species. It occurs in several very striking varieties, and the conjecture was thrown out, that it is in reality not *P. divergens*, but a distinct species, including *P. stauroneiformis*, *P. interrupta* and *P. mesolepta* of Smith, as well as what he took for *P. divergens* in the Mull deposit.

Some remarks were also made upon the value of the generic and specific characters of the Diatomaceæ. It was shown that the genera *Cymbella* and *Cocconema*, *Eunotia* and *Himantidium*, seem to be respectively separated on insufficient grounds. In regard to specific characters, it was pointed out that while certain species vary almost *ad infinitum*, others exhibit a remarkable degree of permanence. Examples of the former are *Eunotia triodon*, *E. bigibba*, *Himantidium bidens*, *H. undulatum*, *Pinnularia divergens*; of the latter, *Eunotia tetraodon*, *E. Diadema*, *Navicula Trochus*, *N. serians*, *N. rhomboides*, *Pinnularia alpina*. It was thought that these very characters of permanence and variableness might be usefully employed as specific characters, and that viewed in this light, each of them afford strong proof of the real existence of species as natural divisions.

Professor Gregory has still several new forms found in this deposit to describe on some future occasion; and he is engaged in the study of other deposits, in all of which he has already found species hitherto overlooked, and among these several of the new forms above named.

2. "On the occurrence of *Desmarestia Dresnayi* on the coast of Ireland," by W. Sawers, Esq.

In a letter to Professor Balfour, Mr. Sawers states, "I have great pleasure in sending you specimens of an Alga new to the shores of the United Kingdom. Specimens having been sent to Dr. Montagne of Paris, he writes, that he gathered the same plant at Fort St. Sebastian, Spain, in 1823, published a description of it, with a plate, in 1842, in the 'Annales des Sciences Naturelles,' naming it *Desmarestia pinnatinervia*, and that it has been found by M. Crouan at Brest, though rarely. M. Crouan makes it a variety of *Desmarestia Dresnayi*, but M. Montagne maintains the distinctness of his species and retains his name *D. pinnatinervia*. I found the young fronds floating early in August at Moville, near the mouth of Loch Foyle, and have visited the locality frequently since, always getting a number of specimens, the great majority imperfect. When fresh, it has the colour of a *Laminaria*, but is not so glutinous to the feel, and thinner. The root is a disc, and sometimes two or three fronds arise from the same disc; in some cases they are slightly proliferous where the margin has been injured. The frond is from 12 to 18 inches long, and 2 to 4 inches in breadth. The lateral nervelets are forked as in the frond of a fern."

Dr. Greville was of opinion that the plant must be referred to *D. Dresnayi*. He read a description of it, and exhibited a drawing, both of which will appear in the 'Annals of Natural History' and the Society's Transactions.

3. "Remarks on the Flora of the Vosges," by Dr. Dubuc.

4. "On *Carex pædiformis* and other new Austrian Plants," by Dr. Adolph Senoner. Dr. S. particularly called attention to *Carex pædiformis*, Meyer, discovered during last summer in Hungary by Professor Harzlinziky.

"Report on the state of the Society's Herbarium," by Dr. Anderson, Curator.

"Since the last report on the state of the Herbarium was read, great progress has been made towards the complete arrangement of the collection.

"Last autumn, the cabinets and their contents, with the exception of those containing the British plants, were removed to a commodious room in the new museum at the Botanic Garden.

"The Society's collection of British plants, which still remains in the Society's rooms at the University, is now, by the labours of Mr. Lawson, in a perfect state, and will prove a valuable aid to those who may be studying critical species or the geographical distribution of plants in the British Isles. The Europæan Herbarium is also in a most satisfactory condition, but its arrangement is not yet quite perfect. The collection is one of great extent, comprising plants from nearly all the countries of Europe. During last year it has been enriched by valuable contributions from Spain and Portugal, and by a very complete set of Scandinavian plants from Professor Blytt, of Christiania. The Asiatic portion of the collection is the most extensive and perhaps the most valuable of the whole. It consists principally of plants from the East Indies, with a few from Arabia and Syria, part of the collection left to the Society by Mr. Christy. The Indian plants have been collected by Roxburgh, Wallich and Wight, the Countess of Dalhousie, Dr. Cleghorn, Captain Campbell and Dr. Jameson, of the Company's Gardens at Saharunpore. By the labours of Dr. Cleghorn and myself, the naming and arranging of the species have advanced to the Ochidaceæ, but still much has to be done in the way of revision, &c. The Society's collection is rather rich in African plants, of which a considerable number of species is from the Cape of Good Hope, some named, but the greater part undetermined.

"The Society have also a large and good collection of plants from America, principally from North America, contributed by Dr. Gavin Watson of Philadelphia, Mr. James M'Nab, and Dr. Philip Maclagan.

"The number of South American plants (rarities in all herbaria) is small. Within the last two years the amount has, however, been increased by very valuable parcels from Mr. Spruce. Since the last report a considerable collection of Australian plants has been purchased.

"In concluding this report, allow me to congratulate the Society on the flourishing condition of its Herbarium; and also to request that the younger members will come forward and assist in completing its arrangement. There is still much to do, and we only require workers; and lastly, I would remind any of our members that may go abroad, that though far removed from us and our meetings, they are still members, and as such they should remember the interests of the Society and its Herbarium; and as a proof I would, as Curator of the Museum, request them to send home specimens of the plants occurring in their respective localities."

MISCELLANEOUS.

On Sciurus glacialis (Læmargus borealis, *Müll. & Henle*) *and its Parasites.* By P. J. Van Beneden.

This fish inhabits the northern seas; it is very common on the coasts of Iceland and Greenland, but exceedingly rare on the European coasts. It is called *Haakal* by the Icelanders; *Aepekalle* by the Belgian fishermen. A specimen was taken in May last by the Ostend fishermen, and came into Prof. Van Beneden's hands quite fresh; its parasites in fact were still living.

The stomach contained at least twenty carapaces of *Æga marginata*, with some *débris* of a *Loligo* and *Echiurus*, and some other matters which could not be distinguished.

The right eye was covered by an enormous specimen of the *Lerneopoda elongata*, Kroyer, firmly attached to the sclerotic coat.

The abdominal cavity contained three large *Tetrarhynchi* in the Scolex state; they were attached by their trunks to the peritoneum. This *Tetrarhynchus* is new; Prof. Van Beneden describes it under the name of

T. linguatula, V. B.

In form this worm differs so much from all other species of *Tetrarhyncus*, that, at first sight, it would not be supposed to belong to that genus; it resembles neither a Tænioïd nor a vesicular worm. It is entirely white. In the state of Scolex the worm consists of two distinct parts; a rather broad anterior portion of a firm consistence, (the head), and a very delicate ribbon-like posterior portion.

The anterior part, or head, is furnished with four very short trunks, resembling a wine-glass in form when torn out, and covered with strong hooks arranged in a quincuncial order. Of these there are about twenty in each circle. Each hook consists of a recurved spine which is directed forwards when the trunk is not exserted, and of a rather large base inserted into the skin, rounded at one end and pointed at the other. The head is flattened like the body of the *Linguatula* of the dog; it has on each side a furrow indicating the point of union of the bothridia, of which there are but two; the furrows only reach half the length of the head. Total length 50 millim.

In the stomach there were several hundred Nematoïd worms, which the author has not yet determined; one extremity of their bodies was always rolled spirally.

Several large Cestoïd worms were found in the spiral intestine and in the narrow portion of the stomach; some of them measured a foot in length; they form a new species of the genus *Anthobothrium*.

A. perfectum, V. B.

The anterior portion of the bothridia is hollowed into a sucker; the posterior portion has always a boat-like form. The strobila is formed of a great number of individuals; it is narrow in front, but broad and tolerably thick in its posterior portion. The segmentation is only visible at some distance from the bothridia. The proglottides are longer than broad, with a black spot in the middle of each. The ovaries are inflated and become black when exposed to the light. The ova much elongated, but without filaments.

The gills of the fish nourished five specimens of a Trematode worm, which has been confounded by Kroyer and Diesing with *Polystoma appendiculata*, a species which lives on *Mustelus vulgaris* and *Scyllium caniculum*. The author says that it is not only distinct from that species, but that it may even form the type of a new genus, distinguished by having Y-shaped hooks on the caudal appendage. He gives it the name of *Onchocotyle borealis*, but does not describe it any further at present.—*Bull. de l'Acad. Roy. de Belgique*, 1853, pt. 2. p. 258.

ON THE GENUS LATIA.

M. Reclus in the 'Journal de Conchyliologie' for July 1851, describes a shell under the name of *Crepidula neritoides*, p. 205. t. 6. f. 16, 17, as coming from *New Holland*, observing that he received it from Mr. Cuming under the name of *Lottia neritoides*. This is the shell which I described in a paper read at the Zoological Society on the 11th of December 1849, and published at length in the 'Annals of Natural History' for January 1851 (vol. vii. p. 68), under the name of *Latia neritoides*. It is almost unnecessary to observe, that it has not so much affinity with *Crepidula* as *Ancylus* has to *Patella*; that it is from New Zealand, and not from New Holland; and that Mr. Cuming never could have referred it to the genus *Lottia*! I should not have thought it requisite to have mentioned these inaccuracies, not very creditable to his reputation as a conchologist, if M. Petit in the 'Journal de Conchyliologie' for 1852, iii. p. 260, after the error had been pointed out to him, had not wished to make it appear that the genus *Latia* was really not published until after M. Reclus' paper had come out, because he erroneously states that the printing of the 'Proceedings' of the Zoological Society for the year 1849 was deferred, because the volume for 1850 has been so delayed, overlooking the fact that the paper, with the description of the genus, had also appeared entire in the 'Annals of Natural History' for January 1851, when M. Reclus' paper was not printed until July of that year. But M. Petit overstates his case in his anxiety to justify his friend; he declares that M. Reclus received the shell without any note of its habitat, when in the description of the shell he gives it as coming from *New Holland*, without any mark of doubt. Or are we to consider this as a gratuitous addition? if so, what authority are we to place in the other habitats given by this author? M. Petit objects to my having used two generic names so alike as *Lottia* and *Latia* (!), and further asks if the genus is distinct from *Grunlachia* of Pfeiffer. When he made this inquiry he could scarcely have compared the figures of the two shells, which are both given in his Journal.—John Edw. Gray.

The Anglesey Morris, Leptocephalus Morrisii.

In vol. ii. page 409 of the second edition of Yarrell's British Fishes, the fish mentioned above is described, and although "twenty specimens had then been taken, within a few years, on different parts of the coasts of England, Wales, and Ireland," there is no mention of it as having been found in Scotland. It is with great pleasure I am able to state, that one was taken at Wick, N.B., about six years ago, by a fisherman, who took it to Mr. Nichol, druggist, of Pulteney Town, Wick, in whose possession my son Joseph saw it, preserved in spirit, since which I have examined it, and find that it agrees in every respect with those described in Yarrell; it is about six inches in length, and in a good state of preservation.

As I have no work on the fishes of Scotland to refer to, I think it right to give publicity to this interesting addition to the Scottish Fauna. Chas. W. Peach.

Wick, 18th Feb. 1854.

FIGURED PEARLS OF THE CHINESE.

Some years ago I described the Chinese mode of producing artificial pearls of a large size and regular form (Ann. Philos. ix. 27). Mr. Fortune has lately sent to England some specimens of *Dipsas plicata*, showing that the Chinese have improved on the process. In the specimen I formerly described, the artificial matrix was a plano-convex piece of mother-of-pearl producing a rounded pearl. In those now sent the pearls each represent a Chinese joss or sitting figure of about an inch in length, and there are often as many as eleven or twelve in each valve, forming three parallel lines, all with the head of the figure directed towards the margin of the shell. They are all of the same form and size, and the matrix is a soft white metal: it is evidently thin, as they do not add much to the weight of the shell. In the specimens I have seen the matrices are most regularly and evenly covered with the pearly layer, but the covering is so thin that I doubt if they can be used for ornament, and rather suspect that they are manufactured for the purpose of being sold as curious shells than for the purpose of setting.

M. Oscar Marescaux has kindly shown me some similar specimens sent from China by his brother Alfred, who procured them from Loo Choo Lake. He has also one of the pieces of metal taken from one of the shells; it is thin, rather brittle, and evidently cast from a kind of bell metal, with a concave inner and a smooth whitish convex outer surface, showing the copper colour on the edge.—John Edw. Gray.

On a Migration of Dragon-flies. By M. C. Morren.

In a short notice communicated to the Royal Society of Belgium, M. Morren mentions, that on the 16th of June last, at about four o'clock in the afternoon, an immense swarm of dragon-flies was seen at Hasseignies, in Hainault, flying towards the north-west. The passage of these insects lasted for about three-quarters of an hour, over a surface of at least three-quarters of a league. Those which flew lowest were at a height of from 6 to 7 feet from the ground, but it was impossible to judge of the elevation of the highest fliers. The species was the common *Libellula depressa*, Linn. No reason could be ascertained for this extraordinary migration.—*Bull. de l'Acad. Roy. de Belgique*, 1853, pt. 2. p. 323.

METEOROLOGICAL OBSERVATIONS FOR JAN. 1854.

Chiswick.—January 1. Clear and frosty: snowing: frosty. 2. Frosty throughout: severe frost at night. 3. Severe frost, with fog: overcast. 4. Overcast and cold: snow 7 inches deep. 5. Thick haze: rain and sleet: 2 inches additional depth of snow. 6. Hazy. 7. Heavy rain. 8. Clear and fine. 9. Rain: foggy: rain at night. 10, 11. Cloudy and cold. 12. Cloudy: slight rain. 13. Slight haze: clear. 14. Clear: hazy. 15. Foggy: cloudy. 16. Dense fog: overcast. 17. Cloudy. 18. Densely clouded: overcast. 19. Dense fog. 20. Rain: overcast. 21. Fine: frosty. 22. Frosty haze: clear and fine: overcast: frosty. 23. Foggy: very fine. 24. Cloudy and windy: rain: frosty. 25. Frosty: clear and fine: cloudy. 26. Fine: very clear. 27. Densely overcast: rain. 28. Slight rain: cloudy: clear. 29. Boisterous, with rain: overcast. 30. Cloudy and mild: clear. 31. Overcast: cloudy.

Mean temperature of the month	37°·88
Mean temperature of January 1853	40 ·41
Mean temperature of Jan. for the last twenty-eight years .	36 ·68
Average amount of rain in Jan.	1·74 inch.

Boston.—Jan. 1. Fine. 2. Cloudy: snow A.M. and P.M. 3. Cloudy: thermometer at 8 A.M. 5°. 4. Stormy: snow-storm A.M. and P.M. 5. Cloudy. 6. Cloudy: snow A.M. 7. Cloudy: rain P.M. 8. Cloudy: rain A.M. 9—13. Cloudy. 14. Fine. 15. Cloudy: rain early A.M. 16—19. Cloudy. 20. Cloudy: rain P.M. 21. Cloudy. 22, 23. Fine. 24. Cloudy: rain A.M. 25. Fine. 26. Fine: rain A.M. 27. Cloudy. 28, 29. Cloudy: rain A.M. 30. Fine. 31. Cloudy.

Sandwick Manse, Orkney.—Jan. 1. Snow-drift A.M.: snow-showers P.M. 2. Bright A.M.: cloudy P.M. 3. Bright A.M.: snow-showers P.M. 4. Bright A.M.: clear P.M. 5. Bright A.M.: snow-showers P.M. 6. Bright A.M.: clear P.M. 7. Thaw A.M.: sleet and rain P.M. 8. Sleet-showers A.M. and P.M. 9. Bright, frost A.M.: cloudy P.M. 10. Bright, frost A.M.: clear P.M. 11. Clear, frost A.M.: clear P.M. 12. Snow-showers A.M. snow-drift, showers P.M. 13. Clear, fine A.M. cloudy P.M. 14. Cloudy A.M.: clear, frost P.M. 15. Bright A.M.: clear, aurora P.M. 16. Bright A.M.: rain P.M. 17. Cloudy A.M.: clear, aurora P.M. 18. Bright A.M.: cloudy, aurora P.M. 19. Bright A.M.: cloudy P.M. 20. Bright A.M.: cloudy, aurora P.M. 21, 22. Cloudy A.M. and P.M. 23. Clear A.M.: cloudy, aurora P.M. 24. Cloudy A.M.: clear P.M. 25. Cloudy A.M.: sleet-showers, lightning P.M. 26. Hail-showers A.M.: cloudy P.M. 27. Cloudy A.M.: showers P.M. 28. Showers A.M. and P.M. 29. Showers A.M.: showers, aurora P.M. 30. Drizzle A.M.: drizzle, aurora P.M. 31. Showers A.M.: cloudy P.M.

Mean temperature of Jan. for twenty-seven previous years ...	38°·46
Mean temperature of this month	36 ·47
Mean temperature of Jan. 1853	38 ·55
Average quantity of rain in Jan. for thirteen previous years .	4·35 inches.

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.
1854. Jan.	Max.	Min.	8½ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8½ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	29·427	29·378	29·16	29·35	29·22	32	17	22	28	28	sw.	nnw.	n.	....	....	....
2.	29·291	29·205	29·08	29·04	29·18	32	4	23·5	34	34	sw.	se.	nw.	....	....	·48
3.	29·316	29·132	29·22	29·32	29·54	32	28	21	34	32½	e.	se.	ne.	....	·15	·19
4.	28·940	28·912	28·97	29·57	29·53	32	31	31	23	27	se.	ese.	ne.	·86	....	....
5.	28·920	28·900	28·78	29·47	29·34	36	31	31	27	32	ne.	e.	ne.	·03	·20	·13
☽ 6.	29·104	28·989	28·82	29·27	29·29	38	28	30	27	23½	w.	e.	e.	·08	....	....
7.	29·158	28·851	28·93	29·22	29·25	42	37	32·5	33	34	s.	e.	e.	·33	·06	·50
8.	29·169	28·897	28·69	29·35	29·51	46	31	36	35	35	sw.	sw.	ene.	....	·12	·60
9.	29·119	29·096	29·00	29·61	29·74	40	37	30	34	30	e.	e.	ne.	·06	....	·61
10.	29·606	29·435	29·28	29·94	30·01	38	34	36	28½	26	n.	nnw.	se.	·02	....	·25
11.	29·896	29·833	29·66	30·00	29·89	38	31	34	31	30	n.	n.	ssw.	....	....	....
12.	29·833	29·659	29·59	29·62	29·52	40	29	33	33½	35	se.	s.	s.	·02	....	....
13.	29·656	29·596	29·43	29·42	29·42	42	28	31	37½	37	s.	ssw.	s.	·08	....	·30
○ 14.	29·873	29·707	29·40	29·48	29·56	45	26	33	37	33	sw.	wsw.	se.	·10	....	....
15.	29·715	29·624	29·45	29·56	29·62	40	32	34	37	36	se.	ese.	s.	....	·04	·08
16.	29·863	29·815	29·60	29·62	29·43	46	41	33	34	39	se.	s.	s.	·01	....	....
17.	30·076	29·928	29·63	29·43	29·54	48	45	44	40	42	sw.	ssw.	sw.	·01	....	·28
18.	30·151	30·134	29·79	29·64	29·78	48	35	48	44	40½	sw.	ssw.	s.	....	....	·03
19.	30·065	29·944	29·75	29·58	29·45	45	29	39	42	41	se.	s.	s.	....	....	....
20.	30·005	29·927	29·60	29·49	29·33	51	35	43	44½	41½	sw.	s.	s.	·01	....	....
21.	30·267	30·175	29·94	29·89	29·63	50	28	40	42	44½	s.	ssw.	s.	....	·03	·04
☾ 22.	30·107	29·978	29·66	29·80	29·62	49	24	40	44	44	sw.	ssw.	se.	....	....	·09
23.	30·089	30·028	29·77	29·73	29·23	50	36	34	39	42½	s.	ssw.	se.	....	....	....
24.	29·743	29·576	29·35	29·03	29·27	51	24	42	38½	39	sw.	s.	wsw.	·02	....	·21
25.	30·123	30·084	29·77	29·34	29·10	48	36	31	39	41	sw.	ssw.	wsw.	·06	·03	....
26.	30·536	30·331	29·90	29·47	30·06	50	26	36	35	41	sw.	sw.	w.	....	....	·23
27.	30·487	30·267	29·10	29·53	29·40	46	42	38·5	48	43	sw.	s.	sw.	·03	·17	·07
● 28.	30·172	30·095	29·75	29·65	29·46	49	29	45·5	39	39	sw.	w.	s.	·10	·04	·18
29.	29·934	29·808	29·37	28·88	29·30	53	48	48	42	39½	sw.	sw.	wsw.	·10	·08	·14
30.	30·141	30·111	29·70	29·48	29·35	52	45	52	41	41	sw.	sw.	w.	....	....	·18
31.	30·204	30·088	29·77	29·65	29·59	53	40	51·5	38½	40	w.	wsw.	wsw.	....	....	·13
Mean.	29·773	29·661	29·41	29·497	29·490	43·93	31·83	36·2	36·45	36·50				1·92	0·92	4·72

THE ANNALS

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XXII.—*On the Structure of the* Echinoderms. By Johannes Müller.

[Concluded from p. 123.]

Crinoidea.

Nature has produced no transitional form between the Sea-urchins and the Starfish, which would be a flattened Sea-urchin with an ambulacral abdominal surface and an entirely antambulacral dorsal surface, but with only the double series of interambulacral plates of the Sea-urchins. The sole approximation to this form is the pentagon of the pentagonal kinds of Starfishes, whose interambulacral plates always form a triangular accumulation, of which only those plates which border upon the ambulacrals are arranged in a similar order to these. Much nearer the Sea-urchins in form, but not in composition, are, among the Crinoids, the *Blastoidea* possessing a solid shell and no free arms, especially those *Pentremites** with rounded calyces, and the genus *Elæocrinus*, Rœmer. The apex has enlarged into the antambulacral area of the calyx. However, the composition of the interambulacral areæ of the calyx departs far more widely from that in the Sea-urchins than these do from the Starfishes; in the *Blastoidea* these areæ are formed partly by the five radialia which are disposed in the direction of the radii, partly by the interambulacral azygos deltoid pieces, a conformation which can be compared to nothing in the interambulacral areæ of the Sea-urchins. The composition of the ambulacra is also aberrant in the *Pentremites*, as well from those of the *Asteridæ* as from those

* See, for an elaborate comparison of *Pentremites* with *Asteridæ* and *Ophiuridæ*, Prof. E. Forbes's Memoir on the British *Cystideæ*, Mem. Geol. Survey.—Transl.

of the Sea-urchins; this is evident from the analysis of the *Pentremites* given by Rœmer. In *Pentacrinus* the antambulacral and ambulacral zones of the calyx (with ambulacral grooves) are equal, and both have become produced upon the moveable arms. The development of the antambulacral side of the radii in the Crinoids takes place either from the very base of the calyx, or from its circumference, or in the neighbourhood of the mouth, as in most *Cystideæ*. In the latter case, the calyx presents no radial arrangement of plates from the base to the immediate neighbourhood of the mouth; it begins only at the mouth in the oral arms, whose ambulacral grooves however lead to the mouth, and, like the articulated antambulacral surface of the arms, present no traces of the general plan of the Echinoderms. Hence it is intelligible why, so long as the Cystideans were held to be armless, the radial arrangement of the Echinoderm was unrecognised.

The determination of the different structures which occur in the radii of the Crinoids is not always easy, but I have come to the following conclusions:—*Radii* are radial divisions of the Crinoid for the reception of the ambulacra, and they are either *calycine radii* or *arms*. *Calycine ambulacra* are grooves with suckers upon the ventral surface of the calyx in the direction of the arms when these exist. *Ambulacra of the arms* are the ventral surfaces of the arms and pinnulæ, provided with suckers. The *Blastoidea* have calycine ambulacra without arms. Many Crinoids, as *Actinocrinus, Platycrinus,* &c., have arms without calycine ambulacra or clefts of the calyx; the *Pentacrinites* and their allies possess both arms and calycine ambulacra. The arms are articulated in either one or two series, and are either simple or dichotomously divided. The divided arms arise from an undivided arm-basis, which is either articulated upon the calyx or is enclosed by its plates. The arms therefore are probably not originally double. The *pinnulæ,* on the other hand, are always in double rows and are never divided or branched. They are articulated processes either of the calycine ambulacra (*Blastoidea*) or of the ambulacra of the arms. Where arms are present the pinnulæ are absent on the calyx, and first appear as the arms become free from the calyx. They are articulated either in single or in double series, and are provided upon their ventral surface with suckers, like the arms and calycine ambulacra. Every single joint of the arm, or every segment of the ambulacrum (*Blastoidea*), has only one pinnula. The pinnulæ always alternate. Unquestionable examples of arms without articulated *pinnulæ* are afforded by *Cupressocrinites*; of *pinnulæ* without arms by *Pentremites*. *Pinnulæ* composed of a single piece, forming series upon a joint (of an arm) like the little plates on the arms of *Cupressocrinites*, pass into marginal ambulacral plates, which are erect plates along the sides of the ambulacral grooves, and may occur as well along the ambulacral grooves of the calyx as of the arms and *pinnulæ* (*Pentacrinus*). They are set so closely upon the arms, that many occur upon a single joint. *Pentacrinus* possesses both marginal plates and *pinnulæ*. *Spines* or *bristles* are unarticulated appendages of the arms, and occur only in the division of *Crinoidea costata* (*Saccocoma*); they are arranged in pairs and opposite, upon each joint of the arms, thus differing from the pinnulæ, which are articulated and alternate. *Cirri* are articulated processes on the stem of the Crinoids and on the terminal knob of the *Comatulæ*.

The ambulacra of the recent Crinoids are treated of in the memoir upon *Pentacrinus*; they are grooves which are continued from the mouth upon the perisoma of the calyx towards the arms and *pinnulæ*, covered by a soft membrane, and in *Pentacrinus* supported upon each side by perpendicular calcified marginal plates. Within the grooves there are two series of fine apertures upon which the minute suckers are seated. Upon the arms and *pinnulæ* the calcareous formations are limited on the ventral surface to the marginal plates of the ambulacral grooves. On the calyx, on the other hand, the ambulacral grooves are supported by calcareous deposits in addition to the marginal plates. Those plates which form the edges of the ambulacral grooves have a wall-like elevation, and serve not only to embrace the ambulacra but to support the erect marginal plates; they may be called the lateral ambulacral plates; they are distinguished, like the marginal plates, from the other ventral plates by the absence of the problematical calycine pores which characterize the latter. Beneath the soft covering of the groove little plates also lie, which were indicated in the memoir upon *Pentacrinus*. For the sake of comparison with the ambulacral plates of the Sea-urchins and Starfishes, I thought it important to subject these subambulacral plates to a closer examination. They form a single and therefore azygos series under the membrane of the groove, and are united to the lateral ambulacral plates by a firm membrane, in which lie the ambulacral pores. These pores are usually situated between the lateral series of plates and the median series. A semicanal is excavated upon the upper surface of the median series of plates, which appears destined to receive the ambulacral vessel. The ambulacral vessel would therefore, as in the *Asteridæ*, lie upon the outer surface of the ambulacral skeleton, and, as in them, be covered by the soft skin of the ambulacral cleft, while the ambulacral pores which are connected with the feet should perhaps be interpreted as passages leading to ampullæ. The presence of calcareous plates renders microscopical investigation impossible, and allows only of dissection under the simple lens, by which the constitution of the plates and the ambulacral pores may be very well detected, but the relation of the feet to the ambulacral vessels is not directly observable. The entire inner surface of the calyx is loosely lined by a membrane, which also contains very minute microscopic calcareous plates. In making a general comparison of the ambulacra in the different orders, it is important to remember that *Pentacrinus* possesses not only median azygos but also lateral conjugate ambulacral plates, and that the ambulacral pores lie between the two. The ambulacra of *Pentremites* so far agree with this, that, according to Rœmer's exact analysis, they possess besides the conjugate plates, a median azygos plate, which however runs under the whole ambulacrum. The ambulacral vessel and its lateral branches towards the pinnulæ, discovered by Rœmer and Yandell, most likely lay above the plates, not under them, and the ambulacra were probably covered by a soft membrane, as in *Pentacrinus*.

The general arrangement of the ambulacral vessels follows one plan in all Echinoderms, but the composition of the ambulacral skeleton and the position of the ambulacral vessels in relation to it are subject to very great variations in the different organs. The ambulacral plates of the Sea-urchins, Starfishes and Crinoids differ essentially from one another, as much as the system of dorsal and interambulacral plating.

There exist however certain azygos median pieces in different divisions, which, when they are present, lie upon the dorsal side of the ambulacral vessel; to this series belong the subambulacral plates of *Pentacrinus*, the great subambulacral plate of the *Pentremites*, the rotulæ in the oral skeleton of the Sea-urchins, and those portions of the oral skeleton of the *Holothuriadæ* above which the ambulacral canals pass to the walls of the body.

Cystideæ.—Among the Crinoids the *Cystideæ* of L. von Buch form a group which is distinguished by the inclusion of the genital organs, together with the other organs, in the calyx. In the *Pentacrinites* and *Comatulæ* on the other hand, the sexual organs are attached to the pinnulæ of the arms; in those Crinoids which have only one calycine opening (mouth), as *Actinocrinus, Platycrinus*, &c., the exclusion of the sexual organs from the calyx is at once rendered probable by the absence of any aperture corresponding with them. The *Cystideæ*, on the other hand, have at least two and sometimes three apertures to their calyx, one of which, distinguished by its valvular closure, is found in no other Crinoids than the *Cystideæ*. L. von Buch has determined that this valvular pyramid is the genital aperture. We owe to him the recognition of the close alliance of these forms with the Crinoids, and at the same time of their peculiarities, the exact analysis of their calyces and the exposition of their genera. That they are not armless, as had hitherto been generally supposed, was first observed by A. von Volborth, who discovered the arms in *Echino-encrinus angulosus* and *striatus*, subsequently in *Echinosphærites aurantium*, where they proceed from the mouth. The figures of the Duke of Leuchtenberg, and those of Volborth of *Sphæronites Leuchtenbergii* and *Protocrinites oviformis* would indicate the presence of arms in these also, although they have not been actually obtained. In fact, branched grooves run from the mouth over a great part of the calyx; the branches of the grooves however end in papillæ of the calyx, which must be regarded as points of origin of arms—a circumstance so much the more remarkable, as it would follow that the arms of these *Cystideæ* must have had a position far removed from the mouth (Verhandl. d. Konigl. Mineralog. Gesellschaft zu Petersburg, 1845–46, Petersb. 1849). A specimen of *Sphæronites Leuchtenbergii* in Von Buch's collection agrees exactly with these figures. When, in his second essay, L. von Buch founded the order *Cystideæ* (1844), the oral arms of *Echino-encrinus* were already known. He did not regard them as Crinoid arms, but called them feelers. With a correct foresight he even then arranged the *Pseudocrinites* and *Agelocrinus*, with long arms passing from the oral part of the calyx, among the *Cystideæ*, but was not inclined to consider these processes as true arms. He had even in 1840 termed the remains of the three arm-like processes in *Hemicosmites* arms or proboscides, but was led away from a just comprehension of their nature by comparing them with oral tubes.

In his beautiful monograph on the British Cystideans (Mem. Geol. Survey, t. ii. Lond. 1848) Forbes has increased the number of forms with oral arms. He divides the *Cystideæ* into,—1st, those with arms: *Pseudocrinites, Apiocystites, Agelocrinites*; 2nd, those with oral pinnulæ: *Prunocystites*; and 3rd, armless forms: *Caryocystites* and *Sphæronites*; to which latter the British form *Echino-encrinus* is added. Forbes considers that the arms observed by Volborth in the Russian species of *Echino-encrinus* are oral pinnulæ. The oral arms of *Echino-encrinus* and *Prunocystites* are articulated in two series. Volborth observed that in the former they are beset with small plates upon their ambulacral surfaces, which he calls tentacles, remarking that pinnulæ are absent. These plates have the characters of marginal plates, which in the Crinoids (*Pentacrinus*) occur on the arms as well as on the pinnulæ. In *Echino-encrinus angulosus* the remains of six arms were present. That this number does not agree with the five depressions which usually surround the mouth is explained by the fact, that the number of these facets varies; Von Buch states that there are five or six; and I possess a specimen with eight round depressions about the mouth, which are united with the mouth by grooves. *Echino-encrinus striatus* possesses, according to Volborth, together with a very much narrower pointed oral extremity of the calyx, only two much larger opposed oral arms, which have the same structure as in *Echino-encrinus angulosus*. From their relations, however, it is probable that these are not pinnulæ, but arms; for it is not usual for pinnulæ to be isolated. If they both belong to a single ambulacrum, how are we to imagine a single ambulacrum in this locality in the immediate neighbourhood of the mouth? If, however, they belong to two different ambulacra, they can, as solitary structures, be only arms.

The arms of *Echinosphærites aurantium*, Wahlenb. (*Sphæronites aurantium*, His.) have essentially exactly the same relations as Volborth has described and figured. In such well-preserved specimens as now lie before me, the origins of three articulated arms at the oral region of the calyx are recognizable. The five uppermost calycine plates are raised into a three-sided pyramid transversely truncated above, whose obtuse edges are prolonged into the arms. Two sides of the pyramid are broader than the third. The sutures between the five pieces are so disposed that two of them are situated upon the broader side of the pyramid, the three others in the obtuse edges. Two supplementary pieces, however, are added to the five principal portions of the pyramid, and extend from the calyx into two of the angular sutures. The pore-grooves of the plates of the calyx extend only on to the lower portion of the circumference of all the seven pieces. The arms immediately subdivide again. From the oral aperture grooves, beset with marginal plates, pass on to the arms. For the rest, the division of the arms shows that they are arms, and not pinnulæ. Whether these arms, like those of a few other Cystideans, as *Pseudocrinites*, were provided with articulated pinnulæ, cannot be decided, since they are broken short off. Whether the *Caryocystites* possessed arms is not as yet known, but it can hardly be doubted, since they are not certainly distinguishable from *Echinosphærites*.

In *Hemicosmites*, three of the six uppermost plates of the calyx are provided with an insection, which arises from the triradiate median calycine opening. Each of the insections is continued into a groove; the groove terminates after a slight expansion in an elevation of the calyx which served for the attachment of an arm. The elevation no longer lies on the plates of the uppermost, but upon three of the plates of the second series. The elevation exists only in specimens which are not worn down, and is beautifully obvious in a specimen which M. Ewald has sent me. The triradiate clefts of the calyx, and the calycine grooves continued from them, are covered with minute plates which readily fall off. In the specimens figured by L. von Buch, they are still perfect, and form a fine series of plates from the mouth to the ventral surface of the three arms. In this series, again, three delicate grooves are distinguishable, as in *Echinosphærites aurantium*, which correspond with the subjacent clefts of the large plates of the calyx and their grooves. In the always much worn specimen of *Cryptocrinites cerasus*, no indications of arms have hitherto been observed.

Forbes regards the *Cystideæ*, like the *Blastoidea*, as sections of the Echinoderms different from the Crinoids. The *Sphæronites* were already arranged among the Crinoids by reason of their stalks before their arms were discovered, and we now have still more reason for considering this to be their true position. Volborth and Rœmer consider the *Cystideæ* as a group of Crinoids, which is also my own view. The position of the arms, however, must not be regarded as one of their characters; for in *Sphæronites Leuchtenbergii* and *Protocrinites oviformis* the arms were situated far away from the mouth, as in the other Crinoids.

The suctorial feet of the Cystideans were unquestionably placed, as in *Pentacrinus*, on the ambulacral side of the arms and in the calycine grooves. In the introductory part of this essay, however, it has been demonstrated to be contrary to all analogy that suctorial feet should exist in any Echinoderm upon the antambulacral side of the perisoma from the apical end to the arms, or between the ambulacral radii. In the *Cystideæ*, therefore, the whole calyx, with the exception of the calycine grooves, is to be regarded as anambulacral.

The genera *Pentacrinus*, *Caryocrinus*, and most Cystideans are distinguished among the Crinoids by the existence of very peculiar pores in the anambulacral plates of the calyx. *Pentacrinus* alone has afforded the opportunity of an exact investigation of these pores. I have described and figured them in the essay upon *Pentacrinus*.

The interambulacral (interpalmar as well as intrapalmar) calycine pores of *Pentacrinus* pierce the ventral calycine plates, and lead beneath the inner membrane of the calyx. They possess no soft external prolongations. In contrast with the ambulacral calycine pores for feet, these may be called anambulacral calycine pores. Their signification is not understood, only it is certain that they are not passages for feet. A comparison with the respiratory pores of the *Asteridæ* suggests itself; soft tubes project from these, with regard to which Ehrenberg has shown (and I can confirm his statement by my own observation) that they are cæca, which are indeed connected with the abdominal cavity, but are perfectly closed externally.

The calycine pores of *Caryocrinus* are equally without relation to the arms; and thence, though differently distributed, resemble the anambulacral calycine pores of *Pentacrinus*. They occupy the antambulacral part of the calyx behind the arms as far as its base.

Most Cystideans (*Cryptocrinites cerasus* excepted) possess calycine pores, which are distributed over a greater or smaller part of the calyx without radiation and in a very peculiar manner. In those forms with calycine grooves, as *Protocrinites* and *Sphæronites Leuchtenbergii*, these pores again appear to be anambulacral, since, like the anambulacral pores of *Pentacrinus*, they are disposed in the areæ external to and between the ambulacral grooves; here, however, their distribution is far wider, since they extend as far as the base.

Two principal divisions have been made, according to the distribution and combination of these pores:—

I. Cystideans with pore-rhombs. The pores are disposed in rhomboidal figures, the one-half of which belongs to one plate, the other to its contiguous neighbour. Every two pores of these rhombs appear to be invariably united by canals or grooves, which are visible either upon the outer or on the inner side of the plates, in such a manner that the united pores belong to two different adjacent plates.

a. Pore-rhombs without external connexion of the pores. *Hemicosmites* and *Caryocrinus*; in *Hemicosmites* the combining grooves are, according to Volborth, upon the inner surface of the plates.

b. In *Echinosphærites granatum*, Wahlenb. (*Caryocystites granatum*, v. B.), the pores are united by bands projecting externally, which contain the connecting canal of the pores, and this canal is always a single one between each pair of pores, or even a series of pores*. The more importance is to be attached to this circumstance, as the number of the calycine plates, even of the basal plates in *Caryocystites granatum*, varies, so that some specimens possess more superimposed plates than others, and even specimens with five basal plates are not rare. According to the arrangement of the plates, I do not think that *Caryocystites* and *Echinosphærites* could be separated.

A form nearly allied to *Caryocystites granatum*, observed by M. Beyrich (Drift [*Geschiebe*] near Berlin), the plates of whose calyx are more numerous, is distinguished by the bands which

* . . . und dieser Canal ist immer ein einziger zwischen je zwei Poren, oder selbst einer Porenreihe.

unite the pores belonging to an entire series of pores, which penetrate the entire thickness of the plates, so that the series of pores appear also upon the inner surface of the plates. Something similar may also be observed in many specimens of *Caryocystites granatum,* inasmuch as the canals of the bands not unfrequently also exhibit clefts here and there between the terminal pores. These clefts may indeed be readily explained by the grinding down of the canals; the occurrence of the regular rows of pores in the species above mentioned, however, leads us to question whether they always have this origin.

c. In *Echinosphærites aurantium* and *aranea* every two pores of two plates are not uncommonly connected by one, usually by two canals, which are recognizable upon the outer surface of the plates; *Echinosphærites testudinarius,* included by Von Buch in the ill-defined genus *Caryocystites,* is an elongated Echinosphærite. Its pore-rhombs agree more closely with the previously-named species than with *Caryocystites granatum,* though the number of the pore-canals between every pair of pores is in some localities still greater. In fact, we not unusually observe not only two, but three, or even four conjoined canals, which open at both ends into a pore, and are so connected.

d. The genera *Echino-encrinus, Pseudocrinites, Apiocystites, Prunocystites,* are distinguished by possessing only a few pore-rhombs—fragments of the system—which however are here justly termed pore-rhombs. In *Echino-encrinus angulosus* and *striatus* there can be no doubt that the elongated pores of these rhombs are clefts which penetrate the whole thickness of the plates. Forbes remained in doubt with regard to these pores, and was inclined to interpret the 'pectinated rhombs' as the situation of ciliary organs comparable with the ciliated epaulettes of the larvæ of *Echini.* Seeing the very problematical nature of all pore-rhombs, and of all non-ambulacral pores of the Crinoids, in fact, the supposition that the cilia are connected with the pores and pore-canals is not to be excluded.

The number of the pore-rhombs in the *Echino-encrinites* appears to vary, and *Echino-encrinus granatum,* Volb., would appear to be only such a variety of the *E. angulosus.*

II. Cystideans with double pores upon the calycine plates, which belong not to two different plates, but to the same. The plates are facetted, and each facet possesses two closely approximated pores. Here belongs a small group of Cystideans, which, since it consists of many genera, might be called *Diploporitidæ* (*Diploporiten*). The genera included in it are:—

1. *Sphæronites pomum,* His. Type of a peculiar genus, which may retain the name of *Sphæronites,* as opposed to the *Echinosphærites* with pore-rhombs.

2. *Protocrinites* (*P. oviformis*, Eichw.).

3. *Sphæronites Leuchtenbergii*, Volb. Type of a peculiar genus, which may be termed *Glyptosphærites*. That the Russian *Sphæronites pomum*, Leuchtenb., or *S. Leuchtenbergii*, Volb., is not the Swedish *S. pomum*, Volborth thought probable from Gyllenhal's account. The specimens of the Swedish form in the Mineralogical Museum of this place put this beyond doubt. There are no calycine grooves on the true *Sphæronites pomum*, His.; on the other hand, the five outermost calycine plates are elevated into a triangular pyramid truncated at the mouth, as in *Echinosphærites aurantium*; the edges of the pyramid are broken off in all the specimens, and leave a doubt as to the form of the arms which were probably present. The base of the calyx is transversely truncated, and very broad in relation to the diameter of the calyx; it consists of 6–7 pieces.

The relation of a few other *Diploporitidæ* to these genera is still unknown. Many of the Cystideans described by Forbes, and enumerated by him among the *Caryocystites*, viz. *C. Litchii* (F.), *C. pyriformis* (F.), *C. munitus* (F.), do not belong to the genus *Caryocystites* (Von Buch), being rather *Diploporitidæ* allied to *Sphæronites pomum*, which require further investigation.

Crinoids with reticulated hands.—A fossil Crinoid with reticulated hands from Gothland has long been recognized as such in Stockholm, but has not yet been figured and described. Many years ago Prof. A. Retzius transmitted fragments of the hands to me, at the same time pointing out the peculiarity of this Crinoid. Numerous dichotomously-ramifying series of joints are united into a petaloid form by lateral processes of the joints. I had never seen anything of the kind, and could hardly imagine them to be portions of a Crinoid.

On mentioning these fragments to Von Buch, he recollected that similar equally problematical fragments from Gothland were in his own possession. We brought them upon the same day to the Gesellschaft Naturforsch. Freunde, and it was evident at once that they were identical. Von Buch, with the friendship which he has always shown, readily offered to share with me the specimens which he possessed. I was obliged however to renounce the attempt to elucidate the nature of the animal from such portions as I possessed without the calyx; and I entertain a thorough aversion for the practice of hastily naming, which inflicts upon science an encumbrance out of all proportion to the possible gain therefrom. I gave over the fragments which I had received to the Mineralogical Museum, as the most proper place for their reception. In this museum there were also additional fragments of this Crinoid from Gothland, sent to me by M. Beyrich.

When M. Peters visited Stockholm in the spring of the present year, he inquired further for the remains of the animal from Gothland; and M. Lovén was so good as to send to me for description the beautiful fragments which he possessed of it. In one of these specimens, the greater portion of the calyx with a part of the hands is preserved; in another, a part of the calyx with the petaloid hands. A third specimen consists of the hands alone. Prof. A. Retzius also sent me besides a beautifully preserved specimen of the hands. Who can contemplate without joyful surprise these remains, in which the peculiar structure of one of the most remarkable forms of the Crinoids is clearly evident?

The base of the calyx, whose plates are perfectly smooth, is not quite perfect, but appears to consist of five *basalia*, on which follow a circle of five *parabasalia*; with these alternate five arm-bases, *radialia*, which are in contact, there is, however, a small intermediate piece between two of the five. This arrangement would thus agree with *Cyathocrinus*. The parabasalia are hexagonal; their breadth to their depth as 3:2. The basalia are exceedingly depressed, three times as broad as they are deep. On each of the basalia three joints are seated,—one, of a triangular form, upon the excavated centre of the anterior edge; two at its sides; the inner edges of the latter lie over the middle piece, and so come into contact. These two lateral pieces are the bases for all the series of joints of both halves of the hands. To each are first attached two joints, an internal, and a far broader external. The broader is the first of the longitudinal series of broad joints which runs along the outer edge of the commencement of the hand. At first very broad, they become successively narrower; their outer edges constitute the outer edge of the hand, while the inner edge is, as it were, cut into steps of two joints, sufficiently deep to allow of a new series of joints being articulated upon the notches thus formed.

The step-like notches therefore pass over one, and further on even many joints. The series of joints soon divides dichotomously again, and the dichotomy is continually repeated. Even at a small distance from the bases of the arms, we find more than thirty longitudinal series in the breadth of a hand; at the distance of an inch from the base of the hand there are as many as eighty series, and so they go on multiplying. The joints lie not merely in regular dichotomous longitudinal series, but in as exactly regular arched transverse series, and are articulated together laterally by opposed processes, so that all the joints of the hand taken together form a petal with innumerable minute gaps. These five hands have an extraordinary breadth at their periphery; in their expanded condition they would doubtless no more cover one another than the expanded petals of a pentapetalous corolla; in the closed condition they mutually overlap, just like the folded petals of a closed corolla; in fact, their sides are quite rolled in. The joints of the coalesced fingers are in general as long as they are broad, or a little longer.

The dorsal surface of the joints is flat, the lateral processes lie in the middle of the length of the joints, but usually somewhat further forwards, so that the joints viewed from the dorsal surface have the form of a cross with very short arms. The union of these joints before and behind, in a longitudinal direction and by their lateral processes transversely, gives rise to a network with regular meshes. At the commencement of the arms the meshes are as yet undeveloped, and the joints not cruciform but four-sided.

Close above the calyx the joints measure in thickness, that is in the direction from the dorsal to the volar side, much more than in length. The lowest, which rest upon the radialia of the calyx, are the thickest. Thence onwards they decrease successively in thickness, so that soon it is only one-third of what it was close above the calyx. The great development of the first joints internally, produces, with the radiale of the calyx, a sort of arch over the periphery of the calycine cavity. A nutritive canal is observed upon the articular surfaces at the end of the joints. In a transverse section also we observe that the volar side of the joints is deeply excavated, the cavity being included by two ridges.

Further outwards the thickness of the joints rapidly diminishes; an inch from the base they are still twice as thick as they are long, but very soon their thickness is not greater than their breadth. They retain the excavation upon the volar side, which forms a deep canal on the volar side of the longitudinal series of joints, and is covered transversely by minute plates, which usually alternately interdigitate with one another. At the sides of the volar surfaces of the joints, including the ambulacra, stand exceedingly delicate pinnulæ or narrow marginal plates, many of which (three to four) occur in the length of a single joint. These pinnulæ are unarticulated; it is only at their base that a small portion appears to be divided off. The height of the pinnulæ on the broader portion of the hand equals the thickness of the joints. The volar surface of the hand was therefore, corresponding with the dichotomy of the series of joints, provided with hundreds of dichotomous ambulacral grooves, supported by delicate calcareous marginal plates.

When the series of fingers have been broken out from the stone and the impressions of their volar sides left behind, these impressions appear like rounded dikes with closely-set transverse or zigzag insections, which appear to correspond in position with the covering plates between the pinnulæ.

On making a transverse section of the hands, the involution of the sides of the arms is observable. In a longitudinal section perpendicular to the calyx, we observe not merely the interior of the calyx and the above-mentioned overarching of the peripheral portion of the cavity of the calyx, but also the ventral perisoma above the calyx, which, passing from the hands, lies above the overarching portion, and stretches like a line over the middle of the calyx. The delicate pinnulæ or marginal plates of the series of joints of the hands are continued on to the ventral surface of the calyx, and in sections may be traced to the middle, where in all probability the mouth was situated.

The composition of the stem is at present unknown.

Among the numerous Crinoids of Gothland described and figured by Hisinger in the 'Lethæa Suecica,' we look in vain for any figure of reticulated arms, though there are not a few among them whose arms have not been preserved. It is difficult to conceive that among the many remains of Crinoids which he saw, there should have been nothing appertaining to the reticulated Crinoid; and in fact there is a figure, not of the reticulated hands, but of the calyx and the first joints, which would appear to do so. It is his *Cyathocrinus pulcher*, "calycis articulis hexagonis margine striatis, manibus circiter 35, brevibus linearibus, puncto medio profundo, angulo recto infractis." Leth. Suec. Suppl. ii. tab. 39. fig. 5. It would be impossible to conclude that this is our Crinoid from the figure of the pieces of the calyx, which is probably imperfect; and the marginal striæ figured upon them are equally in disagreement with it. For in the Crinoid with reticulated arms, the margin of the pieces of the calyx at the edges by which they are in contact is in some parts excavated, and in some entire, without the external surface of the pieces of the calyx themselves being insected or striated. What however strongly suggests that this is our Crinoid, is the figure of the lowermost joints of the arms which are still attached to the calyx, and extend from without inwards as far as in the Crinoid with reticulated arms, and possess the canal in the same situation and the excavation upon the volar side. Hisinger has taken these joints with their bare articular surfaces for short linear hands inflexed at a right angle. The median deep point, which he speaks of, is the nutritive canal which makes its appearance upon the articular surface of the joints. It is very difficult to make out Hisinger's figure, and it would be quite impossible without a knowledge of that internal structure of the joints peculiar to the Crinoid with reticulated arms. The object there figured is assuredly allied with ours; but we should not be justified in identifying the two either from the description or the figure.

In the Royal Mineralogical Museum of this place there is a model in plaster of an English Crinoid from Dudley, the excessively delicate and numerous rays of whose arms, and the regular series of their articulations transversely and longitudinally, present a certain similarity with the network of the Swedish Crinoid. The calyx agrees with that of *Cyathocrinus rugosus*, Müll., *i. e.* *Crotalocrinus rugosus*, Austen, having the same sculpture of the calycine plates. At the first sight of this model, which came from M. Crantz, one is inclined to ascribe to this English Crinoid the same reticulated structure of the hands as in the Swedish form, and to regard them both as species of one and the same genus, or of two closely allied genera. On careful examination, however, no certain evidence of a transverse connexion of the joints in the English Crinoid can be obtained. In fact, the very numerous series of articulations are so given off from the calyx, that there are great difficulties in the way of the supposition that they are united into five hands. However, this point can only be decided by the examination of various original and well-preserved specimens.

Austen thus speaks of *Crotalocrinus* in the 'Annals of Natural History,' vol. xi. 1843, p. 198:—"Dorso-central plates five; first series of perisomic plates five; second series five; on the latter are a series of wedge-shaped plates which bear the rays: the exact number of these plates is unascertained. Column with a pentapetalous perforation.

"*C. rugosus*. The plates surrounding the body agree with the generic character. Rays numerous, probably amounting to one hundred. Column composed of thin joints articulating into each other by radiating striæ. The columnar canal is pentapetalous. The rays are remarkably small in proportion to the size of the animal."

The authors, who could compare with Miller's specimen, observe, that Miller has erred with regard to the plates, which he wrongly regards as scapulæ, with a single excavation for articulation with the arm-joints. These plates possessed no excavation at all, but a regular series of wedge-shaped plates rested upon them, from which the rays, amounting to about 100, proceed.

The description which M'Coy gives of the genus *Crotalocrinus* and of *C. rugosus* in his 'Synopsis of the Classification of the British Palæozoic Rocks,' pt. 2. p. 55, strengthens my belief that the model of the English Crinoid is referable to *C. rugosus*. The description of the calycine plates agrees exactly. It is stated with regard to the five scapulæ that a series of small pentagonal plates rests upon each, which for the whole breadth of each plate support a great number (? 15 or 16) of very delicate rays. None of the English writers mention any reticulated connexion of the rays; I must therefore leave it unsettled, whether this English Crinoid stands in any relation, either close or distant, with our present subject.

Under these circumstances it will be necessary to found a peculiar genus for the Crinoid from Gothland with reticulated arms, for which I propose the name of *Anthocrinus*—species *Anthocrinus Loveni*, Müll. It is obvious that these Crinoids with reticulated arms stand alone and constitute a peculiar small section, of which at the present time only one form, from the Silurian formation of Gothland, is known. I shall hereafter, when I am more fully acquainted with the Crinoids of this formation, be able to speak of its relations with the other Crinoids of the transition limestone.

The continuation of this memoir is concerned with the *Holothuriadæ*, and reports of its contents have been already given. The numerous figures appertaining to the memoir are reserved for the Transactions of the Academy. In conclusion, I offer my hearty thanks to the friends who have so generously assisted my labours.

Supplementary Notice.

It should be added to the remarks upon the interambulacral plates of the *Asteridæ*, that in *Astropecten* the different series of interambulacral plates are simultaneously applied to the ambulacral plates; the outer being the lateral plates of the grooves, the inner only visible in the abdominal cavity uniting the ambulacral plates with the inferior marginal plates. The intermediate plates between the lateral and marginal plates have already been referred to.

Note by the Translator.

Without wishing in the slightest degree to detract from the originality of the views with regard to the homologies of the Crinoid skeleton expressed by Prof. Müller in the preceding pages, we nevertheless feel bound, in justice to our distinguished countryman Prof. E. Forbes, to state that he has long taught in his public lectures an essentially similar doctrine, viz. that the 'head' of a Crinoid may be compared to an Echinid placed mouth upwards, and having its vent brought into proximity with the mouth (as in *Echinocyamus*): that the arms are freed ambulacra; that the cup or 'pelvis' is formed, partly by the oculars, partly, in many genera, by accessory plates (like those in the disc of *Salenia*), and partly by the interambulacral plates,—the genital plates being probably suppressed; finally, that the basal or stem-bearing plate is the homologue of the madreporiform body.

It was our intention to have added some illustrations to the present memoir, but on consideration we think it better to run no risk of misrepresenting Prof. Müller.

XXIII.—*Description of a new species of* Closterium (*Closterium Griffithii*). By the Rev. M. J. Berkeley, M.A., F.L.S.

[With a Plate.]

A pretty but rather puzzling little Alga has been nursed for two years or more by Dr. J. W. Griffith in bog water, in which it has multiplied, without however giving any opportunity of ascertaining its mode of propagation. I have lately had occasion to examine mounted specimens, accompanied by a magnified representation of the plant in a living state, and from these and notes communicated by Dr. Griffith, who is preparing a work on the microscope, to the appearance of which I am looking forward with much interest, it is quite clear that it belongs to the genus *Closterium*, notwithstanding its comparatively minute size, the absence of curvature, and the hitherto unobserved copulation of the filaments. The circulation, which can only be seen under a power of from 1000 to 1500 diameters, is precisely that of *Closterium*, and the green colour and absence of lateral marking forbid the notion of its being a *Synedra*, though there are one or two species figured by Kützing to which it has some resemblance in point of form. The species may be characterized as follows:—

Closterium Griffithii. Minutum rectum fusiforme medio turgidulum, utrinque fortiter attenuatum apicibus acutissimis setaceis hyalinis. Long. ·033–·025 unc., centro lat. ·0002–·0016.

At first the frond is green, but a hyaline band is at length formed in the centre, where division ultimately takes place. *Closterium setaceum* resembles it somewhat in form, but that is more swollen in the centre, much longer, striated, and the tips of the fronds are curved. The var. β. of *C. cornu* approaches it in size, but the whole outline is extremely different. There can be no doubt of its being a very distinct species. The figure (Pl. XIV. fig. 2) represents three individuals in different stages of growth magnified 450 diameters. The species belongs to the genus *Stauroceras*, Kütz., which is very properly considered as part of *Closterium* by Mr. Ralfs.

XXIV.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, F.Z.S., C.M.E.S. &c.

[Continued from p. 218.]

158. Ploceus Philippinus, Linn. *Tokanam cooroovi,* Mal.; lit. Basket-maker Bird. *Tatteh cooroola,* Cing.

Scattered pretty generally throughout the island and migratory. It breeds in June, fabricating hanging nests, which are too well known to the readers of this periodical to need description. I should observe, however, that the male also has a nest for himself which is similar to that used for breeding in, except that it has no gallery, and the chamber that contains the eggs in the one has no bottom in the other, so that the droppings of the bird, which always sits with its head towards the opening which replaces the gallery, fall through to the ground. Here the male bird rests at night, or shelters himself by day from the sun and wind, while he sings to his assiduous partner on the eggs.

The natives all tell me that the male bird conveys fireflies to its nest and sticks them to the side by means of mud for the purpose of illuminating its dwellings. I cannot say that I ever saw this substitute for candle, but I have never found the nest of the male bird without observing a patch of mud on each side of the perch on which the bird sits. It is clearly not placed there to strengthen the structure; can it be for the purpose of sharpening its bill? and may not the husks of seeds, and perhaps the wing-cases of a stray beetle left sticking upon it, have given rise to the idea which the natives entertain?

The bird feeds on seeds of various kind, associates in flocks, and builds in companies on palm and other trees or bushes indiscriminately. The eggs are from two to four in number, and pure white. Axis 8 lines, diam. 6 lines.

Dr. Kelaart includes *P. Bengalensis* in his list, but I think he has wrongly identified the species, the nidification of which is so peculiar that he would have noticed it. Can he have seen

159. Ploceus Manyar, Horsf.,

which I found replacing *P. Philippinus* in the neighbourhood of Tangalle? If so, the species probably extends round to Trincomalie, and occupies the east of the island, while *Philippinus* takes the west.

I procured *Manyar* in April, devouring small seeds on the ground, and keeping to the neighbourhood of low bushes in the uncultivated districts. They congregated in small flocks.

160. Amadina undulata, Lath.

161. Amadina Malabarica, Linn.

162. Amadina Malacca, Linn.

163. Amadina striata, Lath.

164. Amadina rubronigra, Hodgs.

165. Amadina pectoralis, Jerd. *Tinna cooroovi,* Mal., from their devouring *Tinna,* a native millet. *Wie-cooroola,* Cing.; lit. Paddy Bird. These names apply to the whole group of these birds.

These little birds are found in great numbers and in various localities. *Pectoralis* is confined to the hilly zone. Dr. Kelaart found it at Nuwera Elia, and I procured it at Gillymalle. *Rubronigra* Dr. Kelaart does not appear to have seen, and I only found it about Galle. *Malacca* I only noticed at Jaffna and about the peninsula. The rest are universally distributed. They all frequent the fields of paddy and fine grain, upon which they feed; and they breed in trees or high bushes in the vicinity. *M. undulata* breeds in companies, often forming thirty or forty nests in one tree, and in some instances I have found one structure containing several nests; but single nests often consist of a mass of straw and feathers larger than a man's head; in the centre of this is a small passage into the interior, which is thickly lined with soft feathers. The eggs are from three to five in number, and pure white. Axis 7 lines, diam. 6 lines barely. The eggs of *M. Malacca* are—axis $6\frac{1}{2}$ lines, diam. 5 lines barely.

The natives keep large numbers in cages and fatten them to be used as medicine in pulmonary complaints; they catch them in horse-hair nooses.

166. Passer Indicus, Jard. & Selby. *Geh cooroola,* Cing.; lit. House Bird, from building about houses.

The Indian sparrow is certainly distinct from our European bird, though its note is similar, and it lives about the habitations of men; its eggs also run through as many varieties, from an almost spotless white to the darkest mottled brown. Their length is 9 lines, diam. 6 lines.

The natives are much attached to this bird, and to attract it to their dwellings hang on a peg in the verandah a chatty with a hole broken in the bottom; this is soon selected by a pair of sparrows for their nesting place, and I have reason to know that the same pair will return to the spot year after year, and rear their callow nestlings undisturbed by the presence of the inmates of the dwelling.

167. Alauda gulgula, Frank. *Poolloo,* Mal.; lit. "Wormer," from feeding on worms.

This is the "skylark" of Europeans, and is very abundant in all open lands whether pasture or ploughed; it is also found in the sandy plains of the northern, and among the terraced fields of the central province. It sings sweetly enough, but does not mount to the altitude of our English species. For its nest it selects some depression in the soil which it lines with fine grasses, and in it deposits from three to five eggs of a brownish gray colour, profusely streaked and mottled. Axis 9 lines, diam. 7 lines. It breeds in April. Dr. Kelaart introduces this species into his catalogue on the authority of Mr. Blyth—and

168. Alauda Malabarica, Scop.,

on his own. Has he not mistaken *A. gulgula,* or *Mirafra affinis* (which he excludes altogether), for *A. Malabarica*? I have shot several hundred larks, but never found a single specimen of *A. Malabarica,* specimens of which I had from Mr. Blyth for identification. Dr. Kelaart does not inform us in his 'Prodromus' whence his specimens were obtained, and as the various species of this genus are very hard to distinguish without a thorough knowledge of them all, I cannot help thinking that my surmise is correct.

169. Pyrrhulauda grisea, Scop.

I have only met with this species in the northern and eastern parts of the island; when on the open lands it is very abundant, being often seen in flocks of fifty or sixty individuals.

They are fond of dusting themselves on roads, and lie so close that one is frequently within a step of treading on them before they rise. I believe they are migratory, at least I never could find any breeding with us, and I have seen flocks careering from the direction of the continent when I have been out at sea dredging.

170. Mirafra affinis, Jerd.

This species is abundant about Tangalle, and I have procured it at Pt. Pedro. I never saw it in the hills, nor does Dr. Kelaart notice it, so I presume it is confined to the low country; it is not however easily distinguishable from our other larks or pipits until taken in the hand; it may consequently have been overlooked. It has one habit however by which I always distinguished it when alive; on being flushed it soars up uttering a pleasing song, and wings its way towards some tree on to which it descends, its legs pendant and wings fluttering rapidly, and singing the while with all its little might; the instant however it touches its perch, always the highest naked branch, its song ceases, and it stands on the look-out ready for flight on the least alarm.

171. Buceros Gingalensis, Shaw. *Kandatta,* Cing.

The lesser "Horn-bill" is common in the Wanny about Anarajahpoora and in the Mookalane jungles of the southern province. It feeds on the tops of the loftiest trees upon fruits and berries, which it swallows whole.

It is a wary and shy bird, and although its presence is often revealed by its loud harsh call, it rarely falls before the hunter's gun, and the best way to procure it is to lie concealed near a tree in fruit, if it be such it feeds upon.

The irides are reddish, and when partly hidden by the long stiff black eyelashes have a very peculiar appearance.

In some specimens the bill is white, with a black patch extending from the naked space round the eye about three-fourths of an inch along the lower half of the upper mandible: the bill $3\frac{3}{4}$ in. long. The three outer tail-feathers are white, the fourth half black from the quill, the fifth black. The head has a rufous tinge.

In other specimens the head wants the rufous tinge, the first tail-feather is white with the outer shaft black up two-thirds of its length, and slightly tinged up one-third of the inner web; second and third feathers black on both sides up two-thirds of their length; fourth black up to an inch from the top; fifth black altogether.

Bill $2\frac{1}{2}$ in. long and black, with a white patch on the upper mandible about $1\frac{1}{2}$ inch long, beginning about half an inch from the base.

This *species*? is found in the southern province about the base of the hills; the former in the Anarajahpoora Wanny.

172. Buceros Malabarica, Lath.

B. Pica, Scop.; *B. violaceus,* Wagl.; *B. intermedius,* Blyth. *Errana-chundoo-cooroovi,* Mal.; lit. Double-billed bird. *Atta-kandatta,* Cing.; lit. Bone (*atta*) Kandatta, from the bony structure of its bill.

Not so generally distributed as the preceding, though enjoying as wide a range. I have seen it at Tangalle and near Pt. Pedro. It generally flies in large flocks, and seeks much of its subsistence on the ground, to which I never saw *B. Gingalensis* resort. In such situations I never could detect what it sought, but on trees it feeds upon berries and fruits. To procure the latter, when attached to a branch, it resorts to an odd expedient—the coveted morsel is seized in its powerful bill, and the bird throws itself from its perch, twisting and flapping its wings until the fruit is detached; on this the wings are extended, the descent arrested, and the bird regains its footing. The head is now thrown back and the food allowed to fall into the throat and swallowed without mastication.

A live bird which I had for some time in my possession used its bill for the purpose of recovering its perch as a parrot would do, with this exception, that the *Buceros* employed the whole of the bill, hooking on by the *under side* of the lower mandible, while the parrot uses the upper mandible.

I have been credibly informed, that during the season of incubation the male bird encloses the female in the hollow tree selected for the reception of the nest with a wall of mud, as a defence against the monkey tribes, who certainly would need more than ordinary courage to attack a fortress defended by such a formidable weapon as the powerful bill of the bird. The cock bird assiduously provides for his imprisoned partner, feeding her through an aperture left for the purpose, and when the young are excluded breaks down the wall and sets her free, to assist him in satisfying the increased demand upon his parental energies.

As I have rigorously rejected from this list all species that I have not personally identified, and have only included those catalogued by Dr. Kelaart in his 'Prodromus,' in order to give my idea of their authenticity, I do not introduce *Buceros albirostris*, Shaw, but I may say I feel confident that this or an allied species exists in the mountains. I have seen it on two occasions, and Muttu came in full of a new Kandatta which he had seen in the Mookalane while I lay ill at Gillymalle. His description tallied precisely with what I had myself witnessed, and my idea is that the bird was *B. albirostris,* specimens of which I received from Mr. Blyth.

173. Loriculus Asiaticus, Lath. *Gira malitchia,* Cing.; and *Pol-girawa,* Flower Parrot.

Kandy, Putlam, Caltura, Galle, Hambantotte, and Gillymalle are the various localities where I have most plentifully procured this pretty little parrakeet. At Gillymalle they were in such abundance that the flowering trees were literally alive with them; they clung to the bright scarlet flowers head downwards, or scrambled from branch to branch, while the forest echoed with their bickerings. They bit off the leaves (which fell like scarlet snow upon the ground) to get at the calyx, and when this dainty morsel was devoured they flew off to the banana trees, down the broad leaves of which they slid and fastened upon the ripening clusters of fruit or the pendant heart-shaped flower.

174. Palæornis Alexandri, Linn. *Laboo girawa*, Cing.

This, the largest of our parrakeets, is found in countless thousands at Batticaloa, nestling in the cocoa-nut trees and resorting to them by night in vast flocks. I procured a specimen or two near Matelle in the central province, where I also procured all our other parrots, and I shot a single bird at Gillymalle.

The natives tell me they breed in hollow trees and lay two round white eggs. The young are much sought after to rear as pets, and they are taught to speak many native words with great distinctness.

175. Palæornis torquatus, Briss. *Rana girawa*, Cing. *Killy*, Mal.

Exceedingly abundant at Chilaw on the western coast, and northward to Jaffna and round by Mulletivoe to Trincomalie on the east coast, and in the interior of the island likewise. At Chilaw I have seen it in such vast flights, coming to roost in the cocoat-nut trees which overhang the native bazaar, that their noise quite drowned the babel of native tongues engaged in bargaining for the evening provisions.

Hearing of the swarms which resorted to the spot, I posted myself on a bridge some half a mile away, and attempted to count the flocks that came from one direction, eastward, over the jungle; about five o'clock in the afternoon straggling bodies began to wing their way homeward, but many of them came back again to pick up the scattered grains left on the fields near the village; about half-past five however the tide fairly set in, and I soon found I had no flocks to count—it was one living screaming stream: some high in air winged their way till over their homes, when with a scream they suddenly dived downwards with many evolutions until on a level with the trees; others flew along the ground rapid and noiselessly, now darting under the pendant boughs of some mango or other solitary tree, now skimming over the bridge close to my face with the rapidity of thought, their brilliant green plumage shining in the setting sunlight with a lovely lustre.

I waited at this spot till the evening closed in, and then took my gun and went to the cocoa-nut tope which covered the bazaar. I could hear, though from the darkness I could not distinguish, the birds fighting for their perches, and on firing a shot they rose with a noise like the rushing of a mighty wind, but soon settled again, and such a din commenced as I shall never forget: the shrill screams of the birds, the fluttering of wings innumerable, and the rustling of the glazed leaves of the cocoa-nut trees, mingled with the gabbling of the natives below, quite stunned me, and I was glad to escape to the path by the river's bank which led to the miserable Government Rest House where I was stopping, and where the roar of the breaking surf dispelled the noise which still rang in my ears.

P. torquatus breeds in hollow trees, making little or no nest, and laying three or sometimes four pure white eggs, weighing 11 ʒ. 16 grs. Axis 14 lines, diam. 11 lines. It feeds on grain of all kinds, fruits, chillies, plantains, &c.

It is easily domesticated, becomes very attached and familiar, and is usually seen in most native and European houses.

176. Palæornis Layardi, Blyth.

Syn. *P. bitorquatus*? Kuhl.

Of this species Mr. Blyth writes*: "As the Society has now received this species from Ceylon, and as there were some Ceylon birds in the Mauritius collection presented by Mr. Earle, there can be little doubt that No. 8 A. is erroneously assigned to the Mauritius in p. 4." I tried for months to procure another specimen of this bird, but though I had several hundred parrots killed I could not find one. I hardly think it a good species, but time will show. It was shot at Pt. Pedro.

177. Palæornis Calthropæ, Layard, J. A. S. xxxii.

Alloo girawa, Cing.

My first acquaintance with this lovely bird was at Kandy, where I killed a male and female at one shot from a flock flying over my head; I took them for the common *P. torquatus* until I picked them up, and then great was my delight to find such an elegant new species. It proves to be the common parrakeet of the hilly zone, and I have traced it in all parts of it. It feeds on berries, and seeks them on the very summit of the trees. When a flock is occupied in feeding every bird is as silent as the grave, and so difficult are they then to be distinguished, that though I have sometimes marked a flock into a tree, I have stood for ten minutes and could not perceive a single bird, though aided by the keen eyes of my fidus Achates, Muttu, and perhaps three or four natives: suddenly with one consent away would go the whole flock with a scream which almost deafened one. The natives tell me it breeds in hollow trees and lays two white roundish eggs.

* Addenda to Appendix No. 3 of Catalogue of the Birds in the Museum of the Asiatic Society of Bengal.

178. Palæornis cyanocephalus, L. *Malitchia* and *Battoogirawa*, Cing.

Found throughout the island except in the northern province. It is very commonly seen in confinement in the native houses, and is easily domesticated. Nestles in hollow trees: eggs four, pure white and rounded.

[To be continued.]

XXV.—*Monograph of the British* Graphideæ. By the Rev. W. A. Leighton, B.A., F.B.S.E.

[Continued from p. 212.]

2. *Graphis*, Ach.

Apothecium lirellæform, immersed; perithecium carbonaceous, dimidiate or confined to the sides, the base being naked; disk canaliculate, surrounded with a proper margin and an accessory thallodal margin. Thallus crustaceous or membranaceous.

Name from γραφὶς, *a design* or *sketch*.

1. *Graphis scripta*, Ach. Thallus thin, membranaceous, continuous, even; lirellæ emergent, slender, contracted here and there, extremities acuminate; proper margin thin, elevated, wavy and crisped; thallodal margin membranaceous; disk rimæform, naked; sporidia eight, in asci, oblong or oval, margined, containing 8–10 horizontal rows of subrotund, margined, yellow spores.

Lichen scriptus, (Linn.) Ach. Prodr. 25 (1798).
Opegrapha scripta, Ach. Meth. 30 (1803); Fries, L. Ref. 370 (in part); Hook. Br. Fl. 2. 147 (in part); Tayl. Fl. Hib. p. 2. 106 (in part); Bohler's Lich. Brit. no. 28!
Graphis scripta, Ach. L. Univ. 265 (1810).
—— *scripta α*, Ach. Syn. 81 (1814); Spreng. Syst. Veg. 4. p. 1. 252 (in part).
—— *pulverulenta, α. phlæodes*, Wallr. Crypt. Germ. 330 (in part) (1827).

Plate VI. fig. 17. *a*, Vertical section of thallus and lirella; *b*, sporidia—all magnified in different degrees.

The following varieties are noticeable:—

α. diffusa. Lirellæ rather long, simple or with a single branch, variously curved and wavy, lying in all directions.

On oak. Sussex! *Mr. Borrer*. Cultra, Co. Down! Colin Glen, Belfast! *Mr. W. Thompson*.

Thallus thin, membranaceous, very pale whitish yellow or cream-colour, continuous and entire, or cracking, breaking up, and peeling off in thin scales, for the most part smooth and shining, except here and there and about the lirellæ, where there are many minute irregular roundish elevations or granulations more or less crowded, visible only under a lens, limited and circumscribed, when it comes into contact with other lichens, by an irregular, waved, broadish pale black line or margin. *Lirellæ* scattered and distant, uplifting and bursting through the thallus in a kind of irregular cleft, the thin upraised membrane of the thallus forming a spurious thallodal margin by closely adhering to and covering nearly the entire sides of the lirella, leaving only the thin elevated proper margins visible and free, very slender and narrow, simple or with a single branch, either about the middle or at one extremity, if branched at the one extremity then the lirella is furcate, if at the middle the branch is either straight and at right angles to or curved and parallel with the main body, straightish or variously curved, not uniform in any one direction, but lying scattered irregularly and rather openly or not crowded together, of a dull black, scarcely shining, generally rather long, but variable in length, flexuose and wavy. *Disk* in a dry state, rimæform, a mere simple deep chink. When wetted all the parts expand, and the true form and *habit* of the lirella are developed and disclosed. The thin elevated margins are then seen to be in general closely approximated at one extremity of the lirella, and to proceed so along the sides in a flexuose and irregularly waved manner, now approaching, now separating from each other, until approaching the other extremity they form a lanceolate or linear-lanceolate expansion, more or less marked and distinct, terminated by a very finely acuminate point. The disclosed disk is in consequence variable in width throughout the whole length, now a mere chink, now more or less distinctly open and expanded, of a pale colour, naked and never pruinose.

β. flexuosa. Lirellæ elongated, simple or branched, flexuose.

Lichen scriptus, Hoffm. Enum. Lich. tab. 3. fig. 2 *b*.
Opegrapha pulverulenta, Pers. Ust. Ann. st. 7. tab. 1. fig. 2 B. *b*.
Graphis scripta, β. varia, Ach. L. Univ. 265 (1810).
—— *scripta, α. b. varia*, Ach. Syn. 81 (1814).
—— *scripta*, Ach., *var. flexuosa*, Leight. Lich. Brit. Exsic. 18! (1851).

On oak and beech. Sussex! *Mr. Borrer*. New Forest, Hampshire! *Mr. Lyell.* Loch Tay Woods! *Dr. R. K. Greville.* Oswestry, Shropshire! *Rev. T. Salwey.* Gloddaeth near Conway, Caernarvonshire!

Thallus thin and membranaceous, smooth and shining or minutely warty, as in the preceding, with which it assimilates also in colour, though with a whiter or paler aspect. Some specimens have the thallus irregularly raised into verrucæ or rugosities, and become white and pulverulent. Others again are so decidedly rugged all over, that the lirellæ appear seated on thickened upraised irregularly wavy rugosities, white and pulverulent or ashy gray: this latter is supposed to be that of great old age, or resulting from some peculiar circumstances which render the thallus thus thick and tartareous. The *lirellæ* are very long, curved, flexuose and wavy in every form and fashion, either quite simple, or with a single branch at one extremity, or sometimes branched at both extremities, distinct and separate, or curving and anastomosing and running one into the other, narrow or various in breadth.

Some specimens on beech from the New Forest had the lirellæ so very much elongated and so slender, curved, flexuose and wavy, simple and variously branched, as to render it probable that they may be referable to *Graphis scripta, ε. tenerrima*, Ach. L. Univ. 266 and Syn. 82.

γ. radiata. Lirellæ dendritically radiate.

Sussex! *Mr. Borrer*. Rammerseales, Dumfriesshire! Cultra, Co. Down! *Mr. W. Thompson*.

Thallus thin, membranous and shining as in the last, but the granulations or minute rugosities rather more numerous, and slightly white or pulverulent about the lirellæ. *Lirellæ* either scattered or approximate, but not crowded, each consisting of five, six, or more slender, flexuose, wavy, rather elongated members, separate but radiating from a common centre, in a dendritic manner subdichotomously branched, each branch ultimately terminating in a linear-lanceolate elongated acuminate expansion; sometimes however the ultimate branches are shorter and more rigid, terminating in an obtuse wide-spreading furcation. The wavy character of the thin proper margins, the naked, not pruinose, rimæform, more or less expanded disk, and the general *habit* of the lirellæ as in the preceding varieties.

δ. divaricata. Lirellæ divaricately branched.

Lichen scriptus, Hoffm. Enum. t. 3. f. 2 *a*.
Graphis scripta, δ. hebraica, Ach. L. Univ. 266 (1810).
—— *scripta, α. d. hebraica*, Ach. Syn. 82 (1814).
Opegrapha scripta, Johnston! Fl. Berw. 2. 100 (1831).
Graphis scripta, Ach., *var. divaricata*, Leight. Lich. Brit. Exsic. 19! (1851).

Sussex! *Mr. Borrer*. Bangor, Co. Down! *Mr. W. Thompson*. Rae Hill Woods! *Dr. R. K. Greville*. Castle Bernard Park, Bandon, Ireland! *Rev. Prof. Hincks*. Berwick-on-Tweed! *Dr. G. Johnston*. Gloddaeth, near Conway, Caernarvonshire!

Thallus thin and membranous, sometimes quite smooth, shining or dull, generally with more minute granulations or rugosities especially about the lirellæ, whence and from their more crowded condition the plant assumes a pulverulent or ashy and dusty appearance; in some instances becoming ashy-coloured and densely rugose from the thickly crowded lirellæ. *Lirellæ* very numerous and crowded, variable in form and size, straightish or curved, some of them long, simple, straightish and wavy, others simply curved, others curved back on themselves, others short and variable in curvature, either with a single branch from the centre at right angles, or two or three in a sub-stellate form; others simple at one extremity, with one, two, or three branches at the other; others again furcate, or simply and shortly branched at both extremities; others bent into a right angle. The general character and habit resemble all the preceding.

The form and *habit* of the lirella form the chief distinctive characteristics between *Graphis scripta* and *G. pulverulenta* and their respective varieties or forms. In *G. scripta* it is *emergent*, as Acharius expressly says, the uplifted and rifted thallus forming a thin membranous thallodal spurious margin to the lirella, whose proper margins are thin and elevated, encompassing the naked rimæform disk in a wavy, flexuose, irregular manner, narrow and nearly parallel at the one extremity, with a linear-lanceolate elongato-acuminate expansion at the other.

In *G. pulverulenta* the lirella seems uplifted and sessile on or amid the thickened swollen thallodal margins, the proper margins thick and uniform, encompassing in a bold uninterrupted and nearly parallel curving the uniformly expanded pulverulent disk; the extremities being acute, often with a peculiar curve giving to a branched lirella somewhat of a hastate shape.

From *Graphis serpentina* both are separated by the sporidia. I at one time fancied that the sporidia in *G. scripta* were of a regular elliptical shape, those in *pulverulenta* being oblong, but I think not so constantly so as to be distinctive, intermediate variations in form having been noticed in both. However the hint is thrown out for further observation.

The sporidia prove all the specimens of *Opegrapha scripta* in Schærer's 'Lich. Exsicc.' to be in reality forms of *Graphis serpentina*.

G. scripta, *pulverulenta*, and *serpentina* have been so confounded together by authors generally, that without the examination of authentic specimens of the varieties of each, it seems to be a mere hopeless guesswork to attempt an arrangement of the synonyms. Nothing but the sporidia can distribute them correctly.

2. *Graphis pulverulenta*, Ach. Thallus thin, subtartareous, continuous, rugulose; lirellæ subsessile, broadish, extremities cuspidate; proper margin thick, elevated, uniform; thallodal margin elevated, tumid; disk broadly canaliculate, pruinose; sporidia eight, in asci, oblong or oval, margined, containing 8–10 horizontal rows of subrotund margined yellow spores.

Opegrapha pulverulenta, Sm. E. Bot. 1754 (excl. syn.), the magnified figure excellent (1807).
Graphis pulverulenta, Ach. L. Univ. 266 (excl. syn. Pers.) (1810); Leight. Lich. Brit. Exsic. 20!
—— *pulverulenta, α. phlæodes*, Wallr. Crypt. Germ. 330 (in part) (1831).
—— *scripta, β. pulverulenta*, Ach. Syn. 82 (excl. syn. Pers.) (1814).
—— *scripta*, Sprengel, Syst. Veg. 4. pt. 1. 252 (in part) (1827).
Opegrapha scripta a, Fries, L. Ref. 371 (in part, inasmuch as he quotes Ach. L. Univ. and E. Bot. fig. I have not seen his Lich. Suec. Exs. no. 33 & 124) (1831).
—— *scripta*, Hook. Br. Fl. 2. 147 (in part) (1833); Tayl. Fl. Hib. pt. 2. 106 (in part).

On oaks. Sussex! *Mr. Borrer*. Hartshill Wood near Atherstone! Gopsall Wood! Leicestershire! *Rev. A. Bloxam*. Bangor! Montalto! Cultra! Co. Down, *Mr. W. Thompson*. Barmouth! *Rev. T. Salwey*. On poplar, near the Berrow, southern end of Malvern Hills, Worcestershire! *Mr. E. Lees*. Donnington Park, Leicestershire! *Rev. A. Bloxam*. Blarney, Cork! *Mr. I. Carroll*. Gloddaeth near Conway, Caernarvonshire!

Thallus effuse, in some instances very thin and membranous, of a pale dull ashy yellow or cream-colour, thickened and swollen about the lirellæ, minutely verruculose; in other instances becoming much thicker, subtartareous, swollen into upraised irregular rugosities, cracked, the small portions of even surface smoothish and cream-coloured. In other cases, probably from age, becoming very thick, tartareous, pulverulent, very rugged and rough with upraised crowded rugosities, extensively and variously cracked, either whitish or cream-coloured, or of a dull darkish gray hue. In a few instances quite thick, tartareous, pulverulent, even, continuous, and almost quite white. *Lirellæ* generally crowded, exceedingly variable in size, shape and direction, curved into all sorts of forms, simple, or branched either at right angles or in a divaricate and subradiate manner. Under all circumstances and forms, however, maintaining this one uniform and constant character and habit. The lirella appears to be upraised and laid sessile upon or amid the tumid thallodal margins which are thrown fully back, disclosing the entire bold prominent lirella, which is broadish, nearly uniform in width throughout, terminating at each extremity in an acute point, very frequently with a peculiar curve which gives it much of a cuspidate aspect, and which renders a branched or divaricate lirella of a subhastate form. *Disk* broad and open, more or less pulverulent and pruinose, encompassed with a thickened, raised, rounded, incurved, uniform and unbroken proper margin, curving in a peculiar bold and striking manner. The different forms of lirella seem to be so intermixed, even on the same specimen, as to render any attempts to define varieties from the specimens before me altogether hopeless.

"No. 89. *Opegrapha scripta, γ. pulverulenta*"! and "No. 90. *Opegrapha scripta, δ. abietina*"! in Mr. Borrer's copy of Schærer's 'Lich. Exsicc.' 1st ed., are, according to the sporidia, forms of *Graphis serpentina*, Ach. *Graphis pulverulenta*, Ach., does not appear to be represented in that work, and by consequence not in Schærer's 'Spicilegium Lich. Helvet.' nor 'Enumeratio Lich. Europ.'

The sporidia are similar to those in *Graphis scripta*, Ach., but the different character and habit of lirella, peculiar to itself, well distinguish it from that species, whilst the sporidia separate it from *Graphis serpentina*, Ach. It may be however considered as very doubtful whether *scripta* and *pulverulenta* ought to be retained as distinct species.

Plate VI. fig. 18. *a*, Vertical section of thallus and lirella; *b*, sporidium.

3. *Graphis serpentina*, Ach. Thallus thin, membranaceous or subtartareous, continuous, even or rugose; lirellæ immersed, slender, of the same width throughout, extremities obtuse; proper margin narrow, elevated, wavy and crisped; thallodal margin elevated, tumid; disk canaliculate, naked or pruinose; sporidia eight, in asci, linear, margined, rounded at the ends, containing 8–10 transversely oval margined yellow spores.

Lichen serpentinus, Ach. Prodr. 25 (1798).
Opegrapha serpentina, Schrad. Journ. d. Bot. 1801, st. 1. p. 79; Ach. Meth. 29.
Graphis serpentina, Ach. L. Univ. 269 (1810); Syn. 83; Fée, Crypt. Ecorc. Offic. Exot 40 (1824); pt. 2. p. 29. tab. 39. *Graphis*, fig. 20 (sporidia).
Opegrapha scripta, Schær. Lich. Exsicc. 87–91 inclus. 1st ed. (1823); ed. alt. immut. 87–91 inclus. (1842); Spicil. 46 & 322 (excl. syn. & var. ζ, η & ϑ) (1823–1836); Enum. 150 (excl. syn. & var. ϑ).
—— *scripta, c. serpentina*, Fries, L. Ref. 371; Hook. Br. Fl. 2. 147 (in part).
Graphis scripta, Sprengel, Syst. Veg. 4. p. 1. 252. in part (1827).
—— *pulverulenta, b. periblastetica*, Wallr. Crypt. Germ. 330 (1831).

Plate VI. fig. 19. *a*, Thallus and lirella; *b*, sporidia—all magnified.

The following varieties are to be observed:—

α. *minuta*. Lirellæ very short and simple, straight.
On young oak and ash. Sussex! *Mr. Borrer*. Crafnant near Oswestry, Shropshire! *Rev. T. Salwey*.

Thallus thin, membranous, smooth, very slightly shining, pale yellow, limited by a brown wavy line, uplifted so as to form a thin membranous spurious border to the lirellæ. *Lirellæ* numerous, approximate but not crowded, for the most part very short and straight, arranged in somewhat of a subparallel manner, with others longer and variously though slightly curved or waved, interspersed and scattered, subsessile or a little raised above the level of the membranous thallus, narrow, slender and simple, one here and there with a single simple short branch at right angles, the smaller ones generally pointed at both ends, the larger ones of about the same width throughout, and more obtuse or obtusely pointed at the extremities. *Disk* rimæform or slightly channelled when dry, when wetted expanded and flat, brown, with or without a very slight pruina, surrounded by a tolerably thick, uniform, black, curved and wavy proper margin.

β. *diffusa*. Lirellæ elongated, simple, curved, distantly scattered in all directions.

On ash. Charlton Forest, Sussex! *Mr. Borrer*. On sycamore, Derriquin, Ireland! *Dr. Taylor in herb. Borrer*. On *Ulmus montana*, Colin Glen, Belfast! *Mr. W. Thompson*.

Thallus thin, slightly tartareous, continuous, even, or in irregular rugosities, pale yellow or pale olive, elevated into more or less stout and thick spurious margins about the lirellæ, by abrasion probably, becoming there whiter and pulverulent, limited by an irregular wavy brown line. *Lirellæ* elongated and slender, curved, wavy and distantly scattered in all directions, simple or very seldom with a single short branch at right angles, not upraised above the level of the spurious margins, or only in a very slight degree, of about the same width throughout, though here and there a little contracted, obtuse or obtusely pointed at the extremities. *Disk* rimæform when dry, when wetted expanded and flat but still narrow, encompassed by a curved, wavy and crisped narrow proper margin.

The right-hand specimen of "No. 90. *Opegrapha scripta*, δ. *abietina*, Schærer," in Mr. Borrer's copy of 1st ed. of Schærer's 'Lich. Exsicc.,' and the left-hand specimen of No. 90 in my copy of "edit. alt. immut.," apparently belong to this variety.

γ. *varia*. Lirellæ elongated, very various in shape, size and disposition, rather crowded.

On young oak. Sussex! *Mr. Borrer*. On alder, near Little Malvern, Worcestershire! *Mr. E. Lees*.

Thallus thin, membranous, continuous, minutely tuberculate, or nearly smooth and scaly, pale yellow or pale olive, upraised and forming a distinct tumid narrow spurious margin to the lirellæ, bounded where it meets other lichens by a brown, rather broad, wavy, irregular line. *Lirellæ* numerous and rather crowded, lying scattered irregularly in all directions, and of various shapes and sizes, either straightish, or curved and wavy more or less, either simple or furcate at one extremity, or with a longer or shorter simple branch from about the middle at right angles, or branched near one extremity, slender, narrow and elongated, of about the same width throughout, and terminating in a point either quite obtuse or more or less acute, scarcely if at all elevated above the level of the spurious margin. *Disk* in a dry state rimæform or very slightly channelled, when wetted expanded, but still narrow, slightly pruinose, surrounded by a thinnish black proper margin which is very much curved, wavy and crisped.

δ. *flexuosa.* Lirellæ very elongated and slender, flexuose, simple.

On oaks. Sussex! *Mr. Borrer.* Castle Bernard Park, Bandon, Ireland! *Rev. Prof. Hincks.*

Thallus in colour, structure and appearance similar to the last. *Lirellæ* very elongated and slender, flexuose, curved and twisted in all directions, for the most part simple, but some with a minute furcation, or a large forked branch at one extremity, entire or simple at the other, either straight at the extremities or sometimes one or both ends suddenly bent or curved, immersed and not raised above the level of the spurious margins, of the same width throughout, extremities obtuse. *Disk* rimæform when dry, when wet expanding, but still very narrow, of the same width throughout, pruinose, surrounded with a thin elevated flexuose, crisped, black, proper margin.

In Mr. Borrer's copy of the 1st edition of Schærer's 'Lich. Exsicc.,' "No. 90. *Opegrapha scripta,* δ. *abietina,* Schærer," growing on firs, making allowance for slight differences resulting probably from the nature of the bark, seems referable to this variety. The sporidia show it to belong to *G. serpentina* and not to *scripta.* The right-hand specimen attached to this seems to belong to our variety *diffusa.* The same may be said of the two specimens of No. 90 in "edit. alt. immut."

ε. *horizontalis.* Lirellæ crowded, very long and slender, disposed horizontally.

On oaks. Sussex! *Mr. Borrer.* Holly Bush Hill, Malvern Range, Worcestershire! *Mr. E. Lees.*

Thallus thin, membranous, subtartareous, pale yellow, thickly covered with minute tubercles, paler in colour, which give to it a whitish appearance, distinct towards the margin, confluent in the central parts, swollen, thickened and upraised into a narrow spurious margin about the lirellæ. *Lirellæ* very numerous and crowded, exceedingly long and very slender, straightish or wavy, or curving and twisting in various degrees and ways, but all maintaining more or less of a horizontal parallel direction relative to each other, more especially recognizable towards the margins of the patch, simple or with a curved branch, either at right angles from the middle or near one or both extremities, which are also either one or both furcate, or crooked or simple; extremities obtuse or obtusely pointed or more or less acute, immersed in and on a level with the spurious margin. *Disk* when dry very narrowly rimæform, when wetted exceedingly narrow, of nearly equal width throughout, with scarcely any discernible pruina, encompassed by a slender wavy, curved and crisped, elevated black proper margin.

ζ. *divaricata.* Lirellæ short and straight, divaricately branched.

Graphis serpentina, var. divaricata, Leight. Lich. Brit. Exsic. 21! (1851).

On oak and ash. Sussex! *Mr. Borrer.* Colin Glen, Belfast! Bangor, Co. Down! Tullamore Park, Co. Down! Knockdolian, Ayrshire! Rammerscales, Dumfriesshire! *Mr. W. Thompson.* Oxfordshire! *Baxter in herb. Dr. R. K. Greville.* Tunbridge Wells! *Mr. W. Thompson.* Gloddaeth near Conway, Caernarvonshire!

Thallus thin, membranous, continuous, pale yellow or pale olive, slightly shining or dull, generally smooth, sometimes with tubercles and rugosities, scarcely if at all raised into spurious margins about the lirellæ. *Lirellæ* numerous but not crowded, small, short and straight, or only slightly curved, with a short, simple, straightish or curved branch at right angles from the middle, the extremities more or less acutely pointed, a little raised above the thallus. *Disk* narrow and canaliculate when dry, when wet expanded and more or less pruinose, surrounded by a rather stout wavy proper margin.

No. 87 in my copy of "ed. alt. immut.," Schær. Lich. Exsicc., seems identical with this variety. No. 87 in Mr. Borrer's copy of the 1st ed. is referable to var. *spathea.*

η. *radiata.* Lirellæ radiate.

On young oak. Sussex! *Mr. Borrer.*

Thallus thin, subtartareous, irregularly rugose, pale yellow, whitish, the spurious margins by reason of the crowded state and peculiar form of the lirellæ obliterated, only here and there visible in a slight rugosity. *Lirellæ* very much crowded, arranged in a radiate manner from a common centre, the radiations simply or doubly branched, or frequently with lateral branches, terminating in curved acuminate points, immersed in and slightly prominent above the rugosities of the thallus. *Disk* rather widely canaliculate, even when dry, more expanded when wetted, pruinose, surrounded by a stout elevated margin, very irregular in its width from alternate contraction and dilatation, singularly and peculiarly waved and crisped.

The specimen on oak of "No. 91. *Opegrapha scripta, ε. serpentina*, A. Schær." in Mr. Borrer's copy of 1st ed. of Schærer's Lich. Exsicc. is referable here. The other specimen on beech belongs to our *G. diffracta*. No. 91 of "edit. alt. immut." on beech is *eutypa*, Ach. The sporidia prove them to be forms of *G. serpentina*.

θ. stellata. Lirellæ stellate.

On ash. Sussex! *Mr. Borrer.*

Thallus thin, membranous, pale olive, continuous, smoothish, sometimes a little roughened with minute scattered tubercles, elevated into a thin membranous spurious margin about the lirellæ, circumscribed by a brown wavy line. *Lirellæ* distant, few and scattered, arranged in small irregular star-like groups, extremities of the rays or branches rather acute, slightly raised above the thallus. *Disk* rimæform or slightly canaliculate when dry, more expanded when moistened, and surrounded by a rather thick stout proper margin.

ι. spathea, Ach. Lirellæ moderately long, simple, curved, numerous, scattered in all directions, approximate.

Graphis serpentina, δ. spathea, Ach. L. Univ. 270 (1810); Syn. 84.
—— *scripta*, Moug. & Nestl. Stirpes, 650! (1820).

On beech. St. Leonard's Forest, Sussex! *Mr. Borrer.*

Thallus thin, subtartareous, continuous, pale yellow, roughened with minute tubercles or rugosities, elevated about the lirellæ into narrow spurious margins, partially circumscribed by an irregular wavy brown line. *Lirellæ* numerous and scattered, but not crowded, though approximate, moderately long, though varying exceedingly in size, some longer, some shorter, lying scattered in all directions, curved and wavy, simple, immersed in the spurious margins, though elevated a little above their level, obtuse or obtusely pointed at the extremities. *Disk* in a dry state rimæform, nearly closed by the stout rounded incurved proper margins, which when wetted are narrow, surrounding in a wavy, more or less crisped state, the expanded disk which is destitute of pruina.

In Mr. Borrer's copy of Schærer's Lich. Exsicc. 1st edit., "No. 87. *Opegrapha scripta, α. limitata*, A. Schær.;" "No. 88.

Opegrapha scripta, α. limitata, B. Schær." seem identical with our plant. "No. 89. *Opegrapha scripta v. pulverulenta*, Ach." is again the same thing, but in an older state, with the disk broader and more expanded, approaching the *eutypa* form. In "ed. alt. immut." No. 89 is similar to No. 89 of the 1st ed., but No. 87 is our var. *divaricata*, and No. 88 is a form of our *G. diffracta*, much resembling the specimen on beech of "No. 91. *Opegrapha scripta, ε. serpentina*, A. Schær." in Mr. Borrer's copy of the 1st ed., which is also referable to *G. diffracta*; whilst No. 91 of "ed. alt. immut." differs from No. 91 of the 1st ed., being rather referable to *eutypa*. The sporidia prove the identity of all of them to *G. serpentina*.

Mr. Borrer's herbarium contains a miserable morsel from Acharius of his variety *spathea*, which does not however accord with the description in 'Lich. Univ.' and 'Syn.,' but with which our British specimens agree pretty well.

The variety *spathea* is not unlike some states of *G. diffracta* in general external appearance, but is distinguished from that by the nature and structure of the thallus.

κ. tremulans. Lirellæ peculiarly tremulous in their outline.

Graphis serpentina, var. tremulans, Leight. Lich. Brit. Exs. 22! (1851).

On ash. Sussex! *Mr. Borrer*. Killarney! *Mr. W. Thompson*. Gopsall Wood, Leicestershire! *Rev. A. Bloxam*. Cors-y-gedol! *Rev. T. Salwey*. Chelmsford, Essex! *Mr. H. Piggot*. Pentregaer near Oswestry! Weir Coppice near Shrewsbury!

Thallus thin, subtartareous, cracked here and there, more or less roughened with minute tubercles and rugosities, pale ashy yellow or ashy gray, scarcely raised around the lirellæ, the spurious margin being obliterated. *Lirellæ* elongated, chiefly simple, some branched or furcate at one extremity, or from the middle, curved and waved in all directions, giving the general appearance at a little distance of a coarse irregular network thrown over the bark, elevated above the thallus, extremities very obtuse. *Disk* narrow, but widely canaliculate when dry, when wet more expanded, pale and subpruinose, surrounded by the proper margin which is narrowly edged, excessively waved and crisped, and by its irregular contractions and dilatations giving to the lirellæ a peculiar tremulous aspect.

λ. eutypa, Ach. Lirellæ with a very broad densely pruinose disk.

Opegrapha serpentina, Sm. E. Bot. 1755 (1807).
—— *serpentina, ε. eutypa*, Ach. L. Univ. 270 (1810); Syn. 84.
Graphis pulverulenta, Moug. & Nestl. Stirpes, 361! (1813).

On oak, beech and ash? Ardingley! St. Leonard's Forest, Sussex! *Mr. Borrer.* On beech, New Forest, Hants! *Mr. Lyell in herb. Borrer.* Cultra, Co. Down! On Spanish chestnut, Knocknageney, Belfast! *Mr. W. Thompson.* Oxfordshire! *Mr. Baxter in herb. Dr. R. K. Greville.* Berrow, Malvern Hills, Worcestershire! *Mr. E. Lees.* Donnington Park, Leicestershire! *Rev. A. Bloxam.*

Thallus thin, subtartareous, continuous or cracked, smooth and somewhat shining, pale yellow, or sometimes with a grayish white pulverulent aspect, raised in irregular rugosities, especially about the lirellæ, which are uplifted by them, and forming spurious thallodal margins more or less distinctly visible. *Lirellæ* very numerous and crowded, by their breadth and approximation giving a very black appearance to the plant, moderately long, some more elongated, but varying in length, either obtuse or acute at the extremities, considerably raised above the thallus, for the most part simple, though many branched at right angles from the middle or near one end, flexuose and curved and wavy, lying in all directions. *Disk* very wide, canaliculate, flattened or hollowed more or less according to age, white with pruina, surrounded by the very prominent, stout, elevated, curved and wavy proper margin.

"No. 91. *Opegrapha scripta, ε. serpentina,* Schær." Lich. Exsicc. "ed. alt. immut." in my copy is referable to this variety.

μ. recta. Lirellæ elongated, narrow, simple, horizontal and parallel.

Verrucaria typographica, Willd. Flor. Berol. 370. t. 7. f. 14 (1787).
Opegrapha recta, Humb. Fl. Freiberg. 57 (1793).
" —— *Cerasi,* Pers. in Ust. Ann. st. 11. p. 20" (fide Ach.) (1794); Ach. Meth. 27; Sm. E. Bot. t. 2301 (not *O. Cerasi,* Pers. *l. c.,* according to Martius, Fl. Brasil. *l. c.* infra).
? —— *Cerasi,* DeCand. Fl. Franç. ed. 3. vol. 2. 310.
Lichen Cerasi, Ach. Prodr. 26 (1798).
Graphis Cerasi, Ach. L. Univ. 268 (1810) (admirable description).
—— *scripta, γ. Cerasi,* Ach. Syn. 83 (1814).
—— *scripta,* Meyer in Spreng. Syst. Veg. 4. pt. 1. 252 (in part) (1825).
Opegrapha scripta, β. recta, Schærer, Spicil. 46 (in part) (1823); Enum. 151; Tuckermann, Syn. 76 (in part).
Graphis pulverulenta, ε. orthograpta, Wallr. Fl. Crypt. Germ. 1. 331 (in part) (1831).
—— *pulverulenta, recta,* Martius, Fl. Brasil. 1. pt. 1. 71 (excl. *O. macrocarpa,* Pers., according to the fig. rather referable to our var. *horizontalis*) (1833).
Opegrapha scripta, b. recta, Fries, L. Reform. 371 (in part) (1831); Summa Fl. Scand. pt. 1. 118 (in part); Hook. Br. Fl. 2. 147 (in part).

On cherry and plum trees. Sussex! *Mr. Borrer.*

Thallus thin, membranous, continuous, smooth, slightly shining, pale yellow or straw-colour, in very elongated narrow horizontal patches, bounded by a pale blackish watery line, more or less distinct and conspicuous, not unfrequently almost entirely obliterated. *Lirellæ* very numerous, either crowded or more distant, disposed in a horizontal direction parallel to each other, generally rather long and narrow and of the same width throughout, though with others of various lengths interspersed, acuminate and sharply pointed at each extremity, though sometimes obtuse, simple and nearly straight, only slightly curved, sometimes by confluence branched, prominent and emergent or bursting through the thallus, which is uplifted and forms membranous slightly thickened thallodal margins. Proper margins stout, thickened, rounded, prominent and uniform, enclosing a canaliculate disk, generally narrow and almost rimæform, frequently more expanded, either entirely destitute of or with only a faint pruina.

Distinguished from all other varieties of *serpentina* by the horizontal arrangement of the elongated, narrow, simple, parallel lirellæ; and from *scripta* and *pulverulenta* by the sporidia.

Chevallier (Hist. Graphid. p. 16) says that his *Opeg. Cerasi* is not that of Acharius, which he regards as a variety of *scripta*. The lirellæ represented in his tab. 1. fig. 3 & 4 are certainly blunter and not acuminate at the extremities, and also appear interwoven or lying one over the other, not preserving the parallelism so peculiar to our plant. Possibly Chevallier's plant may be a state of *Opeg. atra*.

Plate VI. fig. 20. *a*, Vertical section of thallus and lirella; *b*, sporidium.

4. *Graphis diffracta*, Turn. MS. Thallus thickish, tartareous, pulverulent, cracked, rugulose; lirellæ immersed, slender yet clumsy, of the same width throughout, extremities obtuse; proper margin narrow, elevated, wavy; thallodal margin very narrow, almost obliterated; disk canaliculate, naked; sporidia eight, in asci, linear, margined, rounded at the ends, containing 8–10 transversely oval margined yellow spores.

The thick, tartareous, cracked thallus and the peculiar form and habit of the lirellæ, traceable through a distinct series, appear to justify the separation of this from *G. serpentina*, in which the thallus partakes generally of a more membranous structure, but whether it will be permanently regarded as a distinct species may perhaps be doubtful, among plants so protean and trickey in their variations, particularly as the sporidia are similar. The varieties *spathea* and *eutypa* of *G. serpentina* alone approach it in their subtartareous thallus.

Plate VI. fig. 21. *a*, Vertical section of thallus and lirella; *b*, sporidia.

The following varieties are noticeable :—

α. minor. Lirellæ small.

On beech. Tilgate Forest, Sussex! *Mr. Borrer.* On alder, near Little Malvern, Worcestershire! *Mr. E. Lees.*

Thallus thin, tartareous, extensively cracked, somewhat pulverulent, the surface irregular, spurious thallodal margins nearly or quite obliterated, pale dirty ashy gray, or pale yellow or pale olive. *Lirellæ* exceedingly numerous and crowded, very small, short, broad and simple, varying in form from a mere roundish dot to a small oblong or linear-oblong, or linear figure, very obtuse and rounded at the ends, immersed, slightly prominent above the level of the thallus, the shorter and smaller ones for the most part straight, the longer ones more or less curved and wavy, of a dark brown colour. *Disk* canaliculate, wide, open and concave, even in a dry state, without pruina, when wet expanded and flat, encompassed by the thin, prominent, more or less waved proper margin.

β. major. Lirellæ larger.

On beech. St. Leonard's Forest, Sussex! *Mr. Borrer.*

Thallus very thin, subtartareous, even, extensively cracked, bounded by a wavy irregular brown line, dull olive colour, raised around the lirellæ into a very narrow spurious margin. *Lirellæ* very numerous, not crowded but closely and pretty regularly scattered over the whole thallus, much longer than in the preceding variety, slender and linear, very irregular and varied in their disposition, slightly waved and curved, extremities obtuse or obtusely pointed, or one obtuse and rounded, the other pointed, immersed as in the last, but with a more distinct spurious margin, dark brown. *Disk* as in the last, canaliculate, open and concave, without pruina, elevated and flat when wetted, surrounded by the thin prominent wavy proper margin.

γ. radiata. Lirellæ radiate.

On ash? Sussex! *Mr. Borrer.*

Thallus in the centre moderately thick, tartareous, extensively cracked, pulverulent, white, and raised around the lirellæ into a spurious white pulverulent margin, frequently more or less obliterated, thinner and not so pulverulent towards the wavy irregular paler margins of the patch, which are destitute of lirellæ. *Lirellæ* very numerous and crowded, confined to the central portion of the thallus, elongated, but varying in size, variously branched, either simply or repeatedly, disposed more or less in a somewhat radiate arrangement, linear and slender, of the same width throughout, obtuse at the extremities, black. *Disk* rimæformi-canaliculate, narrow, more or less open when dry, expanded and flat, but still narrow when wetted, brown, slightly pruinose, surrounded by the thin, prominent, wavy, curved, and crisped proper margin.

No. 91 (specimen on beech) in Mr. Borrer's copy of 1st ed. Schær. Lich. Exsicc. and No. 88 in my copy of "ed. alt. immut." are referable to this variety.

δ. *flexuosa.* Lirellæ variously flexuose.

On beech. St. Leonard's Forest, Sussex! *Mr. Borrer.* New Forest, Hants! *Mr. Lyell in herb. Borrer.*

Thallus much thicker and more tartareous than in the preceding varieties, extensively cracked, pulverulent and white, irregular and rugose, raised into spurious margins around the lirellæ, pale yellow or cream-colour, bounded by a brown line. *Lirellæ* very numerous and crowded, either simple and curved, or branched from the middle or the extremities, simply or repeatedly flexuose, curved and twisting in all directions, and with all degrees of curvature, in the more closely crowded specimens anastomosing one with the other, immersed, scarcely prominent, obtuse and rounded at the extremities in the branched form, more acutely pointed in the simple form, though more or less elongated, yet stout and clumsy in general aspect. *Disk* rimæformi-canaliculate, more or less open, encompassed by the stout, rounded, prominent, incurved, wavy, proper margin, not pruinose.

In what appears to be a very old state of this flexuose variety on oak in Mr. Borrer's herbarium, and which resembles a fragment in the same collection from Acharius, labelled "*Graphis serpentina, var. eutypa,* Ach., *an a Gr. rugosa distincta*?" the thallus is quite tartareous, pulverulent and white, altogether raised into innumerable prominent rugosities, by their proximity almost obliterating the slender, narrow, elongated, branched, flexuose lirellæ, which are situate in the hollows or interstices between the rugosities.

5. *Graphis Smithii.* Thallus thin, membranaceous, even or rugose; lirellæ immersed, broad, simple or branched in a subradiate subparallel manner; proper margin very narrow; thallodal margin thin and membranous; disk plane, naked or pruinose; sporidia eight, in asci, linear, margined, rounded at the ends, containing 6–8 transversely oval, margined spores.

Opegrapha scripta, Sm. E. Bot. 1813 (not of Ach.) (1807).
—— *Lyellii,* Hook. Br. Fl. 2. 147 (in part).

On hazel, in a wood at the Berrow, south end of Malvern Range, Worcestershire! *Mr. E. Lees.*

α. vera. Lirellæ radiate, like Chinese characters.

Mostly on young oaks. Sussex! *Mr. Borrer.* St. Leonard's Forest! *Mr. Borrer.*

Thallus thin, membranous, pale yellow, continuous, smoothish, somewhat verrucoso-rugose, in some states very rugose and rugged, probably from age or peculiar locality, limited by a brownish irregular line, slightly raised in a thin membrane as a thallodal margin around the lirellæ, which is sometimes almost obliterated. *Lirellæ* scattered, rather close together but not crowded, variously branched in a subradiate manner, the branches parallel so as to resemble Chinese characters, very black, immersed, but the disk on a level with the surface of the thallus. *Disk* plane, black, with or without pruina, the proper margin very thin and narrow, scarcely discernible. In section the perithecium is seen to be confined to the sides of the lirellæ alone, the base being naked as in *Graphis*.

β. elongata. Lirellæ much more simple, slightly branched, linear-oblong or lanceolate, extremities acute.

Sussex! *Mr. Borrer.* Bangor, Co. Down! *Mr. Wm. Thompson.* Corsygedol! *Rev. T. Salwey.* Gloddaeth, Caernarvonshire!!

With some resemblance to the simple lirellæ of *Hymenodecton dendriticum*, but the structure differs.

γ. divaricata. Lirellæ with a single branch at right angles.

Sussex! *Mr. Borrer.* On ash, Gopsall Wood, Leicestershire! *Rev. A. Bloxam.* Oxfordshire! *Mr. Baxter in herb. Dr. Greville.* Dunscombes Wood, Cork! *Mr. I. Carroll.*

δ. simpliciuscula. Lirellæ smaller, simple.

Sussex! *Mr. Borrer.*

ε. macularis. Lirellæ very small, numerous, crowded, like irregular rounded or oblong spots.

Ireland! *Miss Hutchins in herb. Borrer.* Bagley Wood, Oxford! *Mr. Baxter in herb. Borrer.* Sussex! *Mr. Borrer.* Bangor and Cultra, and Holywood House, Co. Down! *Mr. Wm. Thompson.* Llandrindod! *Rev. T. Salwey.* Castle Bernard Park (sycamore), Bandon, Ireland! *Rev. Prof. Hincks.* Blarney, Ireland! *Mr. I. Carroll.*

Under all forms distinguishable from *Chiographa Lyellii* and *Hymenodecton dendriticum* by the structure of the lirellæ.

Plate VI. fig. 22. *a*, Vertical section of thallus and lirella; *b*, sporidia.

[To be continued.]

XXVI.—*A Reply to two Statements published by the Palæontographical Society, in their volume for* 1853; *one appearing to accuse the University of Cambridge of illiberality in the administration of its Museum; the other reflecting on the character of Professor M'Coy.* By the Rev. Professor SEDGWICK, M.A., F.R.S. &c.

To the Editors of the Annals of Natural History.

GENTLEMEN,

I VENTURE to request the publication of this *Reply* in the next number of your Journal, which is not only an excellent vehicle of scientific information, but also one of the guardians of the honour of scientific men. You can have no interest in the following statements, except so far as they have a bearing on the cause of truth.

Some time after I had seen the 'Third Part of the British Fossil Corals,' published by the Palæontographical Society in 1852, I wrote to their Honorary Secretary, and collected from his reply, that any communication from myself, in opposition to two statements made by Professor Milne-Edwards and M. Jules Haime (in the Memoir, just mentioned, p. 151), would probably be rejected by the Society, or, at least, published in their next volume, in a form which would not be satisfactory either to Professor M'Coy or myself. I therefore resolved to postpone my *Reply* till it might appear in the "Third Fasciculus" of the Cambridge Palæozoic Fossils, which would be published (as I then hoped) in the spring of 1853.

Meanwhile, during my engagements away from Cambridge, I had a letter from Professor M'Coy, agreeing in substance, and almost word for word, with the one which forms the most important part of this communication. Greatly do I blame myself for not having immediately sent his letter to the press. But I was anxious, at the time, to add some words of vindication for the University of Cambridge; and having no access to the Palæontographical volumes, or any other books of needful reference, I was compelled to postpone my *Reply*; and I thereby failed, unconsciously, in my duty to my friend: for I now know that he did not immediately publish his own vindication, because he thought that he had entrusted it to myself.

The plates and letter-press of our Third Fasciculus were in progress immediately after the publication of the Second (July 1852); and Professor M'Coy, who is compelled by his duties at Belfast, to leave Cambridge in the autumn, hoped to complete the plates, by the help of an Irish artist, during the following winter. In this hope he was entirely disappointed; and on his return to Cambridge near the end of April 1853, his work was for some weeks retarded by the unavoidable absence of Mr. West, our artist. Much of the letter-press was however struck off; and on the return of Mr. West the work was pressed forward by almost incessant labour. A very vexatious, and to me a rather costly accident, so much retarded the final completion of the plates, that Professor M'Coy was again compelled to leave Cambridge; and, to our joint mortification, the publication of the Third Fasciculus was necessarily postponed till the spring of 1854.

These dates can have but little interest to the reader; but they form a part of my vindication and apology.

In like manner the First Fasciculus was more than two years in hand before its publication. Its plates of corals were, I believe, all struck off in 1849; but the work was published in May 1851: and out of this latter date an utterly groundless imputation of unfair dealing has been insinuated against Professor M'Coy.

When he had left Cambridge at the end of the summer vacation of 1853, there was no longer the shadow of a plea for any further delay in the publication of this *Reply*; and it would have been sent to the press in November or December last but for a serious attack of illness, which has made me, for almost four months, incapable of undertaking even the humblest intellectual task. Such is my apology to Professor M'Coy, and to those who are interested in the fossil history of our Palæozoic deposits; and I conclude by expressing a hope that the following statements may be thought worthy of a place in your scientific Journal.

I have the honour to be,
Gentlemen,
Your faithful Servant,

A. SEDGWICK.

Cambridge, March 4, 1854.

Reply, &c.

The first statement on which I am called upon to bestow some words of comment I shall immediately subjoin. The second statement appears word for word in Professor M'Coy's letter: and I may here remark, that although the subjoined quotation is word for word, the *italics* are my own—the passages having been underlined in my private copy of the volume from which it is taken.

"Most of the *carboniferous fossils* that we have represented in the plates joined to this monograph belong to the collections of the Geological Society of London, the Museum of Practical Geology, under the direction of Sir Henry de la Beche, the Museum of Bristol, and the rich cabinet of our esteemed friend J. S. Bowerbank, Esq. We much regret *not having been able to obtain the same liberal* aid from the Museum of the University of Cambridge, and to have been therefore obliged to omit representing in this work a certain number of species, that we have not seen in any of the numerous collections so generously placed at our disposal by the great majority of the English geologists. But the omission that we here allude to is *now* of less importance than *it appeared to us, when our application to the Cambridge Museum was rejected,* for, since that time, a young palæontologist belonging to that scientific establishment, Professor M'Coy, has published very good figures of *almost all the corals that we were desirous of obtaining* communication of from the above-mentioned museum. His recent work will enable us, at least, to complete our Catalogue of the Corals found in the Carboniferous formation of Great Britain; and having gone to Cambridge *in order to see the fossils described by that gentleman,* we have easily recognized those species which we had already met with elsewhere, and can without hesitation refer most of the others to generical divisions here adopted." (British Fossil Corals, Part 3. pp. 150, 151, 1852.)

To this passage another is affixed, in the form of a note, which is copied (as above stated) in Professor M'Coy's letter. The two passages cannot be considered apart: and what are the conclusions which any reader of common sense would naturally draw from them? That MM. Edwards and Haime had personally made an application for the loan of certain Palæozoic fossils in the Cambridge Museum which had been rejected; that this rejection was in disadvantageous contrast with the liberal conduct of all other public bodies to which they had applied; that their loss, on account of this rejection, was the less, because Professor M'Coy had (since) published and figured (First Cambridge Fasciculus, May 1851) nearly all the species of which they were anxious to have the loan; that the Professor had made an unfair use of their First Part of British Fossil Corals (*i. e.* Tertiary and Cretaceous Corals, &c. published in 1850); and that to cover his plagiarism he had misdated a portion of his own labours, and virtually stated what was not true. I think that any attentive reader must inevitably have drawn all these inferences from the passage above quoted and the note affixed to it.

Professor M'Coy may safely be left to fight his own battles; for I know that he has truth and reason on his side; and so far as regards the University my direct reply shall not be long. I affirm, that *no application*, direct or indirect, was ever made to me, either by MM. Edwards and Haime, or by any member of the Palæontographical Society, for a loan of any part of the Cambridge Palæozoic fossils; and I was astonished when I first read the above quotation, and the note affixed to it. For till that time I had not so much as heard that the two distinguished authors had undertaken the description of the older British fossil corals, and commenced their task.

This I stated in a letter to Professor Milne-Edwards, who justified what he had written by an appeal to Mr. Bowerbank, the Honorary Secretary of the Palæontographical Society.

With that gentleman (of whom I shall ever speak with kindness and respect) I have, consequently, had a short correspondence, in which he states that Professor Edwards did come to Cambridge and applied for a loan of certain fossil corals. On this point there is no dispute or doubt. But he further states, that *after* the Professor's return from Cambridge, he (Mr. B.) endeavoured to enforce the application by a letter to myself; "*that he never wrote to me* (in behalf of the Palæontographical Society) *but once, and that once was regarding the Palæozoic fossils.*" He further states, "that shortly after having written," he met me at Ipswich, and in a *short* conversation, as we were on the point of starting to a public meeting, he again made his request for the loan of the corals*.

Of the conversation I have not the shadow of a remembrance; but I can prove to demonstration, that his letter (above-mentioned) had reference only to the Oolitic corals. From the very first he appears to have laboured under a positive mistake as to the nature and extent of Professor Edwards's application to our museum; and one mistake inevitably led to another.

Independently of all direct evidence, what are the obvious probabilities of the case? When MM. Edwards and Haime were at Cambridge (in 1849?) they asked for the loan of certain Oolitic species, and *for no others* (Prof. M'Coy's letter, *infra*) †. Therefore any subsequent letter urging their request

* I have no present means of fixing the date of the conversation alluded to in the text; but it must have taken place (as I collect from Mr. B.) at one of the annual Ipswich meetings which preceded the meeting of the British Association in 1851; and therefore probably in 1850.

† I cannot exactly fix the date of the visit of MM. Edwards and Haime, but Professor M'Coy informs me that it took place a considerable time before the publication of the First Part of their British Fossil Corals;—it must therefore have been in 1849 or early in 1850. He adds, in the note I have just received from him, "They made no application for Palæozoic fossils, which they knew I was publishing, and which they told me they had then no intention of touching."

must *inevitably* have been understood by myself as relating *only to certain Oolitic species*, unless the contrary were expressed, which assuredly it was not. Again, Mr. Bowerbank states that my verbal reply (at Ipswich) was considered by him "as equivalent to a refusal;" and that the subject could not afterwards be introduced to me, "without the appearance of undue importunity." All this is perfectly consistent. If the Palæontographical Society thought that I had refused the loan of the Oolitic fossils in 1849 or 1850, it was perfectly natural for them to abstain in 1851 from any request respecting the Cambridge Palæozoic fossils. In one word, I knew exactly what had taken place at Cambridge during Professor Edwards's visit, and Mr. Bowerbank did not; and hence originated that verbal misunderstanding I have just pointed out.

Since the above correspondence closed, I have had a second communication from Professor Edwards (Paris, Feb. 4, 1854), in which he now gives me the positive grounds of his statement respecting Cambridge. Among other matters he quotes a letter of Professor M'Coy (dated March 15, 1850, and now in Professor Edwards's possession at Paris) "*relative to the Oolitic corals*," and without a word of reference to any others. Professor M'Coy's letter contains a copy of a note he had just received from myself, which was painfully written with the left hand; a fact which fixes its date to March 1850, were there no other evidence. My note concludes with the following words: "Pray explain to Mr. Bowerbank that the fossils (*i. e.* 'the Oolitic corals' as they are expressly called by Professor M'Coy) are the property of the University, and are in daily use among the students, in the way of consultation, and that it is impossible for me to send them away to Paris; but all other help in my power shall be given, and every facility for making drawings, &c."

When I lately saw my left-handed note, I was afraid that it might have been written in a petulant spirit; for I was at the time in much suffering, and neither Professor M'Coy nor myself had been quite pleased with the reserve of MM. Edwards and Haime. When at Cambridge they accepted his services for a specific object, and they did not afterwards condescend to inform him or me that those services would not be wanted. There is, however, as I rejoice to find, no petulance in my note.

What took place at Cambridge (in 1849?), when it was visited by Professor Edwards and his distinguished fellow-labourer, is stated in Professor M'Coy's letter. It was my great misfortune not to be present, and I only know the facts at second-hand. But, soon afterwards, I met Professor Edwards in London, who spoke in courteous and, as I thought, in warm terms of his reception by Professor M'Coy; and I declare, with the sincerity of perfect truth, that when we parted I had not the most distant thought that he (M. Edwards) was dissatisfied with the arrangements he had made at Cambridge, or wished to have them changed.

Had MM. Edwards and Haime thought good, in their great essay on the British Oolitic Corals (1851), to charge the University with unwonted illiberality for having "rejected" their application for certain species in our Museum, they might have done so with, at least, verbal truth; although such a charge would, I think, have been uncourteous and unjust. But having let this occasion slip, and as if to make amends for this forbearance, they published their charge in 1852 (transferring it from one memoir in which it might have appeared, with a show of reason, to another in which it ought never to have appeared), so as to make it almost incompatible with plain historical truth; and, I believe, in such a form as to have misled the Council of the Palæontographical Society. Be this as it may, a plain statement of facts would, in 1851, have had no sting, and would never have provoked a reply. But why is the charge against Cambridge taken out of its true historical place, and brought forward in another? For no purpose, which I can comprehend, except that of affording a vehicle for a very unjust insinuation against the character of one of the most honourable and devoted of the sons of natural science. Such insinuations ought never, under any circumstances, to disfigure the Transactions of a public Society. It is most true that public Transactions are not to be the vehicles of short-lived controversy, and the Council (as I now think) did right in rejecting my application to them. Their proper office is to be the great recipients of the stream of truth,—pure, sincere, and strained from every particle of malignity. In one single unhappy page they have overstepped the duties of their high and honourable office.

The *Cambridge Geological Museum* is the property of the University; and there is not a specimen in it which I call my own. Though I have collected largely during thirty-five years, and at the cost of thousands, I have collected for the public; and the public has a true interest in the administration of the Museum*. What, then, is the nature of its administration? It is under a board of Auditors, who are governed by laws given in the founder's will. The Professor does not receive the keys of the Museum till he has signed a very *heavy bond*, which he would forfeit to the University on any culpable neglect of duty. Two

* For a more full account of the contents of the Museum, and of the gradual formation of its very extensive collections, both British and Foreign, the reader is referred to the "blue book" of the Royal University Commission, published by authority in 1852.

Inspectors are annually appointed, who can demand the keys whenever they think right; and they do demand them yearly, so as to see that no specimens, in the arranged catalogues, are lost or out of place. No salary is ever paid to the Professor till after the report of the Inspectors has been given in to the board of Auditors. These stringent regulations have been the means of preserving the *original collection* in its integrity: and though now seldom consulted it possesses many very valuable specimens, and has a great historical and antiquarian, as well as a scientific, interest; as every one knows who has studied the old printed Woodwardian catalogues. The same regulations apply to the additional collections (made during the last thirty-five years) after they have been arranged and placed in the cabinets of the Museum. They are then liable to *Inspection*, and to all its consequences in the annual report.

During the removal (about twelve years since) of the old, as well as the modern, collection into the new museum, it was exposed for several weeks to a great risk of loss—one or two valuable specimens disappeared; but *not*, I believe, *one* from the original cabinets. Since then the modern additions have so far advanced in arrangement, and been so much increased by the bounty of academical friends, by purchase, and by my own labours, that we have now a collection of very great value, and illustrative of nearly all departments of Palæontology.

What, then, is the spirit in which this Museum has been governed? With the exception of very short intervals (necessary for cleaning and repairs) it is open six days a week during the whole year—at the rate of six hours a day during the winter, and eight hours a day during the summer, months. Academical men, and strangers, and foreigners are admitted alike without restriction—may remain during all reasonable hours—may sketch the specimens—and may turn to their own profit and instruction the vast scientific labour that has been bestowed on the collection. Artists have, more than once, been sent down to copy specimens and portions of the great series, and their applications have never been in vain. Every possible facility has been given to their labours. In all these respects the administration of our Museum dares to challenge comparison with that of any other public museum in Europe.

While any part of our vast collection has remained unarranged, I have treated it as my own property; finally, however, to be transferred to the arranged cabinets of the University; after which it becomes subject to the more stringent laws of our Museum. After their arrangement in the University cabinets, I have no right to send any specimens away from the Museum. By such an act I might forfeit a very heavy bond. Not that

I have any fears of this kind; but no man of honourable feeling wishes to owe his safety to the *forbearance* of his friends.

Spite of the regulations here alluded to, I have several times (as Professor Owen, Mr. Searles Wood, Mr. Sowerby, and Mr. Davidson and others could witness) conveyed, for a few days, very rare specimens away from our Museum to serve some scientific purpose. I did so in each instance *meo periculo,* and without consulting the authorities, as I thought the occasions might perhaps justify the irregularity and the risk. My honoured friend, the late Professor De Blainville, strongly urged me to send him, for examination, a very valuable specimen from the old Woodwardian cabinets, which had once formed a part of the ancient collection of Agostino Scilla. I could not comply with his request; but I ventured to place the specimen in the custody of Professor Owen, that good drawings and casts might be made of it for M. de Blainville's use.

After the great labour, continued for more than thirty years, in the formation of our collection, the cost bestowed on its arrangement, the perfect liberality of its administration, and the noble descriptive and scientific catalogue of our whole Palæozoic series by M'Coy, I little expected to hear a whisper of censure against us on the score of our Museum; nor should I have cared one straw for any implied censure in the passage on which I have been led to comment, had it not been followed by a very unjust insinuation against my friend; and I now request the reader's attention to his letter of explanation and defence.

Professor M'Coy's Letter.

Belfast, 26th December, 1853.

My dear Sir,

In reply to your letter, relative to the observations published by MM. Milne-Edwards and Haime in p. 151 of the Third part of their Memoir on Fossil Corals, for the Palæontographical Society, reflecting unjustly on the liberality of the Cambridge Museum, and on myself, I beg to state that I published preliminary descriptions of the new Carboniferous and Oolitic corals in the collection, in the Annals of Natural History for 1849, and that some considerable time after their publication MM. Edwards and Haime came to Cambridge to see them. I was fortunately there, and spent several hours in demonstrating all my species to them; I also showed them the drawings on stone making for our plates. They were highly complimentary on all the work that had been done, and stated that they were about preparing a Monograph on Tertiary, and subsequently one on

Oolitic Corals for the Palæontographical Society, but had no immediate intention of touching the Palæozoic Corals. They then said they were desirous of figuring my newly-published Oolitic species, and asked whether the specimens would be sent to them on application. I said there was great difficulty about sending specimens out of the collection, but that if they wanted figures our artist should draw them in after-time if they liked, and that I would myself superintend them carefully. They were delighted with the suggestion, thanked me, pointed out all the specimens I was to get drawn, and the number and size of the figures, saying they would arrange, on their return, for Mr. Bowerbank to pay the artist. It must be want of memory, therefore, that betrayed MM. Milne-Edwards and Haime into the statement at the top of their page 150: "We much regret not having been able to obtain the same liberal aid from the University of Cambridge." Their lines farther on (top of page 151) are also liable to misconception, at least; as ordinary readers think the paragraph an insinuation that I knew nothing of these new corals till MM. Milne-Edwards and Haime asked for them, and that I hastened with them into print on "their application being rejected:"—the plain facts being, that these gentlemen were attracted to Cambridge by my previously published descriptions of those very corals; that they had then made no application at all; that when they came they saw our artist finishing our plates; that my part of the work was finished; that I gave them every information in my power*, though the Cambridge work was not regularly published till after their departure.

At the foot of the same page (151) MM. Milne-Edwards and Haime mutilate a note of mine (at page 17 of the Cambridge Pal. Foss.), and thus draw so false a conclusion that they seem to have penned a wilful calumny. My note referred to is—"As these pages were passing through the press I received MM. Milne-Edwards and Haime's great English Memoir on Corals, but at too late a period to profit *materially from the new portions not previously published in the Comptes Rendus.*" And yet MM. Milne-Edwards and Haime act as if the underlined, important, portion had not been written. Their note is as follows:—"This work (Cambridge Pal. Foss.) was published in May 1851, some months after the first part of our *Monographie des Polypiers des Terrains Palæozoiques,* and at least a year after the distribution of the first part of our 'Description of the British Fossil Corals' to all the members of the Palæontographical Society. In the beginning of his book (p. 17) Professor M'Coy

* Some of which (*e. g.* the existence of radiating lamellæ in Michelin's *Dendropora*) they published soon after in the *Comptes Rendus* without acknowledgement.

expresses his regret at not having become acquainted with the latter publication early enough to be able to refer to it; and we feel much gratified in seeing that the results, which Professor M'Coy appears therefore to have obtained solely from his own observations, are often so very similar to those published by ourselves a year before; even by a singular coincidence he often makes use of the same names for the divisions previously established in the first part of this Monograph."

With regard to the first statement here made, I got the Cambridge University bookseller to write to the French publisher for the exact date at which he delivered the parts of the 'Archives' containing the French memoir in question (which bears no date, *and had been quoted in print by MM. Milne-Edwards and Haime long before it was published*), and I received the authentic letter in reply, fixing the real date of publication as the 26th of June 1851; I did not of course receive it till July, *our work being out the May previous*. In their second statement, that our Cambridge Fasciculus of May 1851 was "published at least a year after" the First Part of their Palæontographical Memoir, they also err in a matter of fact known to every Local Secretary of the Society throughout the country; and if they mean to deny that I only received it as the sheets on which I wrote the note were passing through the press, they again not only err in a matter of fact, but grievously err in a matter of courtesy. Here I may add, that I received the volume from the Cambridge Local Secretary on the day it was sent down by the Society to him for the members. As for the concluding part of their note, in which they try to make it appear that I used their writings while stating that I did not know them,—I have already pointed out that, to serve this purpose, they have suppressed the half of my note which stated that *I had* profited by their previously published French writings; and those who examine the Cambridge work will find that in it I have repeatedly referred to MM. Milne-Edwards and Haime, and their French papers on Corals in the *Annales des Sciences* and *Comptes Rendus*, of which their English work is little more than a partial translation, and that there is no ground for their insinuation, that either by a "singular coincidence" or otherwise, their names or observations were passed for my own.

In M. Milne-Edwards's letter to you he complains only of the author's name not being put to the Orders, Classes, or Tribes, so that his cannot be distinguished from mine or any other writer's. I need only refer the members of the Palæontographical Society to their last volume (1852), where they will find the same thing done by Prof. Forbes in his Monograph; also by King (who gives his reasons) in a former volume, and by several others; and without wasting time with the reasons, I may say that (except where mistakes might arise) I do not put an author's name to any group larger or less definite than a *genus,* and never mean to do so.

Having now refuted these aspersions at your request, which I should scarcely have done for myself, I may add, that MM. Edwards and Haime have figured and described, as new, in their 'Monographie,' several corals previously published by myself in the 'Annals of Natural History,' and that the first idle time I have, I shall write a paper on this and other *scientific* unfairnesses in their works, with which at present we have nothing to do.

I have the honour to remain,
My dear Sir,
Very truly yours,
Rev. Prof. Sedgwick. FREDERICK M'COY.

So far as Professor M'Coy's letter bears upon matters of fact, I can give my unqualified testimony in its confirmation. There is not a more single-minded, honourable, and truth-loving man in the list of those whom I rejoice to call my friends. No other English writer has more fully and fairly quoted the works of those who have preceded him in his own line of study; and no other English writer has shown the same accurate and extensive knowledge of what may be called the literature of palæontology:—I am not so rash as to offer any estimate of the comparative merits of his classification of Fossil Corals and of that given by MM. Edwards and Haime. In one respect, however, he has an apparent advantage over them, inasmuch as his labours are more directly connected with the works of the best authors who have preceded him in investigations similar to his own.

In clearness of description the work on the Cambridge Palæozoic Corals is almost unrivalled; and the lithographic illustrations, if inferior to those executed at Paris in artistical touch, are by no means inferior to them in accuracy of details, and in the graphic delineation of those characters which give a true scientific meaning to the specimens.

The work, when finished, will contain a careful description of every English palæozoic species in the Cambridge Museum, collected during the last thirty-two years by myself and by my friends from all the old fossiliferous strata of England. To affirm that, in a work of such great extent and difficulty, the author has fallen into no mistake or error of judgement, would be an idle boast. But I do very confidently affirm, that Professor M'Coy began his task at Cambridge after a thorough scientific training of many previous years;—that with acute senses sharpened by long experience—that with a philosophical perception of the highest requirements of natural history, and with a patience in the endurance of continued labour which has seldom had its match, he has produced a work which entitles him to the gratitude of the University, and (I dare to add) of the scientific world.

Praises thus unqualified (called forth by the circumstances which have led me to take up the pen) might seem partial or exaggerated. But I know them to be well deserved; and to confirm my own words, and to prevent any misconstruction of them, I will quote the remarks upon M'Coy's work by Professor Bronn of Heidelberg—a great palæontologist (as I surely need not tell the reader), and, at the same time, a very just but severe critic, who is not inconsiderate or prodigal in his words of praise:

"Dieses Werk ist ausserordentlich reich an scharfen Beobachtungen, fleissigen Beschreibungen und von M'Coy aufgestellten Sippen und Arten. . . . . Mit der ausländischen und insbesondere deutschen Literatur ist der Verfasser wohl bekannt, und er hat sie reichlich benützt; das Ganze ist eine der wichtigsten Erscheinungen in der paläontologischen Literatur und fortan unentbehrlich bei allen paläozoischen Studien." . . . . . "This work is extraordinarily rich in acute observations, careful descriptions, and in genera and species established by M'Coy. . . . . . . The author is well acquainted with the foreign, and especially with the German literature, and has made an abundant use of it; the whole is one of the most important appearances in the literature of Palæontology, and henceforward indispensable in all Palæozoic studies." ('Neues Jahrbuch' by Professors Leonhard and Bronn of Heidelberg, 1853, pp. 97, 98.)

During the early progress of M'Coy's work (though repeatedly urged to do so) I studiously abstained from giving him any scheme of tabular arrangement derived from the physical groups of the Cambrian and Silurian series. I simply gave him the general facts of superposition. He, therefore, began by arranging all the groups of fossils, below the old red sandstone, as parts of one system; and for two successive years, without a single word of interruption from myself, he described them, in the printed labels and catalogues, as Upper and Lower Silurian.

In the further progress of his work he found a great palæontological break in the series, which led him to separate it into two Systems; and then, for the first time, he adopted my name Cambrian for the lower of the two. Still there was an unexplained difficulty: for in one remarkable group (called Middle Silurian in the Government Survey, and containing the greater number of the Lower Silurian rocks of Sir R. I. Murchison) were subordinate groups of strata, some of which conformed to the Silurian, and others to the Cambrian type. My own collection did not seem to sanction the establishment of the so-called

Middle Silurian group; and on the fossil evidence in the Cambridge Museum Professor M'Coy ventured to affirm his conviction, that some great sectional or palæontological error had been committed in the establishment of the middle group.

We put this conclusion to the test in 1852; and on good sectional and fossil evidence, we were enabled to break up this group into two parts, which were not only palæontologically distinct, but generally unconformable one to the other. Thus the May Hill Sandstone became at length the true base (physically and palæontologically) of the whole Silurian series; and by the interpolation of that sandstone there will be no longer any real difficulty in the tabular view which will precede the Third Fasciculus*.

I might here (as not by any means unconnected with the subject of this communication) also dwell upon the great value of Professor M'Coy's determination of the Devonian corals, as distinguished from the Cambrian, the Silurian, and the Carboniferous: but I must forbear; and I hope to take up some of the subjects, here pointed at, in a future communication.

XXVII.—*Notice of the discovery of* Desmarestia Dresnayi *on the coast of Ireland.* By R. K. Greville, LL.D. &c.†

[With a Plate.]

The Alga to which this notice refers was collected towards the close of last year, at Moville, near the mouth of Lough Fyle in the north of Ireland, by William Sawers and — Morrison, Esqrs., and communicated by the former gentleman to Professor Balfour, by whom specimens were placed in my hands for examination. It is a form quite new to the British flora; and as its affinity is involved in some obscurity, its discovery on our shores is invested with considerable interest. Specimens transmitted to the celebrated French cryptogamist, Dr. Montagne, have been pronounced by him to be identical with an Alga found by himself at Fort St. Sebastian in 1823, and published in the 'Annales des Sciences Naturelles' for 1842, p. 251. t. 7. f. 2, under the name of *Desmarestia pinnatinervia*. Dr. Montagne obtained only a single individual, scarcely more than 4 inches high, fully 2 inches wide, and truncate; being evidently an abnormal development. M. Cronan has likewise met with it, though rarely, at Brest, and regards it as a variety of *Desmarestia Dresnayi* of Lamouroux,

* Memoir read before the Geological Society of London, Nov. 3, 1852.
† Read before the Botanical Society of Edinburgh, January 12, 1854.

described and figured in the 'Dictionnaire des Sciences Naturelles,' t. xiii. p. 105, the figure being half the natural size. Professor J. Agardh—the most recent authority—in his great work, 'Species, Genera et Ordines Algarum,' refers both the above Algæ to varieties of *Desmarestia ligulata*, but still includes *D. pinnatinervia* among his "Species inquirendæ," with the additional remark, "videtur pars inferior frondis latioris Desmarestiæ ligulatæ."

D. Dresnayi, Lam., which was published in 1819, was found on the French coast. It has a slender stipes about half an inch high, which immediately gives off two lateral fronds about 2 feet long and 1 to 2 inches broad, linear-lanceolate, with a fine longitudinal nerve and very delicate opposite lateral nerves, which are sometimes forked. The margin is sinuate, more or less toothed, and towards the base some of the lateral nerves are prolonged into very short leaves of the same form as the frond, thus manifesting a tendency to the pinnate development characteristic of the genus. The colour is described as olivaceous, and the substance membranaceous.

D. pinnatinervia, judging from the figure given by Dr. Montagne, has so close a resemblance to *D. Dresnayi*, that were the two side branches in the figure of the latter plant removed, the remaining central portion (which appears to have been shortened by some injury) would be almost a fac-simile of it. The character of the nervation and of the margin is precisely the same in both—so also is the stipes, the colour and the substance. The frond, however, is quite simple, and Dr. Montagne compares it to large specimens of *Laminaria debilis*.

With regard now to the Irish plants, they appear to constitute an intermediate link between the two forms above mentioned. They have a slender well-defined stipes half an inch long or more, a linear-lanceolate frond from 12 to 18 inches long and 2 to 4 inches broad, the margin more or less sinuate and dentate. An exceedingly fine but very perceptible nerve runs from the base to the apex, from which, lateral ones opposite, and frequently forked, are given off at intervals of nearly a quarter of an inch. These lateral veins, which are somewhat inconspicuous, at least in the dried specimens, terminate in the marginal denticulations. Mr. Sawers observes, that the colour in the fresh state is that of a *Laminaria*, while the substance is thinner. That gentleman also describes the margin in one or two specimens as slightly proliferous; bringing the plant so very near to *D. Dresnayi*, that I do not see how the two can be separated; and the latter name having the priority must be retained, if they are to be considered as distinct from *D. ligulata*.

It must be confessed that the transition from the ordinary narrow and decompound state of *D. ligulata,* as it occurs on the British coast, to that of the Alga under consideration, is very remarkable; and as far as I know, intermediate states have not occurred. But Professor J. Agardh speaks of the frond of some French specimens of *D. ligulata* as an inch in breadth. Professor J. Agardh's var. β. (*D. herbacea,* Lamx.) and var. γ. (*Sporochnus herbaceus,* var. *firma,* Ag. Syst.) do not at all agree in their pinnated forms and spinuloso-serrate margin with our plant; and if his conjecture should eventually prove to be correct, it would be difficult to adduce a more extraordinary deviation from a specific type. It might be described as var. δ. *subsimplex.* In the mean time a figure (Pl. XIV. fig. 1) of so interesting an Alga will, it is hoped, be not unacceptable to the British botanist.

XXVIII.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With two Plates.]

[Continued from p. 200.]

The epidermal skeleton of the Arthropoda is histologically peculiar. *Chitine* was first defined by Odier*. In the year 1845 it was more fully investigated by C. Schmidt†. By Lassaigne it has been distinguished under the name of *Endomaderm*: it is a proximate principle which resembles *cellulose*. Both are insoluble in caustic potass. Nitrogen however is present in chitine and absent in cellulose: it is the animal basis of the integumentary structures of Insects and Crustacea. It is a principle of low vital properties. To the presence of this substance is probably to be ascribed the fact, already mentioned as extraordinary, of the universal absence of vibratile cilia from *all* the structures of Insects and Crustacea. And why is *vibratility* not a property of those organized parts of which *chitine* is the proximate basis? The very definedness of this question marks an advance in the real *science* of physiology. Effect is linked to its true cause, attribute to its right substratum, function to its immediate instrument. Chitine is produced under two distinct conditions: in Insects it occurs under the circumstances of atmospheric respiration, in Crustacea under those of the aquatic.

* Mém. de la Soc. d'Hist. Nat. de Paris, 1823, p. 29.
† Zur Vergleich. Physiol. d. Wirbellos. Thiere, p. 32.

The *external* machinery of the process of breathing, however unlike the constituent parts, or different the principle of its action, does not therefore appear to involve any difference in the ultimate products of the nutritive actions of the organism.

The suppression of motive cilia in the Arthropoda is the signal of the saving of power. The economized force is diverted to other purposes. The nervous and vascular centres are raised in standard: the whole muscle-system is augmentedly developed, and the secernent organs are woven into more complex structures. The presence of chitine in the dermal skeleton of the Articulata entails a distinctive character upon the periphery of the circulatory system. Contractile vessels cannot exist in the substance of an incontractile solid. This segment of the circulation of Insects should be studied with special reference to this point. When the skeleton is very thick, it is composed of a series of superimposed laminæ, between which are tunnelled certain channels, as in bone, for the conveyance of the nutritive fluid. In the centre of the larger of these channels tracheæ may be demonstrated*.

The true epidermis of Insects is always and universally composed of a tessellated hexagonally-celled epithelium. The anatomical characters of the ultimate blood-channels of Insects will be most successfully studied in the corresponding parts of the circulatory apparatus of the Crustacea. The same description essentially applies to both.

Crustacea.

Every Crustacean is a water-breathing, every Insect an air-breathing animal. To this rule there can be found no real, many apparent, exceptions. In the system of the Crustacean there exist no *water* tracheæ. Although the Crustacean is an insect breathing water, the mechanism contrived to accomplish the process is comparable in no single particular with that used in the instance of the Insect breathing air. In the former plan there is no wonder-striking singularity. The apparatus employed is common to every aquatic animal. The organs of breathing in every true crustacean conform essentially to the aquatic type. Though some species seem to enjoy the power of respiring on the atmospheric plan, the apparatus used fulfils the requirements of the branchial principle.

One typal form of blood-corpuscle prevails throughout all the species of this class. The fluid, in the embryonic state, as in the larvæ of Insects, and antecedently to the evolution of the branchiæ and the heart, presents a description of corpuscle different from that which afterwards in the same animal charac-

* See Histological Catalogue by Prof. Quekett.

terizes the adult fluid. The former is a real chylaqueous compound, is moved by means of the general muscles of the body, and undergoes the change of aëration without the intervention of any special organs.

Central parts of the Circulatory System.

In this class *the heart* occurs under the character either of a saccular vesiculiform viscus, or under that of the vasiform or tubular.

In the higher species, in which the organ is partly branchial and partly systemic, it is the point of departure of an arterial system of distinctly walled pulsatile tubes which in the lower becomes abortive. It is placed in the axis of the body, directly under the shell, at the anterior part of the back, and is often attached to the internal surface of the dermal skeleton by muscular fibres: it is the chief propelling power of the blood. In the Siphonostoma and Lophyropoda it is a simple sac, either spheroidal or elongated in figure: it has only two orifices, a venous behind and an arterial in front. This organ in the Decapods, occupying the middle of the cephalothorax and star-shaped, passes off into arteries in front, behind and below, the returning venous blood entering through orifices at the upper and lateral portions. In the Pœcilopoda, Isopoda, Amphipoda and Læmodipoda it is tubular in form, and occupies the mid-region of the dorsum, sends off arteries before, behind and laterally, and receives the venous blood through lateral venous orifices. It is most highly developed in the Stomapoda. In the Phyllopoda it approaches the Myriapodal chambered type.

In the lower Crustacea the blood passes from the heart directly into intervisceral lacunæ: no defined vessels exist. In the higher, in which the organ is unarticulated and more centralized, arterial trunks occur; after a short course they are lost in the interstices of the tissues.

The *venous currents* converge from the lower part of the body into various intercommunicating sinuses, situated some upon the median line and others at the base of the appendages. From these sinuses the blood proceeds to the branchiæ and thence into the dorsal sinus, the walls of which are thin and non-contractile, and within which the heart is entirely enclosed.

This dorsal sinus is filled during the systole, and the arterialized blood which it contains is absorbed during the diastole through the venous orifices of the heart without any aid on the part of the walls of the sinus *.

* See Anatomy of the Invertebrata, by Siebold, translated by Burnett, for very copious bibliographic references on the literature of this and all other classes of Invertebrated animals.

General descriptive Anatomy of the Branchial Organs.

The ultimate questions of structures will be more advantageously studied if preceded by a few general statements as to the more prominent characters of the organs dedicated to the office of respiration. The Siphonostoma, Lophyropoda, and many Stomapoda present no special branchial organs.

Those of the Læmodipoda and some Stomapoda are reduced to a few vesicular or cylindrical, sometimes wholly rudimentary appendages which hang freely from the base of some of the feet, or are inserted isolatedly at the sides of the body (Pl. XVIII. fig. 1). The Phyllopoda are provided at the base of each of their swimming feet with an ovoid or lanceolate branchial lamella: it is distinguished from the feet by the absence of bristles.

It is only the first and last pairs of feet in the Amphipoda which are modified into respiratory organs.

In the Isopoda the five pairs of post-abdominal feet are nearly always concerned exclusively in the office of breathing. The two multi-articulate cirri of each of these feet are changed into plates (Pl. XVII. figs. 4 & 5), which directed backwards, are imbricatedly arranged and applied against the under surface of the last caudal segment. In shape these plates differ according to the species. Intermediate between the Isopoda and Decapoda, the Pœcilopoda in their branchial organs partake of the characteristics of both. Inserted on the abdominal feet they resemble those of the first order; lamellar in figure they approach the branchiæ of the Decapods.

The respiratory organs of some Stomapoda (Pl. XVII. fig. 3) are evolved in the highest degree; they consist of tubular tufts arranged around a stalk, and float freely in the external medium. In anatomical structure they fall under the type of those of the Lobster (fig. 8). In *Squilla* these tufts exist on the ten anterior feet.

The branchiæ of the Decapods are attached to the bases of the anterior abdominal feet, lodged in a branchial chamber, and protected by the cephalothorax. The most developed form of the breathing apparatus in the Crustaceans occurs in the Decapods. In this order not only is the function thrown upon particular organs entirely set apart for the purpose, but these organs are lodged and protected within a special cavity; and the renewal of the water necessary to their operation is secured by the motion of distinct appendages or *flabellæ*. The thoracic cavity is formed by a reduplication of the external tegument, and is provided with two orifices, one for the introduction and the other for the expulsion of the fluid. Through these orifices a constantly renewed supply of water is made to pass by the agency of a large valve-like organ, placed in the efferent canal, which by its movements drives a continual current from behind forwards, or from within outwards, and thus occasions a constant ingress through the afferent opening: this organ is the flabellum. It is the modified appendage of the second pair of feet-jaws, specially developed to answer this purpose. The perfect contact of the water with the respiratory surface is further ensured by the actions of the flabelliform appendages of the other maxillary or ambulatory member, which in most Decapods penetrate into the branchial cavity, and incessantly sweep and comb over the surface of the branchiæ. The membrane lining the branchial chamber in some land Crabs, which not only habitually live out of water, but are infallibly drowned if immersed in that fluid, is sometimes disposed in folds capable of acting as reservoirs for a considerable quantity of water, and sometimes presents a spongy texture equally well adapted for storing up the fluid which is necessary to keep the organs of respiration in the state of humidity required for the performance of their functions*.

The preceding cursory account is offered only as an introduction to that narrative of original details which is now to follow.

An exact inquiry into the circumferential circulation of the Crustacea will serve to elucidate the apparatus of the blood-system as it exists in the Insect organism. It is only by a minute scrutiny into the last extreme of the blood-current, that the physiologist can penetrate the mystery of the nutrimental act and the ultimate mechanism of the respiratory process. No opportunity is more favourable than that offered in the example of the Crustacea;—the structures are transparent; the blood-current is obvious to the eye; every element of structure may be readily reduced to its last analysis.

Minute Anatomy of the Peripheral Blood-channels and Branchial Organs.

In nearly all species the *primary* blood-channels, both venous and arterial, are circumscribed by a special membrane which is a distinct and separable structure. The arterial trunks are contractile; they embrace closely the contained fluid. The muscle-tissue present in the parietes of the heart extends evidently to those of the arteries. The veins are non-contractile; their walls adhere externally to the solid parts, amid which they lie; they cannot therefore contract in transverse diameter; they are passive conduits, the arterial are active. The arterial and venous trunks are lined internally by an extremely fine hexagonally-celled epithelium (Pl. XVIII. figs. 2, 3, 4). The cells present re-

* See Carpenter's Principles of Comparative Physiology.

markable regularity in size and outline. They are not detectable on the internal walls of the parenchymatous passages which coincide with the capillary segment. The blood-channels are *therefore* here imparietal. The epithelium ceases where the special boundary of the artery ceases; it begins again at the limit denoting the origin of the true veins. This hexagonally-celled epithelium is the prevailing envelope or lining of all organs and cavities in the Crustacea. It betrays no other diversities than those which depend upon the size and distinctness of the contained cell-granules. The cells are *never* furnished with a nucleus. The granules are in the interior of the cells, and adhere internally to the cell-wall. A different opinion is expressed however by Professor Quekett: he describes the granules as belonging to the underlying structures. The error of this description may be placed beyond doubt by the reagency of acetic acid. Dr. Carpenter denies the existence of cells in the epidermis. In the adult Crab, for some time after the moulting has taken place, that is, after the shell has become hard, it is, as this author states, impossible to detect the cellular arrangement of the membrane exterior to the calcareous layer. The cells seem to have been mechanically worn away. Soon after the moulting however, the presence of *cells* in the epidermis of the carapace, for instance, admits of easy demonstration.

The hexagonally-celled epithelium is an element of varied use and great importance in the crustacean organism; it constitutes real boundaries everywhere of the extreme or capillary circulation (Pl. XVIII. fig. 5). Plates (a, b) are formed by the apposition of its constituent cells laid accurately edge to edge: these plates are united by interposed islets or patches of parenchyma (Pl. XVIII. fig. 1, a). Between the latter are left large, irregularly and angularly bounded passages, traversed by the extreme blood-currents (fig. 1, b). The islets of parenchyma consist of a variable number of nucleated cells, filled obviously with the *fluid* elements of the blood. The groups differ in size and outline in different organs. They are sometimes embraced by a common capsule: in such a case the latter would constitute the real boundary of the blood-channel. As such a capsule is the independent envelope of a detached group of cells, rather than the continuous boundary of a conduit, however irregular in form and outline, it cannot with any anatomical propriety be defined as the *wall* of the latter. The epidermal plates, between which the blood-passages are disposed, are inflexible, firm, non-contractile. "Membranous parietes" of blood-vessels adherent internally to these plates could not contract upon the contained fluid without approximating the plates. Such an effect would imply a strong muscular effort. No muscles exist in these extreme situations. No separate vascular membranes bound the peripheric blood-currents; therefore no "*capillaries*" exist in the Crustacea. The fact then is now susceptible of general expression, that in the articulated animals, most certainly in Insects and Crustacea, the *peripheral circulation* in consequence of the presence of a firm unbending epidermal skeleton, cannnot by mechanical possibility be any other than it is, namely a profusion of irregularly subdivided streams, traversing angularly bounded passages in fixed non-contractile inflexible solids. An exception to this axiom may exist in the example of some of the internal organs—probably in the musculo-glandular walls of the alimentary canal, certainly not in the liver of the Crustacea, as will be afterwards shown.

Let now these general anatomical facts be applied to the analysis of the branchial organs in their several varieties in this class, or to the mechanism of the respiratory act, where there exists to this end no separate provision.

The *araneiform* Crustaceans are furnished with no separate respiratory organs. Almost every English systematic writer describes the Pycnogonidæ as destitute of a true circulating system*. This is an error. In *Pycnogonum* the existence of a dorsal vessel lying on the dorsal aspect of the stomach may be readily demonstrated. The blood follows the cæcal diverticula of the stomach into the legs; it returns by separate channels along the ventral aspect of the cæca into an auricular division of the heart. The peripheral blood-currents do not subdivide. The solids are not permeated by subdivided capillary currents. Everything beyond the main stream is *cyclosis*—that is, *non-corpuscular* fluid passes by endosmose from cell to cell. This extra-vascular movement of fluid plays a part in the nutrition of the solid structures of Invertebrata, of which the frequency and the extent are by no means yet rightly estimated by the physiologist. The floating corpuscles of the blood never pass beyond the walls of the proper vessels: they never reappear *de novo* in the fluid beyond the vessels. In the latter region the fixed cells impress upon the blood required changes. But this extra-vascular fluid *after leaving the vessel,* may unquestionably undergo the process of aëration. This is exemplified in the Pycnogonidæ, in which the blood-current is so little subdivided. In this group the floating corpuscles are relatively to the size of the animal very large. They conform to the crustacean type; they are granular and nucleated, suspended in a clear, colourless fluid. They move in

* "In one of the most degraded forms of the class, we revert to the simplest possible type of the circulating apparatus; even the dorsal vessel, which is so characteristic of the Articulata, being apparently deficient in the Pycnogonidæ."—Dr. Carpenter's Principles, &c., p. 695.

a definite orbit. This fact alone proves the presence of a heart —if the fluid constituted a chylaqueous system its movements would be oscillatory.

The Entomostracous Crustacea present few diversities as regards the number and disposition of the parts dedicated to the office of breathing. In every species the feet are found to be modified parts. The circulating system is crustacean, not insect-like, in type. The dorsal vessel is a simple tube; it is in no instance moniliform; it is *not* multiplied by valves into independent contractile chambers. The peripheral circulation is *lacunar*, not capillary*. In the Branchiopodidæ the articulations of the feet expand foliaceously. An augmented surface is thus created. It is utilized respiratorily. By the ceaseless action of the legs a current in the surrounding element is maintained, which is applied to the purposes of respiration. In every order of Entomostracous Crustacea the extreme circulation coincides precisely in every particular with that afterwards to be described in the higher Crustacea. Every appendage of the body is subservient to the function of breathing.

In the families Nebaliadæ and Branchiopodidæ, the abdominal appendages of which are foliaceous, currents of blood can be traced by aid of the corpuscles, traversing irregular passages which coincide with great exactness with those so easily seen in the corresponding appendages of the Macrourous Decapods.

In several genera of the familiar Daphniadæ, and Lynceidæ, the extreme blood-currents in almost every part of the body can be clearly defined by the eye. In every foot, in every foliaceous appendage, in the very bristles, the act of aëration is accomplished. The blood-corpuscles in all Entomostraca are crustacean in type and structure. They are small in number relatively to the bulk of the blood.

In *Caprella linearis* (Pl. XVII. fig. 6), a filiform crustacean, common in the Bay of Swansea, two membranous processes (a) depend from the under surface of the abdomen. By Milne-Edwards they are said to be vesicular. They are really flat. A *single* current of blood courses round the circumference (b' b). The centre of the lamina is parenchymatous. These organs exemplify a principle in the organization of the Crustacea. They prove how little is the measure of the respiratory function in the Crustacea, compared with the high nervous development and active muscularity of these animals.

* The general facts stated in the text may be verified most readily by the examination of any of the numerous Entomostraca which inhabit our freshwater pools. Microscopic in size, they admit of being easily submitted to inspection.

No setæ or bristles of any description are added to these simple organs. They are enveloped in an exquisitely-attenuated tessellated epithelium. It preserves its tenuity without a sacrifice of stiffness. These organs are very readily converted into *vesicles* by compressing the body of the animal. The force of the fluids separates the parallel laminæ, and converts a plane into a sac. They are moved by muscles at the base; they are attached to the second and third segments of the thorax. The action of the water upon them is auxiliated by flabellæ. They exhibit the apparatus of breathing under the characters of the greatest simplicity.

The common *Talitrus* will serve to illustrate the anatomy of the branchial parts in the Amphipodan family. The thoracic limbs are commonly said to be transformed into branchiæ at their bases. The depending edges of the dorsal plates (the epimeral pieces of the tergal arc) are however much more suitably organized than the proximal articulations of the legs (Pl. XVIII. fig. 1, *c*). They are penetrated by a very dense system of canals (*b*, *c*). The epidermis is reduced to an extremely thin and transparent lamina. The component hexagonal cells may be readily observed (fig. 2). The outer or epidermal lamina is united to the opposite parallel lamina by dots of parenchyma (*a*). The blood streams in the intermediate passages (*b*). These parts therefore correspond in ultimate structure in the most exact manner with leaves of the branchiæ of the Crab. The bases of the legs are filled with muscle fasciculi. In *Talitrus*, as in all Crustacea, the blood-currents are large and few in number. No setæ or bristles of any sort belong to these lateral branchial plates. The respiratory current is maintained by the action, which is ceaseless, of the three pairs of abdominal prolegs. In several orders of this family the flabellæ of the abdominal appendages are converted into branchiæ (Pl. XVII. figs. 4 & 5). In minute structure they coincide with the lateral respiratory plates of *Talitrus*. From these parts, when thus specialized for breathing, bristles are absent. The associated *palp* excites the aërating current.

In the family of Stomapoda, the species of which are rarely found in the British seas, each segment of the abdomen is furnished with a pair of broad natatory feet, the basilar joint being quadrilateral (Pl. XVII. fig. 3, *a*), each bearing two lamellar branches (*d*), the exterior of which gives attachment on its posterior face, and close to the peduncle, to a *tufted branchia* (*b*). The minute structure of the branchial tubuli conforms in every respect with those of the Lobster, afterwards to be described. Each tubule is traversed in its centre by an afferent column of blood, which breaks out into a network along the circumference on its return to the proximal extremity. They are admirably fitted for the intended purpose.

The respiratory organs in the *Decapod* Crustaceans manifest the highest specialization. They are fixed to the sides of the thorax, and lodged artfully in expressly provided thoracic chambers.

Two types of structure prevail among this class, the tubular or cylindrical, and the laminar. Both forms are exemplified in the Macrourous decapods. The tubular is less common than the laminar. *Scyllarus, Palinurus, Gebia,* and *Homarus* are genera which afford examples of the cylindrical or tubular; in *Astacus* the tubules of the branchiæ are less numerous, and are disposed only on two of the sides of the branchial shaft, having a pinnate appearance; those tubules which are inserted on the coxæ are terminated by a thin, multiplicate, lamelliform dilatation, and resemble in structure an ordinary branchial lamella.

The coxæ in *Homarus* and *Palinurus* are provided with a plate-like process inserted at the side of the coxal branchia. It is of a leathery consistence, and covered with numerous hairs. The presence of these bristles proves that it cannot participate in the process of respiration. It is probably only a septum of separation between the branchiæ. In *Aristeus,* in which the branchiæ are sixteen in number on either side, they are penniform. They are composed of a shaft, from which pass off right and left numerous curled filaments, whose convex borders are covered by tufts of very delicate, densely packed, branchial cylinders.

The second or *lamellar type* of branchia occurs in all the Brachyura and Anomura, and in the genus *Galathea* among the Macroura. This type prevails also in the genera *Palæmon, Hippolyte, Alphæus, Penæus, Crangon**.

The familiar Lobster affords the best example of the first or cylindrical type of branchiæ. They consist of plumose pyramidal processes, enclosed in a thoracic cavity, and provided with peculiar *flabellæ.* The latter subserve the twofold use of agitating the water and cleansing, and separating the minute tubercles of which the organs are composed. In number the branchiæ vary in different species. They amount to 20 in *Astacus,* and in the most nearly allied species. In other Macroura the number falls. In the *Palinuri, Scyllari* and *Penæus* it is 18; in *Pandalus,* 12; in the *Calianassæ,* 10; in the *Palæmons,* 8; 7 only in the *Crangons, Hippolytes,* and *Sergestes.* In the Lobster, the Crawfish, in *Nethrops, Palinurus,* and the *Scuyllarus,* the branchiæ are subdivided most elaborately into minute tubular

* Ann. d. Sc. Nat. xi. 1827, pl. 26, and xi. 1839, pl. 3. fig. 1, pl. 4. figs. 1–4.

or cylindrical processes, which diverge at right angles from the axis of support, in which the main afferent and efferent channels of the blood are lodged. The gill of the Lobster (Pl. XVII. fig. 8) expresses, typically, the general and minute structure of the branchial organs of *all* the above-enumerated genera. They consist of fourteen separate organs, disposed in two alternate series, and lodged in a thoracic cavity. Each gill, conical in general figure, resolves itself into a multitude of small tubes (fig. 8, a'''), proceeding from the sides of the axis. In a transverse section, it will be seen that the large afferent trunk (a), running up one side of the axis of the whole gill, sends off a minute branch to *each* lateral tubule (a'''). A single tubule (B) has then its afferent vessel, which runs along its central axis (B, b). The sides of this afferent vessel are cribriform, so that the blood readily escapes at *every* point of its course into the loose lacunose tissue (C) and (B, c) which forms the *circumference* of the tubule, and through which the blood returns to the efferent or venous trunk (B, c). The blood-corpuscle thus runs round the circumference of a cylinder. This latter represents the area and period of aëration. It corresponds with a plane surface equal in length to such circumference. There is not, therefore, either functionally or structurally, any real difference between the cylindrical branchial filament and the leafy variety of this organ. The walls of the tubule are perfectly smooth. The hexagonal cells of the epidermis are detectable at the extreme outermost coat. These cells differ from those of the ordinary epidermis in nothing but in the fact of their greater tenuity. The islets of the included parenchyma are composed of nucleated cells. They are nourished by the branchial blood. The presence of these masses of living solids in the midst of the blood-current, at the very point at which the latter is undergoing aëration, concludes the controversy as to the capacity of the fluid in such place and time, at one and the same period to receive oxygen and to nourish the parenchymatous tissue. Here it is accomplished. The question *why*, in the Lobster and its kindred, nature should resort to this curious method of multiplying and subdividing the branchiæ, illustrates the unsearchableness of ultimate causes.

In the Lobster, as in the Crab, two orders of *flabellæ* exist. The first consists of a whip-like process, moved by powerful muscles, and guarding the *out*let of the branchial chamber (Pl. XVIII. fig. 9. shows the minute structure of extreme end). By its regular movements, a determinate current of water flows outward. The edges and flat surfaces of this marvellous instrument are profusely armed with secondary instruments (Pl. XVIII. fig. 9), matchless for their beauty, surprising as means to an intended end. The external or horizontal *flabellum* is sufficiently long to sweep vertically over the whole group of gills. From its position and structure, it can affect only the outermost surfaces of these organs. If this instrument were a simple, flat, smooth-edged process, it is easy to conceive, that during its motion over the branchiæ from above downwards, the component tubuli of the latter could not by mechanical possibility be separated so as to favour the rush between them of the aërating element. This difficult purpose is accomplished by an inimitable contrivance. The flabellum is covered in rich profusion with minute, flexible, mop-like threads (fig. 8, E). At the distal extremity of each seta or bristle, a group of minute flexible processes are added. A structure of so great singularity cannot be misinterpreted. The purpose which they are designed to fulfil cannot be mistaken. They constitute artfully-adapted provisions for cleansing, mopping, separating, agitating the constituent filaments of the branchiæ. No other description of instruments would answer the same ends. They are not merely substitutes for *cilia*. Cilia would simply effect the rapid renewal of the aërating element. *They* answer the manifold uses enumerated. Another variety of seta is intermixed with the former on the same flabellum. It consists of a sword-shaped process (fig. 8, *f*), less flexible than the former, from the edges of which secondary, acute, minutely-delicate points arise at an obtuse angle. They are designed only to act in one direction. They are situated chiefly on the margins of the flabellum (D). They exist on those placed vertically between the gills, as well as on that long whip-like flabellum which acts horizontally in the branchial cavity. They are less fitted to wipe the surface of the tubules than to catch at their edges when swiftly drawn over or between them. Thus they separate and momentarily hold apart the slender filaments of the branchiæ. Nearer to the root of each of these setæ, and only on one side, a second system of angular teeth occurs, which are turned backwards towards the root (Pl. XVII. fig. 9, C, E, D). They are thus capable of acting in a direction the reverse of the serrations placed on the extremity of the same seta. The *mop-like* variety of setæ does not exist on the flabella of those Crustacea the branchiæ of which are leafy or laminar.

Under the latter circumstances they would prove ineffective as cleansing utensils. They could perform no mechanical work on passing between smooth parallel laminæ. Between cylindrical filaments they act far otherwise. Nothing can surpass the efficiency of the contrivance. There exists such an evidently suitable relation between the structure and form not only of the flabella, but of their minutest hairs, and the shape and figure of the branchiæ in the same subject, that the incomparable ingenuity with which these little implements are adapted to the exact office to be discharged can only be appreciated by studying them in their connexions.

The *flabellum*, examined in its *general structure*, is a machinery no less remarkable. It consists of two horny parallel plates (Plate XVIII. fig. 9, *b*, *c*). Between these plates there travel with great regularity radiating currents of blood (*f*). The currents are separated by muscular fascicles (*e*), observing a similar disposition. The latter are levers of great power. Along the margins of the flabella the blood returns in large obvious channels. It is worthy of the special attention of the physiologist, that from these currents there proceed outwards at right angles minute streams traversing the axis of each microscopic seta (*a*). The fluid in these exists as a *single* column, sometimes as a flux and reflux stream moving in lacunæ (fig. 7, *a*). It does not advance and return along different conduits. In other words, the hollow axis of the seta is not divided by a longitudinal partition into two channels. It is a single tube. The blood in these parts moves in a flux and reflux manner. These little appendages, the structure of which is so accessible to the eye, express with great clearness the method in which constantly, *in all invertebrated animals*, the nutritive fluids reach the collateral recesses, the by-parts of the solids. In the Lobster, the biliary tubules (Pl. XVIII. fig. 10) resemble strikingly in structure the branchial. To establish further the manner in which, in the crustacean organism, the blood is related to the organized parts, it were at this place not inappropriate to allude incidentally to the minute anatomy of the liver-follicle of the Crustacea. It is a simple tube (fig. 10), having two coats embracing one another concentrically (*f*). Between these coats the blood flows in irregularly-bounded channels, forwards on one side, or half, and reversely on the other.

The hollow axis is filled by the secreted product (*c*, *g*, *h*). It is the commencement of the excretory duct. The epithelial cells of the outer coat are the same at every stage of the tubule (*a*). Those of the inner (*e*) begin to change in character as the extreme cæcal end of the tubule is approached. At first they are hexagonal and flat; by degrees they bulge; they become filled more and more with fluid, until at length they become spheroidal (*b*). They form a layer of several series deep. This end of the follicle, as supposed by Mr. Goodsir, is really the producing or secretive centre. The blood pervades irregular passages tunnelled between the spheroidal cells (*b*). The *fluid* elements of the blood pass from the blood-channels *into* the interior of the *modified* epithelial cells. From the latter it exudes into the *hollow axis* of the tubule (*c*). *This is the act of secretion*! The fixed cells impress upon the fluid by which they are traversed a *tendency to change*, a *disposition* to combine its elements anew. This change continues after the fluid escapes from the cells, *beyond the pale of the living* solids. The oil-cells (*c*) in the axis of the follicle are not organized cells, as represented by Dr. Leidy. They are mechanically-formed oil- and albumen-cells (*g*). The chemical change proceeds in the secreted product, *without* the *direct agency of cells,* as it flows from the distal to the proximal end of the tubule*. The *yellow colour* (*h, d*) is not developed until the product reaches nearly the middle of the tubule. The process of respiration can only be resolved to its last analysis by first determining with exactness the manner in which *other* vital nutritive acts are accomplished. The endosmose of gases requires that the partition should be thin (Pl. XVIII. fig. 5, *a, b*), the epithelial cells compressed and attenuated, and all unnecessary contents withdrawn; the act of *fluid* secretion demands the presence of the reverse conditions (fig. 10, *b*): such contrasted reasoning must prove directive to the thoughtful reader. Induction founded on contrasts serves often best to establish the *principia* of a science.

The branchiæ of the *Anomourous Crustacea* are arranged in the thoracic chamber in alternate series of fourteen in number. The chamber is open along the whole extent of its inferior boundary. To this circumstance is to be ascribed the *absence* in these Crustaceans of the flabella. They are not required. The influx and efflux of the water into the respiratory cavity are without such assistance unimpededly rapid. Propelling and guiding instruments would here prove a useless incumbrance. The gills in the Paguridæ are composed of laminæ. They are four-sided pyramids in shape. The respiratory leaflets are arranged however in a bipyramidal manner (Pl. XVII. fig. 7, B); that is, a wide channel (between *f* and *g*, fig. 7, B), coinciding with the length of the gill and with the primary blood-vessels, lies between the rows of leaflets which are built up on each side of the axis. Along this groove (fig. 9, *a*, fig. 7, *d*) rushes a current of water, descending along the gill on one side and ascending on the other. The ascent occurs on the inner side. The minutely-divided streams of water, which directly operate on the respiratory laminæ (or cylinders, as the case may be), connect these two main vertical currents by horizontally passing between the branchial leaves. If these laminæ were to become adherent through the absence of moisture, the respiratory process could no

* I have not attempted in the text, because it would be out of place, to compare the results of my own investigations on the structure of the liver-follicle of the Crustacea with those of Mr. Goodsir and Dr. Leidy. Such comparison must be made by the future student. I venture to think that neither the structure of the hepatic follicle nor the process of secretion has ever before been placed in so clear a light.

longer proceed. Thus the Crustacean dies rapidly in perfectly dry air; but if, in the branchial chamber, a sufficient proportion of humid vapour exist, the gaseous oxygen of the *air* (when the animal is out of water) is dissolved, and the breathing proceeds as efficiently as if the animal were still revelling in its native element. This mechanism explains the capacity with which many Crustacea are gifted, of living almost as well in air as in water. This apparent amphibious power does not prove that when in air they really breathe on the *atmospheric* plan, but that the oxygen of the *air* which is admitted into the branchial chamber is *fluidified by the moisture* which still remains in this cavity. The mechanism of the respiratory process, even under such circumstances, is *really aquatic in type.*

In ultimate structure the branchial laminæ in the gills of the Hermit Crab (Pl. XVII. fig. 7, B), conform exactly with those of the Brachyurous orders, subsequently to be explained. The coats of the axial branchial vessel in the Hermit Crab are smooth, and destitute of those hooks which are distributed so systematically over those of the common edible Crab (Pl. XVIII. fig. 6). The hooks are not required because there are no flabella. The setæ (Pl. XVII. fig. 7, M) which depend from the *roof* of the branchial cavity of the former present the *mop-like* character of those already described in the Lobster.

In the *Brachyurous* orders, exemplified by the vulgar edible Crab, the gills are constructed on the leafy or laminar principle (Pl. XVII. fig. 9, A). They stand vertically in the containing chamber. The leaves on each gill are arranged in two series (*a*), one on either side of the longitudinal blood-channels. The shape of the ultimate leaves differs in different species. In some they are semilunar; in others they are reniform, in others pointed, &c.; in all they leave deep grooves for the free play of the branchial current from the root to the apex of the gill, and from the apex to the root on the other side. The streams passing horizontally between the leaflets connect the two main longitudinal currents. Thus the water-currents on the outside of the branchiæ observe the same distribution and division as the blood in the interior. The structure of the branchial laminæ admits of resolution to the very last elements of organic structure. They are inconceivably slender and delicate. The most cautious attempt to inject the gills converts the leaf into a bag, the lamina into a sac, so delicately are the plates held together; but though thus attenuated in the extremest degree, each lamina consists of two opposed plates.

These plates are composed exclusively of a single layer of epithelial cells, hexagonal in outline, and adjusted edge to edge. Under the highest power of the microscope they exhibit minute granules (Pl. XVIII. fig. 4). Neither tubercles, nor setæ, nor hooks, nor teeth such as those of the cells of the epidermis of insects, occur on any part of their surfaces or edges. The flat surfaces and edges are perfectly smooth. The laminæ are slightly thicker immediately around the vessels than near the margins. In the former situation the intermediate parenchyma is slightly thicker than in the latter.

The microscope readily resolves these patches of solid tissue to their last elements (Pl. XVIII. fig. 5). They are cells, generally but not always bearing nuclei, and frequently oil-globules.

They are enveloped by a common capsule, but not always so. They are filled with a colourless fluid, which reaches them immediately from the contiguous blood-current.

Their office is simply and purely mechanical. They connect together the parallel epithelial laminæ. They divide the blood-stream. They exhibit every possible variety of size and figure. They are undoubtedly penetrated and surrounded by a plexiform arrangement of *nerve*-tubules (Pl. XVIII. fig. 13, *b*). These nerves play no part in the *physical act* of respiration. Nerve-force is here introduced only for the maintenance of the organic structural integrity of the elements. From this condition their right function is inseparable. Oxygen does not therefore *really* enter and mix with the blood independently of nerve-power.

In the Brachyurous Crustaceans the flabella (Pl. XVII. fig. 9, B) constitute important instruments in the machinery of breathing. They are indispensable in consequence of the closed character of the branchial chamber. They amount to three in number: two small ones which move between the anterior gills, and one external horizontal flabellum, which in its arc of motion sweeps over the external surface of the whole row of branchiæ.

Like those of the Lobster, the flabella of the Crab are profusely studded with appropriate hairs (C, D, E) for agitating and separating the branchial laminæ. During the moment of separation a rush of water takes place between these laminæ. So admirably adapted are the setæ of the flabella to the purpose intended, that they must be regarded as express provisions. No other sort of instrument would subserve the end in view. How graceful are the contrivances of nature! how perfect her adaptations!

The ultimate setæ are multiplied at their distal extremities by several parallel rows of acutely-pointed teeth (C, D, E). Those on the base of the stalk point differently from the former. By this inimitable disposition these exquisite organules are fitted to do double work. They also obtain a better leverage by hooking to the corresponding teeth, which in these orders are distributed over the exterior of the vessels of the gills (Pl. XVIII. fig. 6).

The part enacted by the adipose element in the physiological act of respiration, replete with novel interest, belongs to the physiological bearing of the question of respiration*.

In the preceding review of the mechanical condition of the respiratory process as it occurs in the higher Articulata, the physiologist must have observed the comparative fewness of the corpuscles of the blood (Pl. XVIII. fig. 11), the smallness of the bulk of the blood relatively to the dynamical capabilities of the articulated animal, the small proportion of blood which in a given time traverses the branchial organs, the *breadth* of the ultimate blood-stream measured by the size of the pulmonary capillary of the vertebrated animal. These facts seem certainly to prove that there can exist no direct proportionality between the amount of respiratory process and the general dynamical capabilities of the Crustacea†.

EXPLANATION OF PLATES XVII. AND XVIII.

PLATE XVII.

Fig. 1. Appendages of the ninth pair composing the external foot-jaws of Decapod Crustaceans, and which are homologous with the sub-cylindriform process of the first pair in *Squilla*, with the thoracic feet of the twelfth in Isopodan Crustacea, and with the thoracic feet of the third pair in the Branchiopoda: *a*, internal element; *b*, palp; *d*, branchia; *c*, flabellum.

Fig. 2. Appendages of the eighth pair constituting the foot-jaws in the Decapoda,—which are homologous with the prehensile jaws in *Squilla*, with the thoracic feet of the first pair in the Isopods, and with the branchial processes of the second pair in the Branchiopods.

Fig. 3. Abdominal appendage of *Squilla*: *a*, internal member; *d*, external; *b*, branchia.

Fig. 4. Abdominal appendage of the *Isopoda*: *a*, external or cutaneous process: *b*, internal and branchial.

Fig. 5. Abdominal appendage of a Branchiopod. The dotted process is the respiratory.

Fig. 6, A. *Caprella linearis* (*male*): *a*, respiratory appendages; *b*, the same still further magnified; *b'*, shows the *single* blood-current moving

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* See *ante*, "Process of Respiration."

† I have understood that some years ago a paper was read by Prof. Quekett, before the Microscopic Society of London, "On the structure of the *flabella* in the Crustacea." It has never been my good fortune to see that paper. The description given in the text is founded upon a very extensive series of original examinations. I am desirous here to pay the tribute of my gratitude and admiration to Prof. Milne-Edwards, for the assistance and instruction which I have received from the study of his numerous splendid contributions to this branch of comparative anatomy.

round the circumference of the process; C, corpuscles of the blood.

Fig. 7, B. A single pair (magnified and viewed by transmitted light) of the branchial leaflets of the Hermit Crab: *c*, *d*, two longitudinal blood-channels, seen in section; *f*, *g*. embrace a deep groove between the leaflets for the branchial current of water; *i*, *h*. denote the parenchymatous islets situated between and dividing the blood-streams (*o*); M, a single seta, *mop-like*, from the roof of thoracic cavity; *k*, sharp teeth on its shaft; *h*, another variety of seta.

Fig. 8, A. A single gill of the Lobster, represented as a transparent object in transverse section: *a*, section of afferent vessel. The arrows exhibit the division and direction of the afferent blood in its course towards the ultimate branchial tubules (a'''). The ultimate afferent current occupies the *axis* of each tubule; a'', marks (in section) the great afferent trunk of the gill, receiving its blood as shown by the arrows from the *circumferences* of the tubules. B, a single tubule enlarged; *b*, afferent vessel, having cribriform walls; *c*, *c*, the efferent stream; at (*c*) the capillary system of the tubule is seen. C, the same tubule seen in section. D, one of the interbranchial flabella. E, a single mop-like seta from its edge; *f*, one from its flat surface.

Fig. 9, A. A single pair of the branchial laminæ of the Crab: *a* & *b*, afferent and efferent trunk, connected together by means of the intermediate branchial laminæ. These latter are composed of parallel epithelial plates tied together by means of minute intermediate nodules of fleshy substance. Between these the blood streams in *im*parietal passages. B, horizontal flabellum of the Crab; C, D, E, setæ with which it is armed.

PLATE XVIII.

Fig. 1. Leg, and the projecting free border of the epidermal plates of *Talitrus*. Intended to express typically the *ultimate* respiratory structures of all Crustaceans: *a*, a nodule of fixed parenchyma, composed of *slightly refracting* oil-cells, nucleated granular cells, and molecules;—generally such a group is destitute altogether of embracing membrane; *b*, the irregular imparietal, angular passages lying between the parenchymatous nodules; *c*, the cells of the epidermis, *attenuated*.

Figs. 2, 3 & 4. Varieties of epithelial cells met with in different parts of the Crustacean: *a*, a cell shown in full, under a high power, to bring out its granular character; *b*, the same in outline.

Fig. 5. The parenchymatous patch *a*, fig. 1. enlarged, to show its minute structure: *a*, *b*, epithelial laminæ; *c*. represents exactly the peculiar, low refractive character under which oily-element exists in the fixed solids of the Crustacea. The whole *interior* of this patch is permeated by lateral slow-moving currents of blood, diverted from the main stream.

Fig. 6. A small piece of the wall of the large branchial vessels, showing the hooks (*a*) on which act the setæ of the flabella.

Fig. 7. A portion of the proximal end of a *hair*, to exhibit the absence of vessels and to show the lacunose to-and-fro character of the blood-movement.

Fig. 8. The active, vibratory, abdominal palp of the Shrimp.

Fig. 9. The same viewed transparently: *b*, *c*, epithelial laminæ; *e*, radiating muscular fascicles; *d*, radiating imparietal blood-channels; *d*, setæ.

Fig. 10. Liver-follicle of the Lobster, viewed by transmitted light: *a*, *b*, cæcal end, having glandulose walls by the swelling of the parietal epithelial cells; *c*, the secreted product in its first stage, oil-cells colourless and minute; *d*, *d*, the same increasing in size and becoming yellow in colour; *g*, oil-cell; *h*, yellow cell.

Fig. 11 is *fig.* 12 enlarged. It shows the ultimate structure of the tentacle of a Prawn. The muscular masses occupy the axis, and the blood-corpuscles course along the sides.

Fig. 13. Illustrates the mode in which the ultimate nerve-tubules are distributed in the gill-laminæ of several Crustacea: *b*, *c*, nerve-tubules; *c*, patches of parenchyma.

[To be continued.]

XXIX.—*Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites.* By Thomas Wright, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School*.

[With three Plates.]

[Continued from p. 173.]

Genus Pedina, Agassiz.

As this genus was incorrectly defined in our memoir on the Cidaridæ, it having been there stated that the mammillary eminences were "crenulated like those of *Diadema*," we take this opportunity of correcting the error, and giving a definition more in accordance with our present knowledge.

Test thin, circular, more or less depressed; primary tubercles small and perforated; mammillary eminences with smooth ring-like summits without crenulations; pores in general disposed in triple oblique pairs; mouth small and slightly decagonal, margin not much notched; ovarial disc small and not prominent; ambulacral areas with one, two, or more rows of small tubercles; interambulacral areas sometimes with two rows only, sometimes with two rows and additional secondary rows of tubercles more or less complete.

This genus is extinct, and is found in the oolitic cretaceous rocks.

Pedina Bakeri, Wright. Pl. XI. fig. 4, *a–c*.

Test circular, depressed; ambulacral areas narrow, with one row of small tubercles disposed in a slightly zigzag line down the centre of the areas; interambulacral areas broad, with two rows of primary tubercles raised on prominent mammillary eminences in the centre of the plates; the margins of the areolas surrounded with circles of small granules; no secondary tubercles.

Height $\frac{7}{20}$ths of an inch, transverse diameter $\frac{15}{20}$ths of an inch.

Description.—This *Pedina* presents a different form from its other congeners: the test is circular and depressed; the ambulacral areas are narrow, about one-third the width of the interambulacra; the usual double row of tubercles in this region is reduced to one row, the tubercles of which are disposed alternately on the right and left sides of the areas, thereby forming a single zigzag line down the centre thereof; the tubercles at the equator and on the upper surface are small, but there are two or three of a larger size at the base of the areas; a few granules form imperfect crescents round their narrow areolas. The interambulacral areas are nearly three times the width of the ambulacra; they are adorned with five pairs of primary tubercles of nearly a uniform size throughout, which are raised on prominent mammillary eminences, the summits of which are smooth, ring-like and without crenulations; circles of small granules bound the areolar spaces; there are no secondary tubercles, nor any sculpture upon the intertubercular surface of the plates, so that down the centre of the areas there is a smooth valley between the primary tubercles. The apical disc is well preserved in our specimen; the ovarial plates are of an irregular octagonal form and of moderate size, they are covered with a few granules scattered irregularly over their surface; the ocular plates are of a rhomboidal form and have large eye-holes. The base of the specimen is covered up with hard rock, so that it is impossible to expose the mouth-opening without endangering the specimen.

Affinities and differences.—The *Pedinæ* have been so imperfectly described by M. Agassiz in his 'Descriptions des Echinodermes fossiles de la Suisse,' that there is much difficulty in making out the species figured and described in that monograph. When it is recollected how limited were the materials at Agassiz's command when he published that valuable contribution to Palæontology, and how delicate the test of this genus is, we can readily understand how so many different forms of the same Urchin came to be described and named as distinct species. After a careful examination of many specimens, we confess that *Pedina aspera, rotata, ornata* and *sublævis*, Agass., appear to us to be so many different forms of one and the same species. We have before us likewise the original type specimen of *P. granulosa*, Ag., which has been kindly communicated by Professor Deslongchamps. An examination of that Urchin has convinced us that it is only a larger individual of *P. aspera*, as we find it in the Inferior Oolite, and is identical with the fossil which we have described as *P. rotata*. On a further examination of this specimen, M. Agassiz, it would appear, had arrived at a similar conclusion, for on the ticket which accompanies it is the following remark in his handwriting:—"*Pedina granulosa*, Ag. C'est sous ce nom que cette espèce est citée dans mon catalogue; cependant il se pourrait qu'elle ne fut qu'une variété un peu enflée de mon *P. aspera*." This species was collected by Prof. Deslongchamps from the Great Oolite of Ranville. We have likewise before us a portion of *Pedina* collected from the Oxford clay of the Boulonnais by M. Bouchard-Chantereaux, and marked by that eminent palæontologist, who kindly sent us the specimen, "Très rare. J'en ai encore trouvé que trois morceaux de cette espèce." It so nearly resembles the Ranville Urchin that we have no doubt of their identity. By the extreme kindness of M. Michelin and M. de Lorière, we have before us specimens of *P. Gervillii*, Ag., from the Kellovien étage of Chauffour, department of the Sarthe, which are identical with *Pedina aspera* or *rotata*, collected by us from the upper beds of the Inferior Oolite of Gloucestershire. In fact the French and English specimens are so entirely alike, that we should mistake the one for the other had we not previously marked them. It would appear from these remarks, that whether we retain the specific name *rotata* or *aspera* for this widely distributed Urchin, we must at least cancel the other names which have been given to various forms of the same, as we have now before us well-preserved specimens from the Inferior Oolite, Gloucestershire, the Great Oolite, Ranville, Calvados, the Oxford clay near Boulogne, Pas de Calais, the Kellovien of Chauffour, Sarthe.

[Since these sheets were sent to press, the Rev. A. W. Griesbach has communicated a *Pedina*, collected by him in the Cornbrash at Rushden, Northamptonshire; as this fossil is in a good state of preservation, we have been able to make a careful comparison of it with a fine *P. aspera* now before us, and there can be no doubt of their identity. The discovery of this Urchin in the Cornbrash is another link in the chain of evidence showing the wide stratigraphical range of this form in the Oolitic seas.]

P. Bakeri differs so entirely from the forms named in the preceding remarks, that it is impossible to mistake it for either of them; its diagnostic characters consist of the size and small number of the primary tubercles, the absence of secondary tubercles, the scanty granulation on the interambulacral areas, the narrowness of the ambulacra, and the single row of tubercles thereon. We have only met with the small but tolerably perfect specimen of this species figured (Pl. XI. fig. 4, *a–c*).

Locality and stratigraphical range.—We collected this rare form of *Pedina* from the Pea-grit of Crickley Hill, and have seen fragments of its test in the same bed at Leckhampton, but never in any other locality.

We dedicate this species to our friend T. Barwick L. Baker, Esq., of Hardwicke Court, the President of the Cotteswold Naturalists' Club, for the warm interest he takes in the progress of the Palæontology of Gloucestershire.

Pedina Etheridgii, Wright. Pl. XI. fig. 5, *a–c*.

Test circular, depressed; ambulacral areas with from six to eight small perforate tubercles at their base, and a double row of small granules on their upper surface; the interambulacral areas with primary tubercles only, the areolas of which are surrounded with regular circles of granules; pedal pores not numerous, arranged in nearly a single file with a slight elevation between the two pores of each pair; apical disc large; ovarial plates leaf-like; mouth-opening small.

Height $\frac{5}{20}$ths of an inch, transverse diameter $\frac{10}{20}$ths of an inch.

Description.—This pretty little Urchin has a circular outline in the young state, which in larger specimens inclines towards a pentagonal form; the base is flattened, and the upper surface of the test is much depressed. The ambulacral areas are narrow, and have from six to eight small perforated tubercles at their base, and a double row of from twelve to fourteen minute imperforate granules in each row on their upper surface, which in figure and size resemble those covering the other parts of the test; between the pedal pores of each pair is a small elevation; these collectively form a prominent moniliform line which extends from the margin of the disc to the mouth-opening; the pores are disposed in nearly a single file, and do not form the triple oblique pairs which we observe in the larger *Pedinæ*. The interambulacral areas are about twice the width of the ambulacra; the rows of primary tubercles occupying the centre of the plates have seven tubercles in each row, they are small in size and are rendered prominent from being raised upon uncrenulated mammillary eminences, the bases of which are sharply defined and surrounded by complete circles of moderately sized and regularly arranged granules; the regular disposition of these granulations gives an air of decoration to this little species not observed among other congeneric forms; the entire absence of secondary tubercles from the areas renders the decoration more complete. The apical disc is large; the ovarial plates are widely rhomboidal, the oculars are small and heart-shaped, and the surface of both is covered with minute granules nearly as large as those which adorn the other parts of the test. The madreporiform tubercle makes a distinct elevation on the surface of the single plate, and the anal aperture is transversely oblong; the base is flat, the mouth-opening is small, and its margin is divided into ten nearly equal-sized lobes; the spines are unknown.

Affinities and differences.—In its general outline and depressed upper surface, with the pedal pores in nearly a single file, this little Urchin resembles a *Diadema*; from that group however it is distinguished by the rudimentary condition of the ambulacral tubercles, and the absence of crenulations from the summits of the mammillary eminences. It is distinguished from *P. Bakeri* by having small primary tubercles set more closely together, and in having a greater number in each row. From *P. aspera* it is known by having the upper surface more depressed, the pedal pores separated by a moniliform line of granules, and in the absence of secondary tubercles. It has a strong resemblance at a first glance to *Diadema Mooreii*, but an examination with the lens at once discloses the points of difference, which are these:—the ambulacral areas in *Pedina Etheridgii* have imperforate granules on their upper parts, whilst in *Diadema Mooreii* there are perforated tubercles; the moniliform line between the pedal pores in *P. Etheridgii* is absent in *D. Mooreii*; the mouth-opening is likewise much smaller in *P. Etheridgii* than it is in *D. Mooreii*.

Locality and stratigraphical range.—*P. Etheridgii* has been collected from the marlstone of Bredon Hill, Gloucestershire. Mr. Moore found it in the Upper Lias of Ilminster, and we have collected several specimens from the Pea-grit (Inferior Oolite) of Crickley and Leckhampton Hills, but have never seen a trace of this species in any of the upper beds; it seems therefore to have a limited vertical range between the marlstone and the basement-beds of the Inferior Oolite, and is one of the few species which lived in the Liassic and Oolitic seas.

We dedicate this species to our friend Mr. Etheridge, of the Bristol Museum, who has kindly assisted us in comparing our specimens with the fine series of Echinoderms under his care, and has likewise otherwise aided us in the most friendly manner in working out the subjects of these memoirs.

Genus Polycyphus, Agassiz.

Small Urchins having a subglobular form; the upper surface of the test is covered with numerous small imperforate tubercles of a very uniform size; the base and basal angle are furnished with several tubercles of a size disproportionately large when compared with those of the upper surface; the pedal pores are disposed in a triple oblique series of pairs; the mouth is large and pentagonal; the anal plates form a narrow prominent ring at the vertex, and the interambulacral areas are in general divided by a median depression.

Polycyphus nodulosus, Münster.

Syn. *Echinus nodulosus*, Goldfuss, Petrefact. Ger. tab. 40. fig. 16; Agassiz, Cat. Syst. p. 12.
Arbacia nodulosa, Agass. Prodrom.
Polycyphus nodulosus, Agass. & Desor's Cat. raisonné, Ann. Scien. Nat. tome vi. p. 361.

Test hemispherical; ambulacral areas a little more prominent than the interambulacral areas; ambulacra with from four to five rows, and interambulacra with from twelve to fourteen rows of small tubercles disposed in nearly parallel lines; bases of the ambulacra with twelve, those of the interambulacra with sixteen larger tubercles.

Height $\frac{7}{20}$ths of an inch, diameter $\frac{11}{20}$ths of an inch.

This pretty little Urchin was first described by Prof. Goldfuss from specimens named by Count Münster from the Oolites of Baireuth; the hemispherical test exhibits a disposition to assume a subpentagonal circumference from the greater prominence of the ambulacral areas; the surface of the test is divided into fifteen nearly equal lobes by the ten poriferous avenues, and the five depressions which divide the interambulacra down their mesial lines; these lobular divisions are more defined in young and small specimens than in large and old ones; the ambulacral areas are one half the width of the interambulacral, and have nine large tubercles at their base, and four or five rows of small tubercles at their widest part, which gradually diminish to three, two and one as we approach the apex of the area; the interambulacral areas are twice the width of the ambulacral, they have about twenty-four large tubercles at their base, and about twelve rows of small tubercles at their widest part, which gradually diminish by the disappearance of the external rows to ten, eight, six, four and two, as we trace the rows from the equator to the apex of the areas; the tubercles on the sides and upper surface of the test are nearly of a uniform size, they are arranged in rows, the tubercles are opposite each other and do not alternate as in some other genera. The interambulacral areas are each divided by a slightly depressed line into two lobes; these are separated from the ambulacral areas by straight narrow poriferous avenues, so that the test of this beautiful Urchin appears to consist of fifteen nearly equal lobes, those of the ambulacra being the most prominent and best defined, in consequence of the depth of the poriferous avenues being greater than the sulcus which divides the interambulacra.

The mouth is large and decagonal, and lies in a concave depression in the base, surrounded by the larger tubercles which occupy this region of the test. The ovarial plates are small, and form a rather prominent ring around the anal opening; the eye-plates are small, but in some of the foreign individuals now before me the eye-holes are very distinct.

Affinities and differences.—This Urchin resembles *Arbacia Forbesii,* but may be distinguished from that species by having the ambulacral areas proportionately wider, the tubercles larger and opposite to each other, and the poriferous avenues having the pedal holes in triple oblique pairs; it belongs moreover to a newer rock of the Oolitic series.

Locality and stratigraphical range.—We know only one English specimen of this species, which was found in the Cornbrash by Mr. Buy near Sutton Benger, Wilts; on the continent it occurs in the Baireuthian Jurakalke, where it was found by Count Münster. It has been collected from the Great Oolite of Langrune by Prof. Deslongchamps and M. Tesson, and from the Calcaire à polypiers at Ranville by M. Michelin. We beg to record to each of these gentlemen our best thanks for the beautiful series of type specimens of this Urchin with which they have so liberally supplied us.

History.—Figured and described for the first time by Goldfuss. We are not aware that any detailed description of the species has been given before, with the exception of the very brief one contained in the 'Petrefacta Germaniæ.'

Polycyphus Deslongchampsii, Wright. Pl. XII. fig. 4, *a–e.*

Test hemispherical, circumference circular; ambulacral areas with two rows of larger and two rows of smaller tubercles; interambulacral areas with two rows of larger and several rows of smaller tubercles; the small tubercles in both areas often degenerating into mere granulations; basal tubercles large and prominent.

Height $\frac{7}{20}$ths of an inch, transverse diameter $\frac{13}{20}$ths of an inch.

Description.—Amongst the many beautiful forms of Urchin structure, this pretty little species will bear comparison for neatness and symmetry with any of the family to which it belongs. We found the first specimen about eighteen months ago, and since then have added an interesting series to our collection. It must be a rare form, as only two or three specimens have been obtained besides those collected by ourselves. The ambulacral areas are one half the width of the interambulacral, and have one row of tubercles on each side of the margins of the area, between these are several rows of small granulations arranged without much order; at the base of the area ten larger tubercles are disposed in pairs, the tubercles on the right side alternating with those on the left; the interambulacral areas are about twice the width of the ambulacral; a single row of tubercles occupies the centre of each of the two columns of plates, and numerous smaller tubercles degenerating into mere granules cluster around the base of the large tubercles; a second row of tubercles extends upwards from the basal angle towards the equator, where it terminates; the basal tubercles consisting of about six pair occupy all the base of the area—they are about the same size as those of the ambulacra; but are arranged somewhat less regularly The median depression in the centre of the interambulacra is very well marked in this species, so that the test has the appearance of being divided into fifteen lobes. The anal plates form a prominent narrow ring around the oblong anal opening, and the eye-plates are closely soldered to them; the eye-holes are very distinct in most of our specimens. The mouth-opening is of moderate size, and is slightly decagonal; the poriferous avenues lie in considerable depressions of the test, which throws the ambulacral areas into prominent relief from the interambulacra.

Affinities and differences.—The marginal rows of tubercles on the ambulacra, and the central rows of tubercles on the plate columns of the interambulacral areas serve to distinguish this species from *P. nodulosus*. It has a considerable resemblance to the young forms of *Echinus germinans*, but the regularity of the rows of tubercles on the sides and upper surface of the test, and the size and arrangement of those at the base afford good diagnostic characters by which it may be easily distinguished from that common form; the same group of characters serves to distinguish it from *Arbacia Forbesii*.

Locality and stratigraphical range.—We have only found this species in the Pea-grit of Crickley Hill; all the other specimens that were collected by Mr. Gibbs of the Geological Survey, were found in the same bed of this locality.

We dedicate this fossil to Professor Deslongchamps of Caen, to whom palæontology is indebted for many important contributions to the Oolitic fauna published in the 'Mémoires de la Société Linnéenne de Normandie.'

Nucleolites Woodwardii, Wright, 1852. Pl. XII. fig. 5, *a–e.*

Test subquadrate, sides tumid, dorsal surface flatly convex, anal valley deep, narrow and spear-shaped, extending from the apical disc to the posterior border; ambulacral areas narrowly lanceolate; posterior lobes short and truncated; base flat; antero-interambulacra and postero-interambulacra slightly swollen at their base; the single ambulacrum scarcely produced; mouth-opening pentagonal, situated anteriorly; apical disc small and nearly central.

Height $\frac{6}{10}$ths of an inch, antero-posterior diameter 1 inch and $\frac{1}{10}$th, transverse diameter 1 inch and $\frac{2}{10}$ths; the larger specimens are so much deformed by pressure that their proportional dimensions cannot be accurately given.

Description.—Some individuals of this species were formerly considered by us to be only varieties of *Nucleolites orbicularis*, Phil., but a better knowledge of the structure of this Urchin, derived from the study of a series which we collected last summer and have carefully compared with good typical examples of *N. orbicularis*, leaves no doubt about the distinctness of *N. Woodwardii* from that Cornbrash form. The test is thin and not often sufficiently well preserved for determining the species; the one which we have figured is a small but a very perfect specimen, it has a subquadrate outline and is $\frac{1}{10}$th of an inch broader than it is in the antero-posterior diameter; it is slightly narrower anteriorly than posteriorly, and (which is more apparent when it rests upon its dorsal surface) the posterior margin is seen to be broadly truncated; the sides are tumid, sometimes irregularly so, and the test is higher across the apices of the postero-lateral ambulacra than at any other point; the tumidity of the sides produces a greater flatness of the dorsal surface than we observe in any other of the small Nucleolites of the Oolitic rocks; the ambulacral areas are nearly all of the same width, they have a narrow graceful lanceolate form, from the mouth to about midway between the margin and the apical disc, they are nearly of equal width; at this point the pores gradually change their form, and are slightly separated apart for a short distance, and begin again to converge as they approach the disc; the internal row are circular, the external in the form of oblique slits, the widest part of which is outwards, the circles are formed by notches in the upper and under sides of the small ambulacral plates, and the oblique slits by uncalcified portions of the margins of the same plates; from the termination of the petaloid portion of the ambulacral areas to the mouth, the pores are small and set wider apart, whilst the diameter of the areas remains about the same; near the mouth-opening they are again more closely crowded together, and terminate in arches the convexity of which look towards that aperture; the interambulacral areas are of unequal width; the anterior pair are the narrowest, the posterior pair are wider than the anterior, and the single interambulacrum is the widest;

the anal valley is a long narrow depression extending from the apical disc to the margin, it has perpendicular sides and a small anal opening, the base is flat and only slightly depressed at the mouth; the anterior and posterior pairs of interambulacra are moderately convex in this region, and the basal portion of the single interambulacrum is very slightly produced; the mouth-opening is excentral, nearer the anterior margin, it has a pentagonal form with five rudimentary lobes. The surface of the test is covered with microscopic tubercles requiring a good lens to distinguish them; these bodies are only a little larger at the base of the test; the apical disc is small and nearly central, its elements are so closely soldered together that its general form can alone be distinguished; the eyeholes are situated at the apices of the ambulacra, and the ovarial holes further outwards and between them, whilst the madreporiform tubercle occupies the centre of the disc; the test is very thin and often deformed, its upper surface having sometimes an irregular appearance. The beauty and regularity of the specimen figured forms an exception to all the others we possess of this species.

Affinities and differences.—*Nucleolites Woodwardii* most nearly resembles *N. orbicularis*, and is the only one among its Oolitic congeners for which it could be mistaken. The following characters are diagnostic of *N. Woodwardii*. The tumidity of the sides and flatness of the dorsal surface, both of which are absent in *N. orbicularis*. In our species the base is flat and the interambulacra are slightly produced, whilst in *N. orbicularis* the base is concave and the interambulacra are convex and prominent. In *N. Woodwardii* the anal valley is narrow, whilst in *N. orbicularis* it is wide; the general outline of our species is subquadrate, that of the *N. orbicularis* is circular; the petaloid arrangement of the ambulacral areas extends downwards nearer to the margin in *N. orbicularis* than in *N. Woodwardii*; the narrowness of the anal valley in our species establishes an affinity between it and *Clypeus altus*, M'Coy; but the flatness of the base and the depression of the dorsal surface in *N. Woodwardii*, make a wide distinction between it and that species, which has a high convex dorsal surface and extremely prominent basal interambulacra, with a greatly produced interambulacrum; it differs from *N. Hugii* in having the anal valley extended from the disc to the posterior margin, whilst in that species a portion of the test intervenes between the disc and the valley; the difference between *N. Woodwardii* and *N. scutatus* and *N. clunicularis* is so great, that it is scarcely possible that *N. Woodwardii* can be mistaken for either of these forms.

Locality and stratigraphical range.—We have collected this Urchin from the Great Oolite near Cirencester and at Salperton Tunnel, Great Western Railway, and from beds of the same age near Pewsdown, Gloucestershire, and near Burford, Oxon; it has likewise been found near Minchinhampton: as far as we know, it appears to be a Great Oolite species.

We dedicate this species to our friend Mr. S. P. Woodward, of the British Museum, to whose kindness we are much indebted for the privilege of comparing our specimens with the magnificent series of Echinodermata under his care, and which he has rendered so valuable for reference by a systematic classification and a correct nomenclature.

Nucleolites Michelini, Wright. Pl. XII. fig. 6, *a–c*.

Test circular or oblong, discoidal and much depressed, posterior border produced, truncated and slightly deflected in old individuals; ambulacral areas narrowly lanceolate; pedal pores closely set together, vertex and apical disc nearly central; anterior half of the dorsal surface convex, posterior half much declined from the vertex to the posterior border; anal valley narrow above, diverging below, extending from the apical disc to the border; base flat, slightly concave; mouth excentral, margin with five small lobes; postero-lateral interambulacral areas slightly tumid at the base.

Height $\frac{9}{10}$ths of an inch, antero-posterior diameter 3 inches and $\frac{5}{20}$ths, transverse diameter 2 inches and $\frac{2}{10}$ths of an inch.

Description.—The outline of this Urchin varies in different individuals, and it likewise varied at different periods of life in the same individual; its most typical form is oblong, convex anteriorly, produced and truncated posteriorly, and swollen out in the region of the postero-lateral interambulacra; in others the circumference is nearly circular, and in some it is transversely oval; the first form is we think characteristic of adult life, as the production and truncation of the single interambulacrum were markedly shown in the only two large specimens of this rare species which we have seen; in all the test is very flat, the anterior half is gently and nearly equally convex, the posterior half is sloping and much declined in the direction of the posterior border. The ambulacral areas are narrow, the anterior one most so; the antero-lateral and postero-laterals are about the same width, they have a lanceolate form, and are composed of very narrow plates; about $\frac{3}{10}$ths of an inch above the margin, the pores slightly diverge from each other, and continue apart until they approach the apical disc; the distance between the rows of pores in this species is less than in any other Nucleolite of the same size we know, and forms one of the characters by which it is distinguished from its congeners; the ambulacral areas are likewise slightly elevated above the general surface of the test in all the specimens we have examined; the interambulacral areas are of unequal width, the antero-lateral pair are the narrowest, they are however about nine times the width of the anterior single ambulacral area; the postero-lateral pair are $\frac{3}{10}$ths of an inch wider than the antero-laterals, and the single interambulacrum is about the same width as the latter. The anal valley extends from the apical disc to the posterior border; it is very narrow, with deep perpendicular sides above, which become shallow and expanded below; the postero-lateral interambulacra are swollen out at the margin; the single interambulacrum is considerably produced, and its posterior border is broadly truncated and slightly deflected, within which the expanded sides of the anal valley are excavated. The base is nearly flat, the elevations are due to the prominence of the postero-lateral interambulacra, and to the deflection of the single interambulacrum. The mouth is excentral, nearer the anterior margin, and the oral lobes are small; the apical disc was of moderate size, judging from the space it occupied, but it is absent in all our specimens; the surface of the test was covered with very minute tubercles, which in the examples before us are nearly all effaced.

Affinities and differences.—*N. Michelini* in its oblong form, truncated posterior margin, and narrow anal valley resembles *N. Solodurinus*, but it is readily distinguished from it by the form, narrowness, and structure of the ambulacral areas; in *N. Solodurinus* they are expanded and petaloid, and in *N. Michelini* they are narrow and lanceolate; the pores at no point are at any great distance apart; the anal valley in both species extends from the apical disc to the margin, but it is more expanded below and deeper above in *N. Michelini* than in *N. Solodurinus*. We have before us *Clypeus angustiporus*, Agass., from a coarse Oolitic rock (Bradfordien ?) near Metz, collected by M. Terquem, and kindly sent us by M. de Lorière; from this species *N. Michelini* differs in many particulars; in the French Urchin the apical disc is excentral, the anal valley is wide above and not much expanded below, the ambulacral areas are narrow, and the test gradually declines from the vertex to the anterior border, which forms a rather acute angle; the base is undulated, and the mouth-opening is nearly central; these characters clearly distinguish our Urchin from it. *N. Michelini* differs so widely from all the various varieties of *N. sinuatus* with which we are acquainted, that it cannot possibly be mistaken for either of them, if any care be taken when a comparison is made between them.

Locality and stratigraphical range.—We have collected this species only from the Freestone beds of the Inferior Oolite of Wallsquarry and Nailsworth; the specimen figured was cut out of the centre of a block of building stone; the oolitic grains are imbedded in the plates of the test, and have in some measure injured the surface.

We dedicate this species to M. Michelin of Paris, the distinguished author of the 'Iconographie Zoophytologique,' as a tribute of gratitude for the valuable collection of Echinoderms he liberally and generously sent us from his unrivalled cabinet, to facilitate our studies of these beautiful forms of ancient life.

Nucleolites scutatus, Lamarck.

Since the publication of our memoir on the Cassidulidæ of the Oolites *, we have received from Professor Deslongchamps and M. Tesson a series of type specimens of *Nucleolites scutatus* from the Coral Rag of Trouville, Calvados, which we have compared with *Nucleolites dimidiatus*, Phillips, described in that memoir; from this comparison it is certain, that our Wiltshire and the Yorkshire Nucleolite, figured by Professor Phillips as *N. dimidiatus*, is the true *N. scutatus* of Lamarck. This circumstance affords another example of the great importance of comparing all our British Oolitic fossils with those collected from the Jurassic strata of the continent of Europe, before assigning them a position in our catalogues of species.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Botanical Letters to a Friend. By Dr. F. Unger. Translated by Dr. Paul. London: Highley, 1853.

The philosophical botanist, he who regards the vegetable creation as one great group of the collective representatives of the fruit of life, who gathers up plants from far and near, to trace the laws of morphology through the kaleidoscopic multiformity of shapes, to follow the mystery of organization through its progressive stages, or to sift the complex ingredients of the history of the diffusion of vegetation over our globe,—he to whom the word Botany expresses the existence of such fields of inquiry as these, is often exposed to an ordeal such as his brethren labouring in physical science now happily recall as among the traditions of the past. That is to say, while the astronomer, the physicist, and the chemist appear to the outer world armed with mysterious powers, before which the soothsayers and magicians of former ages would 'pale their ineffectual fires,' the botanist, running abreast of his science in these days, is a being altogether removed from the cognizance of the many; and dreads to hear an allusion to his pursuits, in general society, well knowing that it will be the text to a disquisition on the "beautiful wild flowers that grow in such and such a place," a recommendation to visit such

* Annals of Natural History, vol. ix.

and such a spot, for the sake of the curious 'mosses,' found about the rocks, and more such innocent, unconscious irony, conveying to him the impression that he is regarded as an individual, inoffensive perhaps, but somewhat monomaniacally devoted to a pursuit which has no end or aim beyond the collecting and classifying of weeds, and whom it is advisable to the artistic horticulturist to keep out of his garden as a ruthless destroyer, or an encourager of obstructive, unattractive 'curiosities.' Were education what it ought to be,—did Greek roots and the root of evil, with their accompaniments, absorb no more than their appropriate share of the time of our youth, the naturalist would perhaps have a fairer appreciation. For with the majority of mankind, it is only in youth that the mind is freely opened to the reception of new fields of knowledge, and seeing that even the small Latin and less Greek are mostly lost in the bustle of active life, it can hardly be expected that new modes of thought and observation, new sciences, will be readily taken up by the occupied adult; yet, if the young mind had been familiarized with the objects and methods of natural history, many and many a man, now a mere sportsman, a grower of prize turnips, or a hunter up of old first editions or rare copies, might have found delight and advanced human knowledge, in devoting his leisure to the promotion of some branch of inquiry, in which his intellect would have had a fair chance of being kept in healthy exercise and trained to the annihilation of prejudice.

These reflections have been awakened by the sight of the book before us, a translation of a little work written by one of the most distinguished among German botanists of the new school, for the purpose of popularizing the leading ideas of the science. The letters are intended for educated readers, and perhaps may be found to presuppose a larger infusion of scientific knowledge than is generally possessed here; but the conscientious reader, who will take the trouble to read them as carefully as he would a leader in 'The Times' on the subject of free trade or the law of settlement, will not find much more difficulty in understanding them, and will gain acquaintance with laws which have a rather more striking and permanent influence on the world's history.

The translation is fairly done,—perhaps is a little too much tinged with German idiom. As a small matter, but one partaking of the crying sin of modern literature, we must deprecate most strongly the introduction of new words and barbaric compounds, and in this view cannot forgive the expression plant-cell, plant-acid, &c. The woodcut illustrations are very elegant.

Synopsis des Caloptérygines. Par M. E. de Selys-Longchamps. Brussels, 1853.

Every one who has wandered on a summer's day on the banks of any of our rivers, must have noticed a dragon-fly of considerable size, whose beautiful metallic tints, dark wings and graceful motions render it one of the most elegant denizens of such localities. This insect is the *Libellula Virgo* of Linnæus; it was placed by Fabricius in his genus *Agrion*, and adopted by Leach as the type of his genus *Calepteryx* (called *Calopteryx* by recent authors). Since the time of Leach many allied species have been described, some of which have been regarded by their describers as warranting the establishment of new genera, until at length the Linnæan species has become the type of a subfamily, to which the name of *Calopteryginæ* is applied, containing one hundred species, divided into no less than twelve genera. Of these two species only were known to Linnæus, and four to Fabricius; Burmeister in 1839 only mentions sixteen species, and Rambur in the last general work upon the Neuroptera published in 1841, describes only twenty-seven. For the knowledge of the remainder science is indebted to the author of the small work whose title stands at the head of this notice.

The author informs us in his preface that this 'Synopsis' consists of the synoptical tables which he prepared for his own use whilst working upon a monograph of the *Calopteryginæ* which is now in the press. It is intended in fact to serve as a sort of prodromus to the larger work, and contains in a semi-tabular form, short characters of all the divisions, genera and species which will be described more fully in the latter. The reputation of M. de Selys-Longchamps renders it almost unnecessary for us to say anything with regard to the merits of his work; we may observe however that it appears to have been executed with great care, the specific characters especially being very carefully drawn up.

The species are distributed into twelve genera—namely, 1. *Calopteryx* (*Calepteryx*, Leach); 2. *Neurobasis* (suppressed in an appendix and united with *Phaon*); 3. *Echo*; 4. *Phaon*; 5. *Vestalis*; 6. *Hetærina*, Hagen; 7. *Euphæa* (including *Epallage*, Charp.); 8. *Heliocharis*; 9. *Dicterias*; 10. *Libellago* (including *Rhinocypha* and *Micromerus*, Ramb.); 11. *Amphipteryx*; and 12. *Thore*, Hagen. Those genera to which no author's name is attached are due to M. de Selys himself. Of the higher groups or *Legions* the author gives the following tabular arrangement:—

					Legions.	Genera.
Fam. Agrionidæ. Subfam. Calopteryginæ.	Division I. The two sectors of the arculus arising from about its middle.	Subdiv. I. Costal and subcostal nervures nearly equal in number.	Section I. Epistoma not prominent.	Pterostigma short or wanting	1. *Calopteryx*	1-6.
				Pterostigma very long, regular ..	2. *Euphæa* ..	7-9.
			Section II. Epistoma very prominent		3. *Libellago* ..	10.
		Subdiv. II. Only 2-3 subcostal nervules; costal nervules more numerous			4. *Amphipteryx*	11.
	Division II. The two sectors of the arculus arising together from its apex				5. *Thore*	12.

Of the geographical distribution of these insects M. de Selys speaks as follows:—The *Calopteryginæ* are distributed over the whole of the warm and temperate portions of the globe, except in Oceania.

Half the species belong to the old world, which is inhabited by species of the Legions *Euphæa, Libellago* and *Calopteryx*. The genus *Hetærina*, containing thirty species, six species of *Calopteryx*, the genera *Heliocharis* and *Dicterias* each containing a single species, and the Legions *Amphipteryx* and *Thore*, are found in America, and principally in the tropical parts.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

February 10, 1854.—Right Hon. Baron Parke, Vice-President, in the Chair.

On the Structure and Homologies of Teeth. By Prof. Owen, F.R.S.

The Lecturer commenced by observing that, although the teeth were among the least vitalized of animal parts, and commonly possessed no power of repairing fracture or decay, they presented many phænomena of anatomical, physiological, and homological interest, a selection from which he proposed to offer as the subject of the evening's discourse.

Any hard body attached to the walls and projecting into the cavity of the mouth, where it is exposed to view when the mouth is open, is called a *tooth*: but the parts properly so called, are those which consist of a gelatinous basis, hardened by earthy salts, in which the phosphate of lime predominates. Such teeth are peculiar to the Vertebrate Classes. In them they present manifold varieties as to number, size, form, structure, position, and mode of attachment, but are principally adapted for seizing, tearing, dividing, pounding, or grinding the food; in some species they are modified to serve as formidable weapons of offence and defence; in others as aids in locomotion, means of anchorage, instruments for uprooting or cutting down trees, or for transport and working of building materials; they are characteristic of age and sex; and in man they have secondary relations subservient to beauty and to speech.

Teeth are always intimately related to the food and habits of the animal, and are therefore highly interesting to the physiologist: they form for the same reason important guides to the naturalist in the classification of animals; and their value, as zoological characters, is enhanced by the facility with which, from their position, they can be examined in living or recent animals; whilst the durability of their tissues renders them not less available to the palæontologist in the determination of the nature and affinities of extinct species, of whose organization they are often the sole remains discoverable in the deposits of former periods of the earth's history.

Teeth are not of a uniform tissue or substance like bone: that which forms the body of the tooth is called "dentine;" the tissue which forms the outer crust is called "cement;" and in most Vertebrata a third substance is situated between the dentine and cement, called "enamel." The characteristics of these three primary tissues of a tooth were briefly defined: they differ in hardness, the cement being least dense, the enamel most.

The tubular structure of the dentine relates to the disposition of the hard material so as best to resist pressure, and to the circulation of plasma, transuded from the pulp through the dentine, so as to maintain a certain, though languid, vitality of the tissue.

Some secondary modifications of the chief tissue of teeth were noticed under the names of osteo-dentine, vaso-dentine, vitro-dentine, dendro-dentine, and labyrintho-dentine; the latter highly complex and beautiful modification being due rather to a modification of disposition, than of composition of the dentine itself. The singular labyrinthic interblending of the dentine and cement reaches its maximum of complexity in the teeth of some gigantic extinct batrachian Reptiles, from the Triassic formations, called from their distinct peculiarities, "Labyrinthodonts."

The chief varieties in the form of the teeth in Fishes were then enumerated, and more especially illustrated in the predatory Pike, the vegetarian Carp, the shell-crushing Myliobates, and the coral-browsing Scarus. The elastic attachment of the teeth of the Lophius, and the mode of growth and succession of the Shark's numerous teeth were explained.

From the class of Reptiles examples of dental structure were selected from the Serpent-tribes, in relation to the poison-apparatus, and from the Crocodile, in respect of the constant succession and displacement of the teeth. The structure of the teeth of the extinct Iguanodon and Megalosaurus was also noticed.

The Mammalian class might be divided, in regard to the succession of the teeth, into two groups—the *Monophyodonts*, or those that generate but one set of teeth, and the *Diphyodonts*, or those that generate two sets of teeth.

The Monophyodonts include the Cetacea and the *Bruta* (*Edentata* of Cuvier); all the other Orders are Diphyodonts.

The teeth of the Mammalia, especially the Diphyodonts, have usually so much more definite and complex a form than those of fishes and reptiles, that three parts are recognised in them; viz. the "fang," the "neck," and the "crown." The fang or root (*radix*) is the inserted part; the crown (*corona*) the exposed part; and the constriction which divides these is called the neck (*cervix*). The term "fang" is properly given only to the implanted part of a tooth of restricted growth, which fang gradually tapers to its extremity; those teeth which grow uninterruptedly have not their exposed part separated by a neck from their implanted part, and this generally maintains to its extremity the same shape and size as the exposed crown.

It is peculiar to the class Mammalia to have teeth implanted in sockets by two or more fangs; but this can only happen to teeth of limited growth, and generally characterizes the molars and premolars: perpetually growing teeth require the base to be kept simple and widely excavated for the persistent pulp. In no mammiferous animal does anchylosis of the tooth with the jaw constitute a normal mode of attachment. Each tooth has its particular socket, to which it firmly adheres by the close co-adaptation of their opposed surfaces, and by the firm adhesion of the alveolar periosteum to the organized cement which invests the fang or fangs of the tooth.

True teeth implanted in sockets are confined, in the Mammalian class, to the maxillary, premaxillary, and mandibular, or lower maxillary bones, and form a single row in each. They may project only from the premaxillary bones, as in the Narwhal, or only from the lower maxillary bone, as in Ziphius; or be apparent only in the lower maxillary bone, as in the Cachalot; or be limited to the superior and inferior maxillaries, and not present in the premaxillaries, as in the true Ruminants and most Bruta.

The teeth of the Mammalia usually consist of hard unvascular dentine, defended at the crown by an investment of enamel, and everywhere surrounded by a coat of cement. The coronal cement is of extreme tenuity in Man, Quadrumana, and terrestrial Carnivora; it is thicker in the Herbivora, especially in the complex grinders of the Elephant; and is thickest in the teeth of the Sloths, Megatherioids, Dugong, Walrus, and Cachalot. Vertical folds of enamel and cement penetrate the crown of the tooth in the Ruminants, and in most Rodents and Pachyderms, characterizing by their various forms the genera of the last two orders; but these folds never converge from equidistant points of the circumference of the crown towards its centre. The teeth of the quadrupeds of the order *Bruta* (*Edentata*, Cuv.) have no true enamel; this is absent likewise in the molars of the Dugong and the Cachalot. The tusks of the Narwhal, Walrus, Dinotherium, Mastodon, and Elephant, consist of modified dentine, which in the last two great proboscidian animals is properly called "ivory," and is covered by cement.

The Dolphins and Armadillos present little variety in the shape of teeth in the same animal; the teeth are often very numerous; and this sameness of form is characteristic of most of the monophyodonts.

In almost all the other Mammalia, particular teeth have special forms for special uses: thus, the front teeth, from being commonly adapted to effect the first coarse division of the food, have been called cutters or *incisors*; and the back teeth, which complete its comminution, grinders or *molars*; large conical teeth, situated behind the incisors, and adapted by being nearer the insertion of the biting muscles, to act with greater force, are called holders, tearers, laniaries, or more commonly *canine* teeth, from being well developed in the Dog and other Carnivora, although they are given, likewise, to many vegetable feeders for defence or combat: *e. g.* Musk-deer.

Molar teeth, which are adapted for mastication, have either tuberculate, or transversely ridged, or flat summits, and usually are either surrounded by a ridge of enamel, or are traversed by similar ridges arranged in various patterns. Certain molars in the Dugong, the Mylodon, and the Zeuglodon, are so deeply indented laterally by opposite longitudinal grooves, as to appear, when abraded, to be composed of two cylindrical teeth cemented together, and the transverse section of the crown is bilobed. The teeth of the *Glyptodon* were fluted by two analogous grooves on each side. The large molars of the Capybara and Elephant have the crown cleft into a numerous series of compressed transverse plates, cemented together side by side.

The modifications of the crown of the molar teeth are those that are most intimately related to the kind of food of the animal possessing them. Illustrations were given of the chief of these modifications in the purely Carnivorous mammals, where the molars are simple, trenchant, and play upon each other like scissor-blades: in the mixed feeding species where the working surface of the molars is flattened or tuberculated: in the insectivorous species where it is bristled with sharp points: and in the purely herbivorous kinds, where the broad grinding surfaces of the teeth are complicated by folds and ridges of the enamel entering the substance of the tooth: the most complex forms being presented by the Elephants.

Teeth of each of the kinds above determined, and arbitrarily named "incisors," "canines," "molars," have received other special names, in regard to certain peculiarities of form or other property; and the ablest comparative anatomists have been led astray in determining their homologies when they have suffered themselves to be guided exclusively by morphological characters. The small anterior grinding teeth in the human subject have been called "bicuspids." The penultimate upper tooth and the last lower tooth in the Lion are termed, from their peculiar form, "sectorials," or "carnassial teeth," "molaires carnassières" of Cuvier. Teeth of an elongated conical form, projecting considerably beyond the rest, and of uninterrupted growth, are called "tusks;" such are the incisors of the Elephant and Dugong, and the canines of the Boar and Walrus: the long and large incisors of the Rodents have been termed, from the shape and structure of their cutting edge, scalpriform or chisel-teeth, "*dentes scalprarii.*" The inferior incisors of the flying Lemurs (*Galeopithecus*) have the crown deeply notched like a comb, and are termed "*dentes pectinati.*" The canines of the Baboons are deeply grooved in front, like the poison-fangs, "*dentes canaliculati,*" of some serpents. The compressed conical crowns of the molar teeth of the small clawed Seals, *Stenorhynchus,* are divided either like a trident into three sharp points, or like a saw, into four or five points; the molars of the great extinct *Zeuglodon* had a similar form; such teeth have been called *dentes serrati.* But the philosophical course of the knowledge of nature tends to explode needless terms of art, invented for unimportant varieties, and to establish and fix the meaning of those words that are the signs of determinate species of things.

The Cuviers divided the molar series of teeth, according to their form, into three kinds: "false molars," "carnassials," and "tubercular molars;" and, in giving the generic characters of Mammalia, based the dental formulæ on this system: thus the genus *Felis* is characterized as having "fausses molaires $\frac{2-2}{2-2}$, carnassières $\frac{1-1}{1-1}$, tuberculeuses $\frac{1-1}{0-0}$; $= \frac{8}{6}$."

In a diagram of the leading modifications of Diphyodont dentition, an uninterrupted line marked "Cuvier" was made to intersect the teeth in each jaw of the Carnivora, called by that great anatomist "carnassières:" those anterior to them being the teeth which he called "fausses molaires;" those behind being the "tuberculeuses." Most zoologists, both at home and abroad, have adopted the Cuvierian system of formulising the molar teeth. Prof. De Blainville, however, abandoned that classification of the molar series, without assigning his objections to it; and proposed another, in which he divides the series into "avant-molaires," "principales," and "arrière-molaires;" he exemplifies this division by the human dentition, in which the five grinders on each side of both jaws are formulised as "two avant-molaires, one principale, and two arrière-molaires." The teeth regarded by De Blainville as the homologues of these, were indicated in the diagram above referred to by a dotted line intersecting the "dent principale" in each species.

Truly homologous teeth are determined, like other parts, by their relative position, by their connexions, and by their development. The teeth of one side of the jaw repeat, are answerable to, or are *homotypes*, of the teeth on the other side; and those in the upper jaw usually correspond, in like manner, to those in the under jaw.

Those teeth which are implanted in the premaxillary bones, and in the corresponding part of the lower jaw, are called "incisors," whatever be their shape or size. The tooth in the maxillary bone, which is situated at, or near to, the suture with the premaxillary, is the "canine," as is also that tooth in the lower jaw which, in opposing it, passes *in front of its crown* when the mouth is closed. The first-formed incisors and canines are deciduous; they are succeeded and displaced vertically by the permanent incisors and canines. With regard to the other teeth, their true nature and homologies, about which the difference of opinion has chiefly prevailed amongst anatomists, are determinable not by shape or size, or by relative position to the zygoma, but by developmental characters exclusively. The first set are the "deciduous molars;" the teeth which displace and succeed them vertically are the "premolars;" the more posterior teeth, which are not displaced by vertical successors, but succeed each other horizontally, are the "molars," properly so called.

The phænomena of the development and succession of the teeth were then explained and illustrated in examples of Carnivorous, Herbivorous, and mixed-feeding species of Diphyodont Mammalia.

Genus *Felis*.—In the Cat, the deciduous incisors begin to appear between two and three weeks old; the canines next, and then the molars follow, the whole being in place before the sixth week. After the seventh month they begin to fall in the same order; but the lower sectorial molar and the tubercular tooth above, appear before the deciduous molars are shed; they do not push out any predecessors, and have no successors; they are, therefore, true molars. The first deciduous molar in the upper jaw is a very small and simple one-fanged tooth; it is succeeded by the corresponding tooth of the permanent series, which answers to the second premolar of the Hyæna and Dog. The second deciduous molar is the sectorial tooth; its blade is trilobate, but both the anterior and posterior smaller lobes are notched, and the internal tubercle, which is relatively larger than in the permanent sectorial, is continued from the base of the middle lobe, as in the deciduous sectorial of the Dog and Hyæna; it thus typifies the form of the upper sectorial, which is retained in the permanent dentition of several Viverrine and Musteline species. The third or internal fang of the deciduous sectorial is continued from the inner tubercle, and is opposite the interspace of the two outer fangs. The Musteline type is further adhered to by the young Feline in the large proportional size of its deciduous tubercular tooth. In the lower jaw, the first milk-molar is succeeded by a tooth which answers to the third lower premolar in the Dog and Civet. The deciduous sectorial, which is succeeded by the premolar, answering to the fourth in the Dog, has a smaller proportional anterior lobe, and a larger posterior talon, which is usually notched; thereby approaching the form of the permanent lower sectorial tooth in the *Mustelidæ*. The last tooth which is functionally analogous to the carnassial above, is the first of the true molar series, and is the homotype of the little tubercular tooth above.

The true nature of the dentition of the Lion and other Felines, as determined by the above phænomena of development, is:— $i. \frac{3-3}{3-3}$, $c. \frac{1-1}{1-1}$, $p. \frac{3-3}{2-2}$, $m. \frac{1-1}{1-1}$: signifying that there are 3 incisors, 1 canine, 3 premolars, and 1 molar, on each side of the upper jaw, and the same, with the exception of a small premolar, on each side of the lower jaw. The teeth, which are the seat of the sectorial or carnassial modifications, are not homologous or homotypal in the two jaws.

In the genus *Ursus* the dentition was, in like manner, shown to be:—$i. \frac{3-3}{3-3}$, $c. \frac{1-1}{1-1}$, $p. \frac{4-4}{4-4}$, $m. \frac{2-2}{3-3}=42$.

In the Hog, four deciduous molars are succeeded by four premolars, vertically; and three molars are developed in horizontal succession behind these, the dental formula being:— $i. \frac{3-3}{3-3}$, $c. \frac{1-1}{1-1}$, $p. \frac{4-4}{4-4}$, $m. \frac{3-3}{3-3}=44$.

This number of teeth is never surpassed in the Diphyodont series; and the Lecturer regarded it as the typical dentition. It is, however, rarely maintained in existing species, but appears to have been much more common in extinct Mammalia, especially those from the most ancient tertiary epochs; illustrations of which were given in the *Hyænodon* and *Hyopotamus*, and examples cited in the extinct genera *Chœropotamus, Anthracotherium, Hyracotherium, Oplotherium, Merycopotamus, Hippohyus, Anoplotherium, Palæotherium,* and *Paloplotherium*. In the three latter genera, Professor Owen had determined the nature of the molar series to be the same as in the Hog, by specimens showing the deciduous dentition.

In the hoofed quadrupeds with toes in uneven number (*Perissodactyla*), whose premolars, for the most part, repeat both the form and the complex structure of the true molars, such premolars are distinguished by the same character of development as those of the *Artiodactyla*, or Ungulates with toes in even number; although here the premolars are distinguished also by modifications of size and shape.

In most of the South American Quadrumana, the number of teeth, as contrasted with the Monkeys of Africa and Asia, is increased to thirty-six, by an addition of one tooth to the molar series on each side of both jaws. It might be concluded *à priori*, that as three is the typical number of true molars in the placental Mammalia with two sets of teeth, the additional tooth in the New-World Monkeys would be a premolar, and form one step to the resumption of the normal number (four) of that kind of teeth. The proof of the accuracy of this inference was given by the state of the dentition in the young of the Howler-Monkey (*Mycetes*), in which a diagram was exhibited of a dissection of the jaws, exposing the germs of the permanent teeth: the crown of a premolar being found above the *third* milk-molar in place, as well as above the *second* and *first*. As regards number, therefore, the molar series, in *Mycetes*, is intermediate between that of the Bear, *Ursus*, and *Felis*; the little premolar *p. i.* in *Ursus*, tells plainly enough which of the four is wanting to complete the typical number in the South American Monkey, and which is the additional premolar distinguishing its dental formula from that of the Old-World Monkeys and Man.

With regard to the Human Dentition, the discovery, by the great poet Goethe, of the limits of the premaxillary bone in man, leads to the determination of the incisors, which are reduced, as in Apes and Monkeys, to two on each side of both jaws; the contiguous tooth shows by its shape, as well as position, that it is the canine; and the characters of size and shape have also served to divide the remaining five teeth in each lateral series into two bicuspids and three molars. In this instance, as in the dentition of the Bear, the secondary characters conform with the essential ones. But since we have seen of how little value shape or size are, in the order Carnivora, in the determination of the exact homologies of the teeth, it is satisfactory to know that the more constant and important character of development gives the requisite certitude as to the nature of the so-called bicuspids in the Human subject. The condition of the teeth was shown in the jaws of a child of about six years of age. The two incisors on each side are followed by a canine, and this by three teeth having crowns resembling those of the three molar teeth of the adult. In fact, the last of the three is the first of the permanent molars; it has pushed through the gum, like the two molars which are in advance of it, without displacing any previous tooth, and the substance of the jaw contains no germ of any tooth destined to displace it; it is therefore, by this character of its development, a true molar, and the germs of the permanent teeth, which are exposed in the substance of the jaw between the diverging fangs of the two anterior molars, prove them to be temporary, destined to be replaced, and prove also that the teeth about to displace them are premolars. According, therefore, to the rule previously laid down, we count the permanent molar in place, the first of its series, and the adjoining premolar as the last of its series, and consequently the fourth of the typical dentition; the next premolar in advance being the penultimate or third of the typical series.

We are thus enabled, with the same scientific certainty as that whereby we recognise in the middle toe of the foot the homologue of that great digit which forms the whole foot, and is encased by the hoof in the Horse, to point to the second bicuspid in the upper jaw, and to the first molar in the lower jaw of Man, as the homologues of the great carnassial teeth of the Lion and Tiger. We also conclude that the teeth which are wanting in Man to complete the typical molar series, are the first and second premolars, the homologues of those which were marked in the diagram of the dentition of the Bear. The characteristic shortening of the maxillary bones required this diminution of the number of their teeth, as well as of their size, and of the canines more especially; and the still greater curtailment of the premaxillary bone is attended with a diminished number and an altered position of the incisors. One sees, indeed, in the Carnivorous series, that a corresponding decrease in the number of the premolars is concomitant with the shortening of the jaws. Already in the *Mustelidæ*, the first premolar below is abrogated; in *Felis* also above, with the further loss of the second premolar in the lower jaw; the true molars being correspondingly reduced in these strictly flesh-eating animals, but taken away from the back part of their series.

If we were desirous of further testing the soundness of the foregoing conclusions as to the nature of the teeth absent in the reduced dental formula of Man, we ought to trace the mode in which the type is progressively resumed in descending from Man through the Order most nearly allied to our own.

Through a considerable part of the Quadrumanous series, *e.g.* in all the Old-World genera above the Lemurs, the same number and kinds of teeth are present as in Man; the first deviation being the disproportionate size of the canines and the concomitant break or "diastema" in the dental series for the reception of their crowns when the mouth is shut. This is manifested in both the Chimpanzees and Orangs, together with a sexual difference in the proportions of the canine teeth. Then comes the added premolar in the New-World Monkeys, and the further additions in lower quadrupeds, until in the Hog genus we see the old primitive type of Diphyodont dentition resumed or retained.

With regard to the application of the above principles and characters to other or newly-discovered species:—When the premolars and the molars are below their typical number, the absent teeth are missing from the fore part of the premolar series and from the back part of the molar series. The most constant teeth are the fourth premolar and the first true molar; and, these being known by their order and mode of development, the homologies of the remaining molars and premolars are determined by counting the molars *from before backwards, e.g.* "one," "two," "three;" and the premolars *from behind* *forwards*, "four," "three," "two," "one." The incisors are counted from the median line, commonly the foremost part of both upper and lower jaws, outwards and backwards. The first incisor of the right side is the homotype, transversely, of the contiguous incisor of the left side in the same jaw, and, vertically, of its opposing tooth in the opposite jaw; and so with regard to the canines, premolars, and molars; just as the right arm is the homotype of the left arm in its own segment, and also of the right leg of a succeeding segment. It suffices, therefore, to reckon and name the teeth of one side of either jaw in a species, with the typieal number and kinds of teeth; *e. g.* the first, second and third incisors,—the first, second, third and fourth premolars,—the first, second and third molars; and of one side of both jaws in any case.

The homologous teeth being thus determinable, they may be severally signified by a symbol as well as by a name. The incisors, *e. g.*, by their initial letter *i.*, and individually by an added number, *i.* 1, *i.* 2, and *i.* 3; the canines by the letter *c.*; the premolars by the letter *p.*; and the molars by the letter *m.*; these also being differentiated by added numerals. Thus, the number of these teeth, on each side of both jaws, in any given species, Man *e. g.*, may be expressed by the following brief formula:—$i.\ \frac{2-2}{2-2},\ c.\ \frac{1-1}{1-1},\ p.\ \frac{2-2}{2-2},\ m.\ \frac{3-3}{3-3} = 32$; and the homologies of the individual teeth, in relation to the typical formula, may be signified by *i.* 1, *i.* 2; *c.*; *p.* 3, *p.* 4; *m.* 1, *m.* 2, *m.* 3: the suppressed teeth being *i.* 3, *p.* 1, and *p.* 2.

These symbols are so plain and simple as to form no obstacle to the ready comprehension of the facts explained by means of them. Were those facts described in the ordinary way, by means of the verbal phrases or definitions of the teeth; as for example, in Man, "the second deciduous molar, representing the fourth deciduous molar in the typical dentition," instead of *d.* 4, and so on, the descriptions of the manifold modifications of the teeth and of dental development must continue to occupy much unnecessary space, and levy such a tax upon the attention and memory, as would inevitably tend to enfeeble the judgement and impair the power of seizing and appreciating the results of the comparison.

Each year's experience had strengthened the lecturer's conviction that the rapid and successful progress of the knowledge of animal structures, and of the generalizations deducible therefrom, would be mainly influenced by the determination of the homology of parts and organs, and by the concomitant power of condensing the propositions relating to them, and attaching to them signs or symbols equivalent to their single substantive names. In the lecturer's work on the "Archetype of the Skeleton," he had denoted most of the bones by simple numerals: the symbols of the teeth are fewer in number, are easily understood and remembered; and, if generally adopted, might take the place of names: they would, then, render unnecessary the endless repetition of the verbal definition of the part, harmonise conflicting synonyms, serve as a universal language, and at the same time express the expositor's meaning in the fewest and clearest terms. The entomologist had long found the advantage of such signs as ♂ and ♀, in reference to the sexes of Insects and the like; and the anatomist would find it to his advantage to avail himself of this powerful instrument of thought, instruction and discovery, from which the chemist, the astronomer, and the geometrician have obtained such important results.

ZOOLOGICAL SOCIETY.

February 10, 1852.—William Yarrell, Esq., in the Chair.

The Chairman exhibited a specimen of the *Echiodon Drummondii* of Mr. Thompson of Belfast, a very rare species of fish, of which only one example has been previously known. Dr. Drummond obtained the first specimen on the beach at Carnclough, near Glenarm in the county of Antrim, in June 1836, cast ashore probably by the tide of the preceding night, after a strong easterly wind. The species was considered new to ichthyology, and was first described and figured in the Transactions of this Society by Mr. Thompson, vol. ii. p. 207. pl. 38. Nothing that has transpired since the publication of Mr. Thompson's paper has induced a belief that this species had been previously known.

The specimen now exhibited was most liberally sent to Mr. Yarrell by Mrs. Blackburn of Valencia, in the county of Kerry, who was perfectly aware of the characters, the rarity, and the value of the fish. It was found by her daughter Helen on the shore of the harbour of Valencia, after a violent storm from the west, which occurred there on the 23rd of January last.

This example is smaller than the one noticed by Mr. Thompson, measuring only 8 inches in length, but quite perfect. Mr. Thompson's example measured 12 inches (Brit. Fishes, vol. ii. p. 417).

The following papers were then read:—

1. On Cystosoma Saundersii, of Curtis and Westwood. By A. W. Scott, M.A.

Head small; sides of the thorax running in a straight line from the head to an acute angle behind; abdomen of the male deeply constricted immediately behind first segment; second joint of the antennæ distinct from the third, and not forming with it the tapering setæ which terminates them; upper wings destitute of a nervure running parallel to their inner margin.

The male measures, in expanse of wings, nearly $4\frac{1}{4}$ inches; the female $3\frac{3}{4}$ inches.

The antennæ in both sexes are very short, 7-jointed, the two basal joints strong and thick, the remainder much finer and gradually terminating in a point.

The legs, anterior pair, with two minute spurs at the apex of tibia;

the femora are robust, with their lower edges serrated; the second and posterior pairs longer than the anterior, with minute spurs on the ends of the tibiæ and setæ, placed in pairs and evenly distributed along the inner edge; the femora of these are slender and not serrated. The tarsi of all the legs 3-jointed, and terminated by two strongish claws, and fringed underneath by setæ. From the base of each coxa of the second and posterior pairs there proceeds a large flexible spine.

The upper wings are coriaceous, lanceolate and sharply pointed, with the cells of inner side open, and not shut in by a long marginal nervure as in the true *Cicadæ*. The under wings are small, and furnished with very weak nervures.

The colour of the whole upper surface of both sexes is of a pale delicate green, with the exception of the posterior wings, which are transparent, possessing, however, a slight greenish tinge. The costæ of the fore-wings are white, with a pinkish hue running along the centre. The under portion of the base of the upper wing inclines to yellow, which colour extends round the thorax. The antennæ are black, and the eyes a bright, light reddish colour. In the preserved specimens, the beautiful delicate green, which constitutes the general colour, becomes duller and darker, and frequently assumes a hue of sickly yellow.

The drums of the male are rounded, and marked by seven transverse furrows, slightly tinged with brown, in the middle, and different from those of the true *Cicadæ* in being more conspicuous on a dorsal view of the insect. Besides, the abdomen is deeply constricted immediately behind them, so that the first segment appears as it were to form part of the metathorax, and the abdomen seems merely composed of the seven last segments, which are here exceedingly inflated, as in the orthopterous genus *Pneumora*.

The abdomen of the female is of a size and form more corresponding to that of the female *Cicadæ*, but it is of a more cylindrical form and less angular at the sides. The dilated sides of the metasternum, which form the two plates covering the under sides of the drums in the male, are here comparatively small.

These insects are extremely numerous on Ash Island, principally inhabiting an orange grove of about 1200 trees, and we scarcely ever remember seeing one beyond a few rods of the limits of this garden, nor have we ever heard of or discovered a single specimen elsewhere, with the exception of the few brought by Sir Thomas Mitchell from the interior.

During the short twilight of this country, the male commences and ends his song, which resembles a loud deep guttural, R, continued incessantly, and with vibrations. So loud indeed is this sound, that when near to several insects it becomes even painful to the ear. It is, moreover, very unlike the shriller and harsher notes uttered by the common *Cicada*.

In this brief period after sunset the males and females occasionally fly from tree to tree, their flight being slow and steady, particularly that of the former. The only other time in which these insects are heard is immediately, in hot and sultry weather, before a thunderstorm, and then only at broken intervals. This habit was particularly noticed on our placing the males on a bunch of flowers in the drawing-room, where every evening they regaled us with their short-lived song, and at other periods occasionally predicted the coming storm.

The larvæ live underground upon the roots of plants, and in their habits and transformations closely approximate to those of the common *Cicada*.

The perfect insects appear early in September, and are to be found until about February. They are extremely easily captured, the females being taken when in flight by a common butterfly net, and the males by going to the spot from where their voices proceed, and suddenly shaking the bough, which causes them to drop to the ground, when they may be picked up.

The male has been indifferently figured under the name of *Cystosoma Saundersii*, in the 'Arcana Entomologica,' in which Mr. Westwood mentions its affinity to *Hemidictya*, and gives good dissections. His description, however, is not correct, when he characterizes the insect as "pallide lutea," whereas the species is "læte viridis." The female, we believe, is not known in England.

Ash Island, Hunter River, New South Wales,
Nov. 6, 1851.

2. Description of a new species of Anomalurus, from Fernando Po. By Louis Fraser, H.B.M. Vice-Consul for the kingdom of Dahomey.

The Proceedings of this Society contain the description of a very interesting new form of Rodents, discovered by myself at Fernando Po, and to which the name *Anomalurus Fraseri* was given by Mr. Waterhouse. A second species of the genus has subsequently been found in Ashantee, by an enterprising collector sent out by the Directors of the Leyden Museum, and has been named after its discoverer, by M. Temminck, *Anomalurus Pelii*. I have now to submit to your notice a third species of the genus, which I propose to name after my friend and coadjutor, John Beecroft, Esq., H.M. Consul for the Bights of Benin and Biafra, also Spanish Governor of the island of Fernando Po, as a just tribute to one who has devoted upwards of twenty-three years to the cause of Western Africa and its inhabitants, and whose knowledge of both is unequalled. This extraordinary gentleman has entered all (or nearly all) the rivers on this coast, so fatal to Europeans, and after six weeks' search amongst the swamps and creeks, has discovered the junction of the Benin and Niger: this latter river he has navigated three or four times as high up as Rabba. He also ascended Clarence Peak.

The principal peculiarities of the three species of *Anomalurus* are as follows:—

Anomalurus Fraseri, Waterh.

General hue of the upper parts brown; the flank-membranes dusky or black; under parts dirty white, slightly washed with buff-yellow; a considerable area around the base of the ears black, as well as the long hairs on the basal part of those organs; cheeks deep brown; throat grey; feet and tail dusky.

Hab. Fernando Po.

Anomalurus Beecrofti, Fraser.

Upper parts, including the greater portion of the flank-membranes, yellowish grey, slightly inclining to rufous on the mesial line of the back, especially on the fore part; under parts of a bright rust colour; cheeks and throat grey, excepting that the latter has a narrow rust-coloured mark in the middle; a white spot on the crown of the head (probably not constant), and a short white band on either side of the neck running on the shoulders; a dusky patch on the flank-membrane above, commencing on the margin of the membrane near the anterior part, and extending backwards and inwards rather less than half way along the flanks; tail dusky brown.

Hab. Fernando Po.

This species is rather larger than the *An. Fraseri*, and differs, moreover, in the upper parts of the body being yellow-grey, instead of brown; in having the greater portion of the flank-membranes as well as the feet grey, instead of dusky; in wanting the conspicuous black area around the base of the ears—the part in question being of the same general grey colour in *An. Beecrofti* as other parts; in having the cheeks hoary grey, intead of deep brown; and in having the under parts of a bright rusty red. There are differences likewise to be observed in the scales on the under side of the tail; they cover less space in the longitudinal direction, are broader, and have the projecting angles less prominent.

	in.	lin.
Length from tip of nose to root of tail	15	0
—— of tail	9	0
—— of the scaly portion beneath	3	3
—— from nose to ear	2	3
—— of ear	1	3
—— of fore foot and claws	1	11
—— of hind foot and claws	2	9

Anomalurus Pelii, Temminck.

Larger than either of the foregoing. Black above; dirty white below; throat dusky; chin, upper surface of the nose, the region of the muffle (or naked portion of the nose), the long and soft hairs on the outer surface of the ears at the base, and the tail, white; the flank-membrane is broadly margined with white, and the hairs on the feet are for the most part white, but with an admixture of black or dusky; the long hairs springing from the base of the nails of the hinder feet are black.

Hab. Ashantee.

BOTANICAL SOCIETY OF EDINBURGH.

February 9, 1854.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On the occurrence of *Anacharis Alsinastrum* in Ireland," by G. Dickie, M.D. The author remarks that they have probably the earliest record of the presence of the *Anacharis* in the United Kingdom, for Mr. John New, a gardener, informs him that "about eighteen years ago, the pond at Waringstown was cleared of overhanging trees, when the *Anacharis* was immediately observed, after the planting of some aquatics, making it necessary several times during the summer to clear it out. It is not known whether it existed in the pond previously to the above date, or was introduced with the aquatics at that time. For many years its name was not known to any person in the neighbourhood."

2. "Notes of a Botanical Trip to the Tents Muir, in the north of Fife, in July last," by Mr. G. Lawson. The object of these notes was to call attention to a rich locality, which, although within easy reach, had not hitherto been much examined by Edinburgh botanists. It is an extensive tract, chiefly of sand dunes, extending along the coast from Ferry-Port-on-Craig to the river Eden. The following were among the plants noticed: *Anagallis tenella, Lycopodium inundatum, Littorella lacustris, Teesdalia nudicaulis, Radiola Millegrana, Sisymbrium Sophia, Fumaria micrantha, Senecio viscosus, Juncus balticus, Papaver Argemone, Chrysanthemum segetum, Veronica Anagallis* and *scutellata, Peplis Portula, Malva sylvestris, Myosotis collina, Bryum warneum* (Mr. Ogilvie), *Weissia nigrita, Didymodon inclinatum, Stereocaulon tomentosum.* The pools and moist hollows on the Muir were rich in freshwater Algæ, including Nostochineæ and Desmidieæ. The party did not find *Isnardia palustris*, and fancied that the abundance and luxuriance of *Peplis Portula* might have led to some mistake. The *Peplis* afforded a retreat for myriads of *Hydra viridis.*

3. "Notice of Localities for Rare Plants in the neighbourhood of Edinburgh," by Mr. G. R. Tate. The following were among the plants noticed:—

Alyssum calycinum. On debris below the Queen's drive, near Duddingston. "I noticed the plant in this locality in the month of May before it was in flower; at that time there were a number of specimens. As the season advanced and the locality became more generally known, nearly the whole were eradicated. It is hardly possible that the *Alyssum* could have escaped the notice of the numerous botanists visiting Arthur's Seat and its neighbourhood, had it existed in this locality for any length of time. The probability is, that it had been introduced by seed sown, at no very distant date, by some one anxious to add a species to a flora already overstocked with doubtful natives. I obtained this plant at Burntisland, in very small quantity."

Sinapis Cheiranthus. In a field near Gullane. Not previously found in Scotland, and doubtfully indigenous.

Drosera longifolia. In bogs at the foot of the Knock Hill, not far from the station of *Carex irrigua.*

Hypericum Androsæmum. Near Culross.

Hypochæris glabra. Near Culross.

Lamium maculatum. Banks of the Esk, about two miles above Musselburgh.

Rumex alpinus. In two localities near the Knock Hill, both near cottages.

Tulipa sylvestris. Sides of the Water of Leith, above Currie.

Zannichellia palustris. Canal near Fountain Bridge.

Carex incurva. Sea-shore between Longniddry and Prestonpans.

4. "On the Nightshade Family," by Mr. Peter Fairbairn. Mr. Fairbairn detailed the character and properties of the *Solanaceæ,* and alluded particularly to the nature and qualities of the alkaloids yielded by different genera and species. He remarked that the effect produced by such alkaloids as Hyoscyamine, Daturine, and Atropine were different from those produced by Solanine, especially as regards the dilatation of the pupil.

Dr. T. Anderson remarked that Mr. Fairbairn had not adopted the division proposed by Miers into *Solanaceæ* and *Atropaceæ,* orders which were distinguished by æstivation and other botanical characters, as well as by their physiological properties. He did not consider that any correct evidence had been adduced of the narcotic properties of the species of *Solanum.* The infusion of *S. Dulcamara* could be given in large quantities without producing any narcotic effects, and its berries had been used as a preserve. The effects of the plants belonging to the order *Atropaceæ* did not develope themselves like those of opium; they were more of a stimulant character and were slowly produced, and they were accompanied with marked enlargement of the pupil.

5. "Illustrations of the value of Botanical Histology to the Medical Student and Practitioner," by Dr. Lindsay, Assistant Physician to the Crichton Royal Institution, Dumfries. The author stated that the origin of this paper was due to the fact that there existed among the medical students of the Edinburgh University, a strong feeling that they are compelled by the Curriculum-regulations to learn too much of the collateral sciences of natural history, chemistry and botany,—botany being, in particular, a science, the knowledge of which is regarded as quite unnecessary for the practice of their profession. The idea that the study of the scientific or theoretical disqualifies to a certain extent from the acquirement of practical knowledge is a fatal error, and he believed that every Professor of the University could bear testimony to the fact that those students who had distinguished themselves in one department of their Academic curriculum generally did so equally in every other. Dr. Lindsay's object in this communication was merely to lay before such sceptics the results of the short experience of one but lately a *student*—of one who had been at the same time a scientific and a "practical man,"

and to point out more especially by a few illustrations the value of microscopical botany to the general practitioner.

March 9, 1854.—Professor Balfour, President, in the Chair.

The following papers were read, viz.:—

1. "On the Pollen of *Zamia horrida*," by J. H. Balfour, M.D. The pollen is in its ordinary condition elliptical, with a groove in one side, resembling very much a grain of wheat in appearance. The groove is formed by the folding inwards of the edges of the pollen-grain, which when fully expanded under the action of water becomes completely spherical. When water is applied under the microscope, the two edges of the groove are seen to unfold and spread out so as to produce the circular grain; when allowed to dry, the grain resumes the elliptical grooved condition. It is perhaps difficult to say whether the elliptical or the spherical form is to be looked upon as the characteristic one; the elliptical being the dry state of the pollen, while the spherical is the moist condition. The true structure is rendered more apparent by an application of iodine. The pollen of Cycads is stated by many to be angular. This is not the form in *Zamia horrida*.

2. "Notice of the Muscology of the East Coast of Fife," by the Rev. Thomas Brown. The author offered some observations on the distribution of Mosses on the east coast of Scotland, with reference more particularly to such stations as the Sands of Barrie, the Tents Muir, Elie and Gullane Links, which although all situated close to the sea-shore, presented several alpine species. He enumerated the Mosses found by him in the neighbourhood of Elie, which included a variety of *Mnium affine* not previously found in fruit in Britain, *Bryum dealbatum, Hypnum abietinum, Encalypta rhaptocarpa, Didymodon inclinatum*, and other unusual species.

3. "Note on the supposed Antheridia of the *Rhamneæ*," by J. S. B. Sanderson, M.D. A careful examination of the buds of various species of *Rhamnus*, particularly of *R. catharticus*, led the author to believe that the club-shaped organs described by Grisebach differed from the antheridia in not being developed from a single special mother-cell, in not possessing a central cavity at any period of their growth, and in containing a resinous secretion. He could not detect the "long-tailed globules enclosed in minute spherical cells," observed by Grisebach to oscillate in a very lively manner.

4. "Register of the Flowering of certain hardy plants in the Royal Botanic Garden from 9th February to 7th March, 1854," by Mr. James M'Nab.

5. "On the Anatomical Structure of Coniferæ and other Gymnogens," by Mr. G. Lawson. The author remarked that the structure and development of the wood-cell had been well elucidated by Hugo von Mohl in various papers in the 'Annales des Sciences Naturelles,' and in his work on 'The Vegetable Cell,' but there was one aspect in which the subject had not been so fully viewed as appeared desirable. Mr. Lawson's examinations had been undertaken principally for the purpose of ascertaining in how far the peculiarities in the minute

anatomy of the Coniferæ coincided with their general structure, and might be depended upon in the determination of their orders, genera and species,—an inquiry from which fossil botany and investigations relative to timber were likely to derive advantage. After detailing the general structure of the wood-cells of Coniferæ, and pointing out peculiarities that occurred in various plants of the order, he described a remarkable modification which had been noticed in the Yew, viz. the presence in the wood-cell of what appeared to be a spiral fibre, but which had been shown by Harting to be a connected pellicle with thickened ridges arranged in a spiral manner. Mr. Lawson had found this structure to be by no means so rare as had been supposed, and although principally confined to plants belonging to Taxaceæ, it was stated not to be universal in that order, nor peculiar to it. He had observed it in the following plants:—*Cephalotaxus Fortuni, C. pedunculata, C. tardiva, Torreya taxifolia, T. nucifera, Taxus baccata, T. canadensis, Podocarpus japonica, P. koraiana, Abies Douglasii, Fitzroya patagonica.* It also occurred in a specimen of pine wood from Upper California, which presented interesting microscopical characters, but which he had been unable as yet to identify. This structure was not to be confounded with the faint spiral streaks seen under a high power on the secondary membrane of the wood-cells of many Coniferæ. It had been long a question whether true punctated tissue was strictly confined to Gymnogens. A careful examination of *Drimys granatensis* and other plants had led him to believe that the disks which occurred in aromatic trees were essentially the same as those of Coniferæ, and indeed accorded in a remarkable manner with those of many Araucariæ and Taxaceæ, in which the central dot was not circular, but formed by two elliptical slits crossing each other. The manner in which this appearance arose was fully explained by a reference to the spiral arrangement of the slits, which also seemed to account for the alternation of the disks in *Araucaria*. In the determination of fossil plants and of unknown timbers, Mr. Lawson believed that valuable characters were afforded by the peculiarities of the wood-cell, such as its general size, presence or absence of a spiral tertiary membrane, arrangement of disks (alternate or opposite), their distance from each other in different directions, and whether in single, double, treble, or quadruple rows on each cell; absolute size of the disc, and its breadth as compared with that of the cell; form of disc, whether circular, elliptical or angular, or a combination of these forms; form of central dot, and (if not circular) direction of the same. The cells of the medullary rays, and the pits in connection with them also afforded useful marks of distinction. By aid of the above characters, to which many more might be added, he had been able to mark distinctions between timbers whose appearances to the naked eye presented no definite characters. It was of great importance, however, in adopting such distinctions, that we should also retain the other means of investigation we possess, and his present attempt was meant not to displace, but to supplement these. He is still engaged in the prosecution of the subject, and expressed an anxiety to obtain additional specimens for examination. Specimens of the timber of *Wellingtonia gigantea* presented under the microscope a double row of opposite disks, which, as well as their central dot, were elliptical.

6. "On *Ophioglossum lusitanicum*, Linnæus," by Thomas Moore, F.L.S. The author remarked that the discovery of the *Ophioglossum lusitanicum*, L., within the politico-geographical limits of Great Britain, so soon after that of the *Gymnogramma leptophylla*, another S. European fern, is a fact of much interest; and thought that a short account of the plant drawn up from fresh Guernsey specimens might be of some interest to those who are studying either our native Ferns or our native flora.

MISCELLANEOUS.

Note on the Vegetation of Mount Argæus in Cappadocia. By M. P. de Tchihatcheff.

As Mount Argæus, of which I have ascertained the height to be 3841 metres above the level of the sea, consists of a certain number of *plateaux*, forming so many terraces arranged one above another, with intervening slopes of greater or less abruptness, the study of the most characteristic vegetable forms of these *plateaux* may furnish an approximative idea of the vegetable physiognomy of the giant of Asia Minor, which had not been visited by any botanist until I ascended it in August 1848. Amongst these *plateaux*, of which I have indicated the respective positions in my work on the 'Géographie physique de l'Asie Mineure,' the most considerable are, that of Tékir, situated on the eastern side of the mountain, at an altitude of 2128 metres, and the three *plateaux* arranged in steps on its southern face, by which one ascends from the plain of Everek to the summit of the mountain. These plateaux may be designated by the following names, rising from the bottom upwards: the basaltic plateau, placed immediately above the plain of Everek, which constitutes the southern foot of the mountain; the lower plateau; and lastly, the upper plateau, which leads to the central cone, crowned by the crater, which is surrounded on the south side by a barrier of inaccessible trachytic rocks.

The great number of limpid streams which water the surface of the Tékir plateau, maintain a pretty good vegetation in that locality. Amongst the plants in flower on the 17th of August, I observed, *Oxyria reniformis*, R. Br. sp., *Carduo deflorato* aff., L., *Podospermum intermedium*, *Solidago Virgaurea*, L., *Chamæmelum oreades*, Boiss., *Helichrysum globiferum*, Boiss., *Andrachne telephioïdes*, L., *Lamium armenium*, Boiss., *Silene argæa*, n. sp., *Phyteuma linifolium*, Boiss., *Pulsatilla albana*, Stev., *Sibbaldia parvifolia*, Willd., &c.; as well as some species of *Asperula*, *Odontites* and *Androsace*, which were less characteristic.

The basaltic plateau, the dry poor soil of which is strewed with blocks of stone and pierced by projecting rocks, is only covered with vegetation in isolated spots: I found in flower, *Plumbago europæa*, *Anchusa officinalis*, L., variety *angustifolia*, *Potentillæ argenteæ* affinis, *Rosa*, n. sp., *Coronilla glauca*, &c.: the most characteristic features of the plateau, however, were *Quercus nana*, *Populus græca* (both in the shrubby state), a great number of *Euphorbiaceæ*, *Erigeron alpinum*, *Astragalus aureus*, and the *Verbascum olympicum*, Boiss.; the latter plant scarcely attains a height of 40 centimetres in this locality.

The lower plateau has scarcely any characteristic forms. In proportion as we ascend the steep declivity which leads from the lower to the upper plateau, the *Quercus nana* gradually disappears, and is replaced by the *Juniperus nana*, which continues to grow a little above the upper plateau, so that the limit of shrubby vegetation may be fixed (at least on the southern exposure of the mountain) at an absolute height of about 2600 metres, and consequently 137 metres above the upper plateau, the elevation of which is 2463 metres. The surface of the latter is covered with immense quantities of *Verbascum chrysorrhœos*, Boiss. It was here that I observed for the first time the *Jurinea depressa*, Mey., a plant much sought for by the Turks on account of the musky odour which it exhales, and which has obtained for it in the neighbouring country the name of *Muskgulé* (musk-rose). This fine and rare Composite plant had already (18th of August) passed its period of flowering, and I had much trouble in discovering and collecting a few good specimens. The lower limit of the *Jurinea depressa* is consequently 2463 metres; its upper limit probably attains 2700 to 2800 metres. Associated with this plant were *Daphne buxifolia*, Wahl., *Silene argæa*, n. sp., *Thymus angustifolius*, *Ziziphora nummularia*, n. sp., *Satureia argæa*, n. sp., *Hieracium pannosum*, Boiss., *Morina persica*, *Astragalus aureus*, *Potentilla argentea*, &c. Of these plants, the *Daphne*, *Astragalus*, *Potentilla*, *Silene* and *Thymus* descend below 2463 metres, whilst the *Ziziphora*, *Satureia* and *Hieracium* keep at this altitude, or even occasionally rise still higher. The *Hieracium pannosum* attains, if not the zone of perpetual snows, at least a region where these descend frequently, as was the case when I was there; its stem usually attains a height of 30 centimetres; all parts of the plant, but especially the large radical leaves, are covered with white woolly hairs to such an extent, that, when seen at a certain distance, the solitary heads, bristling with a close pappus, appear like so many balls of snow.

In ascending the precipitous side of the central cone, which rises immediately from the upper plateau, a tolerably fine vegetation is met with to an elevation of 3005 metres. On this space, that is to say, between 2463 and 3005 metres, I observed *Jurinea depressa*, Mey., var. *sulphurea*, *Astragalus nummularius*, Lam., *Astr. chianophilus*, and two other species of *Astragalus*; a *Cotyledon*, an *Evax*, and an *Arenaria*, which have not been determined; *Sibbaldia parvifolia*, Willd., *Polygonum alpinum*, L., *Cystopteris fragilis*, Bernh., *Myosotis palustris*, *Silene argæa*, n. sp., *Sedum olympicum*, Boiss., *Veronica fruticulosa*, L., *Alopecurus vaginatus*, Pall., *Alsine recurva*, *Solidago Virgaurea*, *Podospermum intermedium*, &c. Of these plants, *Silene* *argæa, Alsine recurva, Solidago Virgaurea* and *Podospermum intermedium* rise above 3005 metres, for I found them in the fissures of the abrupt rocks which pierce through the incline of the central cone and reach the most elevated region. On this naked slope, covered with loose cinders and with scattered bands of snow, the four last-mentioned plants are found associated with *Euphorbia nicæensis*, All., *Scrophularia olympica*, Boiss., *Pyrethrum Kotschii*, Boiss., and some species of *Chamæmelum*, *Saxifraga* and *Erigeron*, which have not been determined; thus, without counting the latter, the seven species just referred to are the representatives of the highest regions of Mount Argæus, as they all attain an altitude of 3841 metres. It is interesting to observe in this number the *Euphorbia nicæensis* and the *Solidago Virgaurea*, which I am in the habit of seeing so frequently in my garden in the plain of Nice. These plants, of which the horizontal development is so great, have consequently also a vertical development of 3841 metres, flourishing indifferently in the neighbourhood of the eternal snows, and beside the date-palm, the *Opuntia* and the *Agave*.—*Comptes Rendus*, 23rd January, 1854.

On certain Statements contained in Dr. T. Williams' Papers on the Respiratory Organs of the Articulata.

To the Editors of the Annals of Natural History.

Gentlemen, London, March 6, 1854.

I have observed with surprise and regret such a mass of erroneous statements in the papers now publishing in the 'Annals' on the Respiratory Organs of the Articulata, by Dr. T. Williams, that I write at once to say, that, at a future period, at my earliest convenience after Dr. Williams has completed his remarks on the subject of the Blood and the Respiratory Structures, I shall feel myself called upon to beg for space in your Journal to attempt to remedy the injury which these errors are likely to inflict on science by their promulgation. I hasten to inform you of this least it should be supposed that I assent to these statements.

I am, Gentlemen,
Yours very obediently,
George Newport.

ON THE GENERA VOLUTELLA AND CYMBIOLA.

It was formerly considered that the chief distinction between *Voluta* and *Marginella* of Lamarck was, that one had the shell exposed, and the other covered by the expanded and reflexed lobes of the mantle. M. D'Orbigny, in his work on the Mollusca of South America, figured the animal of *Voluta angulata*, and showed that that species had the mantle lobes expanded and partly covering in the shell; on this character it has been formed into a genus under the name of *Volutella*, for it differs from *Marginella* in having the expanded cephalic veil of other true *Volutes*. A very fine specimen of *Voluta papillosa* having lately passed under my examination, I was struck with the fact that it also showed, from the peculiar enamel coat on the whorls and outer edges of the outer lip, that its mantle must also have been similarly expanded; though this character had hitherto escaped notice from the shells having been cleaned,—this peculiar coat, the great beauty and character of the shell, having been destroyed. This led me to examine carefully the other species of the family, and it is now clear that several species of the Volutes have the same character. They may be divided thus:—

* Mantle lobes largely expanded and entirely covering the spire, which is often entirely hidden by a shell-deposit.

1. *Volutella angulata.*

** Mantle lobes moderately expanded, covering the lower side of the spire, and leaving a callous band on the suture of the other part.

2. *Volutella Scapha.* 3. *Volutella imperialis.* 4. *Volutella cymbiola.* 5. *Volutella Sophia.* 6. *Volutella volvacea*; and perhaps 7. *Voluta tuberculata*, Swainson.

*** The mantle lobes moderately expanded, not covering the spire, the suture of the spire simple.

8. *Volutella papillosa.* 9. *Volutella fulgetrum.* 10. *Volutella ancilla.* 11. *Volutella fusiformis.*

The genus *Cymbiola*, which differs from *Voluta* in having simple conical teeth, as described in a former number of this Journal, is peculiar for having a narrow callous band round the suture, showing that the hinder part of the mantle is expanded, as may be observed in *Cymbiola undulata*, *C. reticulata*, *C. maculata*, *C. pallida*, *C. Turneri*, *C. zebra*, and *C. lineata*: the two latter have been referred to the genus *Marginella*, but they are perfectly distinct from it.

J. E. Gray.

Observations on Notamia bursaria. By G. H. Kingsley, M.D.

To the Editors of the Annals of Natural History.

August 4, 1852.

Gentlemen,—I found several tiny specimens of *Notamia bursaria* today, about low-water mark, off Harriet Lodge, West Cowes, attached to pieces of seaweed and decaying wood.

The water was as usual very foul and the specimens exceedingly dirty, so much so, that they might easily have been overlooked without the aid of the microscope. Under a good ½-inch glass, however, the beautiful pearly lustre of the general polypidom, the exquisitely graceful shape of the individual cells, and the activity of the polypes in the few cells occupied by living tenants, soon gave interest to the minute and exceedingly dirty zoophyte.

The polypes resembled in general features the others of their class: the tentacles, now grasping and ciliated—the alimentary canal, curved on itself, packing so closely and cleverly into its cell—the well-defined stomach, with its contents whirling swiftly round and round, possibly by the agency of cilia—the distinct muscular apparatus for the retraction of the polype—the delicate membrane continuous between it and its protecting envelope—and moreover the *very liver-like* appendages to the stomach, presented no especial peculiarities differing from other Bryozoa.

But whilst watching the polypes gently and cautiously emerging from their cells, like the lady from the gold vase in Hoffmann's 'Goldenen Topf,' and suddenly and swiftly retreating when the currents formed by their ciliated tentacula brought morsels, grateful or otherwise, within their lips, or when their expanding arms touched those of a neighbour (for, as is unfortunately the case with other beings when forced into close companionship with others having the same personal interests, they seemed to fear and dislike each other most cordially),—the eye was startled by an occasional sudden *snap*, as sharp and decisive as the descent of the hammer when the trigger is touched,—a little out of focus, and proceeding from the bulbous termination of a slender tube which arose from the central stem just above the vase-like cell in which the polype lived.

On examining more closely (with a good $\frac{1}{4}$-inch object-glass), one saw that this bulbous termination—this bowl of the tobacco-pipe—possessed a pair of jaws—no, not jaws, but a bill, an inverted parrot's-bill; the lower mandible sharp, hooked, and firmly fitted onto the edge of the bowl, with a process running down its external convex border, and the upper slender, curved, moveable, fitting accurately into the lower one, attached to the bowl by an exquisitely formed flexible membranous hinge, acted on by a distinct fan-shaped muscle, whose expanded origin was attached to the greater part of the inner surface of the bowl, and whose tendon was inserted into the slightly inflated base of the mandible.

The action of this muscle was seen very distinctly at each opening or shutting of the beak.

Both mandibles were of a distinct, bluish, *steely* gray, sharp and keen, looking fit for their business (whatever it was).

The only thing I have ever seen at all like it is the 'parrot-beak' of a Mediterranean Cephalopod which resembles it very strikingly.

The upper beak may be often seen to move up and down two or three times before it closes entirely, which it generally does sharply and with a sort of *snap*, so decisive that one almost fancies that one can *hear it*. At the same time the globular contents of the bowl are jerked sharply upwards.

Within the bowl and behind the fan-shaped muscle, or perhaps *between the two fan-shaped muscles*, was seen indistinctly an irregularly globular mass, which was thrown into active motion whenever the jaw closed.

I never could trace any communication between the tobacco-pipe apparatus and the lower larger polype-cell, or the central stem. Indeed the '*bowl*' seemed to be distinctly separated from the '*shank*' by a *septum*. I could never trace fluid or globules passing down the shank to the common stem of the polypidom.

The polype and the tobacco-pipe seemed perfectly independent of each other. I found active polypes without accompanying tobacco-pipes, and very often tobacco-pipes in full snap, with the inhabitants of the capacious drawing-room floors beneath dead and gone, their cells swept and garnished, tenanted only by some vagabond Solifer, and possessing no signs of their former inhabitants, beyond a few of the brown liver-like spots adhering to their transparent walls.

I never could make out *why* the tobacco-pipe opened his mouth, or why he shut it, although the jerking movement of the globular *stomach* (?) would make one believe that he did so to some purpose. I once saw a small Navicula evidently pinched tightly by the beak of a tobacco-pipe, which in a few seconds opened and let him escape, whereupon having been saved from this Scylla he plunged incontinently into the Charybdis of the polype below, and in a short time was whirling round and round on his long axis in its stomach. I watched it for some time, and it certainly appeared to me as if he (or *it*) was being ground down or *sucked* out in some manner, as he went in of a strong burnt sienna colour, and gradually became nearly transparent. I was unfortunately prevented from seeing his exit.

These tobacco-pipe appendages *bud* out from the central stem at its free extremity at the same time with the larger polype-cells, but appear to arrive at maturity later than these, remaining as mere inflections of the tube, without jaws, for some time after the cell below is tenanted by an active polype.

The large polype seems to bud out from the central stem into the cell prepared for it, and at first has a very simple and hydroid appearance, but rapidly gains all the functions of its elder brethren.

I never found any appearance of egg-capsules on any of my specimens.

[We have inserted the above as a clever piece of Natural History description,—but the "tobacco-pipes" have long since been fully described by Van Beneden, Busk, &c. as 'Avicularia.'—Ed.]

Description of a new species of Helix *from Van Diemen's Land.* By Lovell Reeve, F.L.S. &c.

Helix Launcestonensis. *Hel. testâ umbilicatâ, abbreviato-conoideâ, trochiformi, supernè rugosâ et ferrugineâ, quasi epidermide indutâ, infra lævigatâ, nitente, intensè nigrâ; fasciâ distinctâ luteâ cingulatâ; spirâ obtusâ; anfractibus sex, supernè convexis, medio concavis, carinis lineisque gemmulatis undique cingulatis, peripheriâ acutè carinatâ, basi convexâ; umbilico mediocri, pervio, subprofundo; aperturâ obliquè lunari, peristomate tenui, vix reflexo, margine columellari breviter dilatato.*

Hab. Launceston, Van Diemen's Land.

This very characteristic new species of *Helix* has just been received from Van Diemen's Land, where it was collected last summer by Mr. Ronald Gunn in a dense beech forest, north-east of Launceston.

It differs materially from any of the vast numbers of *Helices* now known to conchologists, especially in the different character of the upper and lower parts of the shell. The upper portion of the whorls has a rough rusty surface encircled by numerous finely beaded lines and keels; the lower surface is smooth and shining, jet-black, encircled by a distinct yellow band.—*Proc. Zool. Soc.* Feb. 24, 1852.

On the Colours of Plants. By M. Martens.

At the close of a long memoir on this subject, the author gives the following summary of his results:—

1. The only two fundamental or primitive colours in plants are blue and yellow, or in other words *anthocyane* and *anthoxanthine*.

2. These primitive colouring matters are formed under the vital influence, not only in the petaloid, but also in the herbaceous portions; in the latter they are most frequently associated together and with other organic matters, thus forming the insoluble green *chlorophylle*.

3. Chlorophylle always has a tendency to become yellow in plants in consequence of the great alterability of the blue colouring principle, unless the latter has been rendered more stable by union with an acid which reddens it. In this case the leaf, instead of acquiring a yellow colour by the alteration of the chlorophylle, becomes red.

4. The red colour of leaves is not always the result of the presence of an acid, whether by the action of this upon the blue or upon the yellow colouring principle of the leaves. The red matter of the leaves, the so-called *erythrophylle*, may also arise from the oxygenation of the yellow principle or *xanthophylle*.

5. The blue and yellow colouring matters, especially the former, being often, when isolated, in a liquid state, must be carried in this case by aqueous transpiration towards the surface of the plant, by which means they must become deeper in colour, or more concentrated, in the cells which lie immediately under the epidermis, where they are constantly met with, and where they may also be subjected to the action of oxygen.

6. Although the coloured juices usually exist in the most superficial layers of cells, in which the chlorophylle is scanty, they may nevertheless arrive there from more internal cells by the action of endosmose and exosmose.

7. In proportion as the blue, yellow or red colouring juices appear in the cells of the herbaceous parts, the quantity of chlorophylle diminishes; it may even disappear entirely when the petaloid coloration becomes very intense, as in the red cabbage.

8. Chlorophylle, being capable by its decomposition of giving rise to blue and yellow matters, may assist indirectly in the formation of the colours of flowers as well as of coloured leaves.

9. The colours of flowers can only change according to the variations of which the blue and yellow are capable. Now blue is able to pass to red by means of acids, and also to present all the colours

resulting from the mixture of blue and red, whence is obtained a series of shades or colours, called the *cyanic series*.

10. The yellow colouring matter being capable of reddening by oxygenation, and also by acids (as in the yellowish juice of some cells of the leaves of red cabbage), yellow flowers may pass to red, and also present all the shades intervening between these colours; these colours constitute the *xanthic series*.

11. The red colour of the two series is far from being the same, not only as to its origin, but also as to the variations of tint which it may undergo. That of the xanthic series is less common in leaves than in flowers. The contrary is the rule for the red of the cyanic series.

12. The two kinds of red, like the two fundamental colours, are sometimes united in the same flower, which may then present every imaginable variety of colour. — *Bulletins de l'Acad. Royale de Bruxelles*, xx. pt. 1. p. 232.

METEOROLOGICAL OBSERVATIONS FOR FEB. 1854.

Chiswick.—February 1. Cloudy: rain. 2. Overcast: clear, with bright sun: frosty. 3. Frosty: dense fog. 4. Frosty: very fine: overcast. 5. Clear: cloudy. 6. Fine. 7. Cloudy: clear at night. 8. Clear: cold and dry: overcast. 9. Cloudy: rain. 10. Clear and frosty: cloudy and cold: clear. 11. Cloudy and fine: hazy. 12. Foggy: clear and fine. 13. Frosty: cold and dry: clear, with sharp frost at night. 14. Sharp frost: fine. 15. Overcast. 16. Cloudy: clear: overcast. 17. Cloudy. 18. Drifting snow: clear and cold: boisterous at night. 19. Clear and cold. 20. Overcast. 21. Clear and fine. 22. Fine: cloudy. 23. Clear. 24. Cloudy. 25, 26. Very clear. 27. Uniformly overcast: clear: overcast. 28. Fine.

Mean temperature of the month	37°·67
Mean temperature of February 1853	32 ·53
Mean temperature of Feb. for the last twenty-eight years	39 ·13
Average amount of rain in Feb.	1·57 inch.

Boston.—Feb. 1. Cloudy. 2—4. Fine. 5—9. Cloudy. 10. Fine: snow A.M. 11. Cloudy. 12. Fine. 13. Cloudy. 14. Fine. 15, 16. Cloudy. 17. Cloudy: rain P.M. 18. Cloudy: stormy. 19. Fine. 20. Cloudy: rain A.M. and P.M. 21. Fine. 22. Fine: rain P.M. 23—26. Fine. 27, 28. Cloudy.

Sandwick Manse, Orkney.—Feb. 1. Showers A.M.: clear P.M. 2. Showers A.M. and P.M. 3. Cloudy A.M.: cloudy, aurora P.M. 4. Cloudy A.M. and P.M. 5. Sleet-showers A.M.: showers P.M. 6. Showers A.M. and P.M. 7. Sleet-showers A.M.: hail-showers P.M. 8. Hail-showers A.M. and P.M. 9. Snow-showers A.M.: clear P.M. 10. Cloudy A.M. and P.M. 11. Drizzle A.M.: cloudy P.M. 12. Cloudy A.M. and P.M. 13, 14. Drizzle A.M. and P.M. 15. Hail-showers A.M. and P.M. 16. Drizzle A.M. and P.M. 17. Snow-showers A.M. and P.M. 18. Snow-showers A.M.: hail-showers P.M. 19. Cloudy A.M. and P.M. 20. Showers A.M.: clear P.M. 21. Bright A.M.: cloudy P.M. 22. Drizzle A.M.: showers P.M. 23. Snow-showers A.M.: hail-showers P.M. 24. Showers A.M.: showers, aurora P.M. 25. Showers A.M.: aurora P.M. 26. Cloudy A.M. and P.M. 27. Rain A.M. and P.M. 28. Sleet-showers A.M.: showers P.M.

Mean temperature of Feb. for twenty-seven previous years	38°·20
Mean temperature of this month	39 ·20
Mean temperature of Feb. 1853	33 ·74
Average quantity of rain in Feb. for thirteen previous years	3·33 inches.

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.
1854. Feb.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·960	29·939	29·50	29·62	29·77	53	35	46	37	38½	sw.	sw.	wsw.	·42	....	·30
2.	30·274	30·119	29·86	29·95	30·03	44	22	33	41	45	ne.	calm	sw.	....	....	·14
3.	30·327	30·241	30·05	30·17	30·14	33	21	28	45	43	ne.	calm	s.	....	....	·06
☽ 4.	30·071	29·833	29·84	29·68	29·22	45	35	28·5	40	40	se.	se.	se.	·10	....	....
5.	29·937	29·869	29·60	29·38	29·06	44	40	34	39	48½	sw.	w.	sw.	....	....	·12
6.	30·081	30·081	29·58	29·32	29·29	56	50	51	44	41	w.	w.	w.	....	....	·24
7.	30·061	30·031	29·66	29·40	29·37	54	35	46	36	35	sw.	w.	w.	....	....	·33
8.	30·172	30·103	29·75	29·53	29·83	45	38	36	35½	35	nw.	w.	nw.	....	....	·24
9.	30·129	30·002	29·70	30·04	30·33	45	30	43	37	36½	nw.	nw.	nw.	·04	....	·12
10.	30·263	30·237	30·00	30·37	30·32	42	32	33	38	38	n.	nw.	sw.	·04	·02	·02
11.	30·273	30·185	30·00	30·10	30·15	40	26	34	38	30½	n.	nw.	nnw.	....	....	·07
12.	30·286	30·157	29·94	30·22	30·32	41	26	26	39	31	ne.	n.	w.	....	....	·09
○ 13.	30·611	30·502	30·24	30·36	30·30	38	17	35	44½	35	e.	nw.	w.	....	....	·11
14.	30·632	30·342	30·28	29·95	29·62	43	30	30	45	30½	sw.	w.	wnw.	·06	....	·13
15.	29·980	29·926	29·66	29·95	29·94	44	29	28	31½	32	ne.	nw.	nw.	....	....	·04
16.	30·025	30·005	29·76	29·66	29·34	42	34	33	37½	44	n.	nw.	nw.	....	....	·13
17.	29·769	29·404	29·35	28·89	28·84	48	26	43	34	29	sw.	w.	nw.	....	....	·19
18.	29·735	29·485	29·16	29·37	29·81	40	27	33	33½	35	nw.	n.	nw.	·08	·03	·07
19.	29·959	29·894	29·68	29·85	29·58	40	25	31	37½	39	n.	w.	sw.	....	....	·05
☾ 20.	30·296	29·908	29·63	29·54	29·96	52	28	38	42½	40½	w.	wsw.	w.	·02	·02	·08
21.	30·263	29·722	30·00	30·03	29·68	49	25	32·5	42	46½	ne.	n.	s.	....	·15	·02
22.	30·247	29·947	29·87	29·48	29·61	47	33	36	46½	39	sw.	ssw.	w.	·06	....	·23
23.	30·612	30·307	30·00	29·93	30·06	49	24	37	40	42	n.	w.	sw.	....	·06	·28
24.	30·502	30·291	30·06	29·46	29·62	47	35	36	48½	38	sw.	wsw.	w.	....	....	·14
25.	30·470	30·395	30·00	29·86	30·30	51	25	41	39½	35	nw.	w.	wnw.	....	....	·22
26.	30·543	30·475	30·20	30·35	29·97	50	23	35	40	43½	n.	n.	sw.	....	....	....
● 27.	30·415	30·321	30·00	29·75	29·69	53	32	40·5	36½	43	w.	wsw.	w.	....	....	·30
28.	30·517	30·285	29·90	29·85	30·04	53	19	44	30	44½	nw.	w.	w.	....	....	·38
Mean.	30·300	30·071	29·83	29·787	29·792	46·00	29·35	36·1	39·94	38·51				0·82	0·28	4·10

THE ANNALS

AND

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[SECOND SERIES.]

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XXX.—*A Synopsis of the Fissirostral family* Bucconidæ. By Philip Lutley Sclater, M.A., F.Z.S.

Though Brisson (to whose exact descriptions the greater part of the species of birds contained in the last edition of the 'Systema Naturæ' are referred) gives several members of his genus *Bucco*, Linnæus adopted but one of them, founded on the bird denominated '*Bucco*' *par excellence* by the former author, and to which the latter added the erroneous specific term *capensis*. This *Bucco capensis* therefore—however far in accordance with the views of modern systematists we subdivide the family to which it belongs—in whatever way we arrange the birds with which others have associated it—must always be retained as the type species of the Linnæan genus *Bucco*.

Gmelin and Latham made large additions to Linnæus's solitary species, uniting, as Brisson did before them, in *their* genus *Bucco* members of two very different families—that is, of the present fissirostral true *Bucconidæ*, and of the scansorial family *Capitonidæ*, between which and the *Bucconidæ* there has been continual confusion even up to the present day.

Cuvier in his 'Tableau Elémentaire d'Histoire Naturelle' (1798–99), was the first to recognise the necessity of a separation between the *Barbus* of the old world and those of the new. For the former scansorial group he suggested the restriction of the French term *Barbu*, and proposed the name *Tamatia* for the new world *B. capensis* and its allies. Here we have the first traces of the *heresy* afterwards so widely spread, of using the Linnæan title *Bucco* for a group of birds with which Linnæus himself was perfectly unacquainted.

In 1806 Le Vaillant published the second volume of his magnificent work the 'Histoire Naturelle des Oiseaux de Paradis,' which contains a monograph of the *Barbus*. These he divides into three sections :—

1. Barbus proprement dits (i. e. *Capitonidæ*).
2. —— Tamatias (i. e. *Bucco*, Linn.) } (*Bucconidæ.*)
3. —— Barbacous (i. e. *Monasa*, V.) }

In the correctness of these divisions we see how far in advance Le Vaillant was of preceding authors, and have to lament that from his having used only French terms in his writings, others, who merely latinized his names, have obtained the credit of being the authors of many scientific discoveries which are rightly due to him alone.

Neither Illiger nor Vieillot kept clearly apart the *Bucconidæ* and *Capitonidæ*, though the latter in his 'Analyse' (1816) first formed the important genera *Monasa* for Le Vaillant's *Barbacous*, and *Capito* (with the type *B. cayanensis*), from which (as the earliest proposed genus in the family) the *Capitonidæ* take their name.

Temminck however employed *Capito* for the fissirostral *Bucconidæ*, and *Bucco* for a genus of *Capitonidæ*, exactly reversing the correct use of these two names. His example was followed by Wagler, Swainson, and other writers. Wagler in his 'Systema Avium,' 1827, gives an excellent monograph of the two genera *Bucco* and *Monasa*, under the titles *Capito* and *Lypornix*. He includes 14 species in these genera; Le Vaillant in 1806 had given only 7; we are now acquainted with more than 30, an illustration of the rapid progress lately made in the extension of the number of species of birds.

To Mr. G. R. Gray is due the credit of proposing to restore to the present family the Linnæan appellation *Bucco*; correcting in this, as in many other instances, the inaccurate practice of using generic names in different senses to those originally attached to them by their first founders. In his 'Genera of Birds' he makes the present group the first subfamily of *Alcedinidæ*, under the title *Bucconinæ*, or Puff-birds. The scansorial *Buccones* of Temminck and others he places under the term *Capitoninæ*, or Barbets, as the first subfamily of *Picidæ*. The only alteration I venture to suggest to this arrangement is to raise both these groups to the rank of families, retaining them respectively among the *Fissirostres* and *Scansores*, in the places assigned to them by Mr. Gray. The peculiar structure of the feet and eccentric habits of the Puff-birds are, I think, sufficient to warrant our doing this in their case, and what we know of the mode of life of the Barbets seems also to favour the idea of their being constituted a distinct family of *Scansores**.

* Mr. Wallace tells me that the *Capito amazoninus* (?) observed by him at Guia, on the Rio Negro, feeds on fruit, and seems like a little Toucan in its habits.

I have thought it necessary to make the preceding remarks in order to vindicate the usage of the name *Bucconidæ* for the present family; the Prince of Canino having in his 'Conspectus Generum Avium,' notwithstanding Mr. G. R. Gray's before-mentioned corrections, continued the terms *Bucco* and *Capito* in their respectively perverted senses,—precisely the opposite to those assigned to them by their original propounders.

The members of the family *Bucconidæ* are inhabitants of the most tropical portion of the new world, ranging from about 15° N.L. to 30° south of the equator, and not passing the ridge of the Andes as far as I am aware.

The generic divisions hitherto established among the *Bucconidæ* and their types are as follows:—

Bucco, Linn.
B. collaris, Lath.
Tamatia, Cuv.
T. macrorhyncha (Gm.).
Chaunornis, G. R. Gray.
C. tamatia (Gm.).
Cyphos, Spix.
C. macrodactylus, Spix.

Malacoptila, G. R. Gray.
M. fusca (Gm.).
Nonnula, Sclater.
N. rubecula (Spix).

Monasa, Vieill. (Lypornix, Wagl. Scotocharis, Gloger. Monastes, Nitzsch.)
M. atra (Bodd.).

Chelidoptera, Gould. (Brachypetes, Sw.)
C. tenebrosa (Pall.).

Of these divisions I propose to adopt only four, namely *Bucco*, *Malacoptila*, *Monasa*, and *Chelidoptera*, as truly generic; the others may be placed at the head of different subsections to mark out slighter differences, in the manner adopted by Mr. G. R. Gray in his recently published Catalogues of the British Museum.

In the first genus, *Bucco*, with fifteen species, the gonys is always curved upwards from the base towards the apex; the upper mandible, which is strongly hooked over the under, is deeply channelled in the interior, and often bifid at the extremity. The plumage is black and white, varied with brown, and generally with bars or spots upon the breast. In the first sections of the genus the bill is excessively dilated laterally at the base; in the latter section in several species, on the other hand, much compressed.

In the next genus, *Malacoptila*, the gonys is nearly straight, with a slight curve downwards at the extremity. The upper mandible is gradually curved into a point over the under, and has not the fierce hook observable in the former genus. I am acquainted with eleven species of this genus: the additional one here given (the *inornata* of Du Bus) may possibly be the same as one of the others. The plumage is generally brown, more or less striated with lighter shades, and frequently with a gular or super-pectoral uniform patch. The rictal and mental bristles are strong and largely developed, the latter forming a striking character in several species.

The third genus, *Monasa*, with four species at present known, contains the largest birds in the family. The plumage is dull lead-coloured or blackish, the bill bright red or yellow. The upper and under mandibles are regularly curved downwards. The tail is much lengthened. The spiny processes at the carpal joint, which are present, I believe, all through this family, are principally noticeable (as being most developed) in the genus *Monasa*.

In the fourth and last genus, *Chelidoptera*, the wings are much longer than in the preceding genera, and are evidently formed for rapid flight. The tail is quite short and nearly square. The plumage is *Monasa*-like, but relieved by a brown patch on the belly.

I may observe that I have worked into the present synopsis all the synonyms I have been able to discover as having been applied to members of the present family, except one, to wit *Capito senilis*, Tschudi, Av. Consp. 301, et Fauna Per. p. 259, founded on *Bucco senilis*, Pöppig, a MS. name in the Leipsic Museum. As no description has ever been published of this species, the name is of no authority, and need not be noticed. Indeed I hardly know whether the bird referred to belongs to this family or the *Capitonidæ*.

Genus I. Bucco.

A. *Bucco*, Linn.

1. Bucco collaris, Lath.

Bucco, Brisson, Orn. iv. p. 92.
Bucco capensis, Linn. S. N. i. 168; Gm. S. N. i. 406.
—— *collaris*, Lath. Ind. Orn. i. 202; Vieill. Enc. Meth. p. 1420; Gray's Gen. p. 74; List of B. M. pt. 2. sect. 1. p. 47.

Capito collaris, Temm. Tabl. Meth. p. 41; Wagler, Syst. Av. sp. 3; Tsch. Av. Consp. p. 300; Tsch. F. P. p. 259; Bp. Consp. p. 146.
Tamatia collaris, Less. Man. d'Orn. p. 167.
Le Tamatia à collier de Cayenne, Pl. Enl. 395.
Le Tamatia à collier noir, Le Vail. Ois. de Par. ii. t. 42.

B. supra ferrugineus, tenuissime nigro lineatus: vitta dorsali nigra, supra ochracea marginata: subtus albescens; vitta pectorali nigra; ventre fulvescentiore: rostro rubro, culmine nigro: pedibus flavidis.
Long. tota 7·0; alæ 3·1; caudæ 3·5.
Hab. in Cayenna; Guiana (Le Vail.); Rio Negro (Wallace); Peruv. reg. sylv. (Tsch.).

This well-known bird is, as I have mentioned before, the only species of Linnæus's genus *Bucco*. It was erroneously called *capensis* by him, which renders it necessary to adopt for its name Latham's appellation *collaris*. Cayenne specimens occur in most collections. Le Vaillant says it is also to be found in Guiana, though Richard Schomburgk does not include it in his catalogue of birds in the third volume of his 'Reisen in Britisch Guiana.' It extends across the branches of the Rio Negro (whence examples were brought by Mr. Wallace) into the wood region of the Peruvian provinces bordering on Brazil, where it was found by Dr. Tschudi.

B. *Tamatia*, Cuv.

2. Bucco macrorhynchus, Gm.

Barbu à gros bec de Cayenne, Buff. Pl. Enl. 689.
Bucco macrorhynchus, Gm. S. N. i. 406; Lath. Ind. Orn. i. p. 203; Vieill. Nouv. Dict. d'H. N. iii. 240; Vieill. Enc. Meth. p. 1420; Schomb. Reisen, iii. 719; Gray's Gen. p. 74; Gray's List of B. M. p. 47.
Capito macrorhynchus, Wagl. Syst. Av. sp. 1; Tsch. Av. Consp. p. 300; Tsch. F. P. p. 259; Bp. Consp. p. 146.
Cyphos macrorhynchus, Strickl. Ann. Nat. Hist. vi. 418.
Tamatia à plastron noir, Le Vail. Ois. de Par. ii. t. 39.

B. supra niger, torque, collari et fronte latissime albis: subtus albus; vitta lata pectorali nigra; ventris lateribus nigro conferte radiatis; rostro pedibusque nigris.
Long. tota 10·0; alæ 4·5; caudæ 3·5.
Hab. in Cayenna, Surinamo (Le Vail.); Guiana (Schomb.); Para, fl. Amazon, Rio Negro (Wallace); Honduras (Dyson); Peruv. reg. sylv. (Tsch.).

This is the largest species of the genus and one of the earliest known. It appears to be rather widely distributed, since I cannot find any real difference between Honduras examples collected by Mr. Dyson and those from the Amazons. Schomburgk says it is one of the rare birds of British Guiana, and he met with only a few individuals on the Canuku mountains. It seems more common on the Amazon, where many specimens have been lately collected by Messrs. Hawxwell and Wallace. Dr. Tschudi found it in Cis-andean Peru, in the provinces bordering on Brazil. The feathers of the back and wings, except the primaries, are narrowly edged with white, the rectrices slightly tipped with white. My measurements are taken from a full-sized individual. Younger birds are rather smaller, the bill considerably inferior in size, and the white front much narrower. The breast band is broader in some examples than in others.

3. Bucco Swainsoni, G. R. Gray.

Tamatia macrorhynchus, Sw. Zool. Ill. (1821–22) t. 99.
Bucco Swainsoni, Gray's Gen. p. 74; Gray's List of B. M. p. 47.
Capito Swainsoni, Bp. Consp. p. 146.

B. supra niger, fronte et vitta subnuchali albis: subtus albus; vitta pectorali nigra; abdomine fulvo: rostro et pedibus nigris.

Long. tota 9·0; alæ 4·1; caudæ 3·0.

Hab. in Brasil. Merid.

This South Brazilian representative of the preceding species was figured by Mr. Swainson in his 'Zoological Illustrations' under the name of its prototype. To Mr. Gray belongs the credit of distinguishing it therefrom and naming it after its first describer. It may be easily recognized by its smaller size, weaker bill and fulvous vent. My specimens are from Rio de Janeiro, I believe. The bird is to be found in most collections, more commonly even than the true *macrorhynchus*.

4. Bucco pectoralis, G. R. Gray.

Bucco pectoralis, Gray's Gen. p. 74. pl. 26; Gray's List of B. M. p. 41.
Capito pectoralis, Bp. Consp. p. 146.

B. niger æneo tinctus; regione auriculari et nucha late albis: subtus albus vitta pectorali latissima nigra; ventre medio crissoque albis, lateribus nigrescentibus: rostro pedibusque nigris.

Long. tota 8·0; alæ 3·8; caudæ 3·0.

Hab. in America Meridionali.

The nuchal collar extending from eye to eye and the broad pectoral band render this species easily recognizable. The British Museum type-specimen is unique, as far as my experience goes.

5. Bucco Ordi, Cassin.

Bucco Ordi, Cassin, Pr. Ac. Sc. Phil. 1851, p. 154. pl. 8.

I am only acquainted with this species from Mr. Cassin's original notice of the type-specimen, which is in the Museum of the Academy of Natural Sciences of Philadelphia. He describes it as follows:—

"*Form.*—Generally short and robust; feathers of the head but little elongated, wings and tail short. A strict congener of *B. macrorhynchus* and *pectoralis*.

"*Dimensions.*—Total length $7\frac{3}{4}$; wing 3·3; tail 2·8.

"*Colours.*—Tail with a central transverse white bar. Breast with a narrow band of black, immediately succeeded by another much wider of dark chestnut-brown; throat and abdomen white, which is the colour also of the frontal feathers and of the internal webs of the primaries at their bases, and of a narrow collar on the back of the neck. Entire superior surface of the head, body, wings and tail black, with a greenish gloss. Tail with a band of white most observable on the inner webs of the feathers and narrowly edged with white at its end. Flanks striped with the same dark brown as the broader belt of the breast.

"*Hab.* Venezuela.

"*Obs.*—A bird resembling generally the several species of which *B. macrorhynchus* is a representative, but immediately recognizable by the white in its tail, and its smaller size. I have seen only the specimen now described."

This bird appears certainly quite distinct from any other of the genus.

6. Bucco tectus, Bodd.

Barbu à poitrine noire de Cayenne, Buff. Pl. Enl. 688. fig. 2.
Bucco tectus, Boddaert, Tabl. d. Pl. Enl. p. 43.
Bucco melanoleucus, Gm. S. N. i. 406; Lath. Ind. Orn. i. p. 203; Vieill. Nouv. Dict. d'H. N. iii. 241; Enc. Meth. p. 1420; Licht. Verz. d. Doubl. p. 8.
Capito melanoleucus, Wagl. S. A. sp. 2; Bp. Consp. p. 146.
Bucco tectus, Gray's Gen. p. 74; Gray's List of B. M. p. 47.
Le petit Tamatia à plastron noir, Le Vail. Ois. de Par. ii. t. 40.

B. supra niger, capite albo punctulato, alis albo variis: striga oculari alba: fascia caudali media et altera terminali alba: subtus albus vitta pectorali lata nigra; rostro pedibusque nigris.
Long. tota 6·0; alæ 2·9; caudæ 2·0.
Hab. in Cayenna, Surinamo et Guiana (Wagl.); Para (Wallace).

This is the smallest of the five species of *pied Barbets* we are at present acquainted with, and to be recognized at once by the round white spots on the head, which are not found in any of the preceding.

Its range is from Guiana southwards, as far as the banks of the Amazon, where Mr. Wallace collected specimens.

C. *Chaunornis,* G. R. Gray.

7. Bucco tamatia, Gm.

Barbu à ventre tacheté de Cayenne, Buff. Pl. Enl. 746. fig. 1.
Bucco tamatia, Gm. S. N. i. 405; Lath. Ind. Orn. i. p. 202; Vieill. Gal. des Ois. pl. 34; Enc. Meth. p. 1421; Licht. Verz. d. Doubl. p. 8; Schomb. Reisen, iii. p. 719; Gray's Gen. p. 74; Gray's List of B. M. p. 48.
Capito tamatia, Wagl. Syst. Av. sp. 6; Steph. Gen. Zool. xiv. 156; Temm. Tabl. Meth. p. 41.
Tamatia maculata, Cuv. Règn. An. (1817) i. p. 429; Sw. Orn. Draw. pl. 11.
Nyctactes tamatia, Strickl. Ann. Nat. Hist. vi. 418.
Chaunornis tamatia, Gray, List of Gen. (1841) p. 13.
Tamatia tamatia, Bp. Consp. p. 146.
Le Tamatia à gorge rousse, Le Vail. Ois. de Par. ii. t. 41.

B. supra fuliginoso-brunneus, rufescente plus minusve transversim lineatus: fronte superciliisque ferrugineo tinctis: striga utrinque suboculari in torquem nuchalem obscure producta alba: collo antico ferrugineo vitta nigra utrinque marginato: ventre maculis nigris conferte transvittato: rostro pedibusque nigris.
Long. tota 6·2; alæ 3·0; caudæ 6·5.
Hab. in Guiana (Le Vail.) (Schomb.); Cayenna; Para et fl. Amazonum (Wallace).

This species appears to me to be closely allied in shape and structure to the preceding, although some authors have made it the type of a different genus. Schomburgk found it in the deepest woods of British Guiana, where, he says, "it seems to have an extensive range. They are seen in solitary spots, and sit alone, more rarely in pairs, phlegmatic and sorrowful-looking upon the branches of the low bushes. They are by no means shy, and let one approach within six or eight steps, when they fly a little way farther and resume again their sorrowful melancholy position. Their food is insects." It extends thence down to the banks of the Amazon, where it was procured by Mr. Wallace.

8. Bucco ruficollis (Wagler).

Capito ruficollis, Wagl. Isis 1829, p. 658; Bp. Consp. p. 146.
Bucco ruficollis, Gray's Gen. p. 74.
Tamatia gularis, d'Orb. and Lafr. Rev. Zool. 1838, p. 166.
Bucco gularis, Gray's Gen. p. 74.
Capito gularis, Bp. Consp. p. 146.

B. fuliginoso-brunneus; torque cervicali postico, loris et regione auriculari albis: dorso et alarum tectricibus albo mixtis: subtus albidus; gutture medio rufo; vitta pectorali nigra:

ventre medio paululum rufescente, lateribus nigro maculatis: rostro pedibusque nigris.

Long. tota 8·5; alæ 3·5; caudæ 3·3.

Hab. in Nova Grenada; Carthagena (Lafr.); Santa Martha (Verreaux); Mexico (Wagl.) (?).

An accurate description of this bird was first given by Wagler in the 'Isis,' in one of the papers which he called "Beitrage und Bemerkungen zu dem ersten Bande seines Systema Avium." MM. de Lafresnaye and d'Orbigny named it afresh in an article upon some birds from Carthagena, in the 'Revue Zoologique,' in 1838. An example in the Munich Museum is labelled as from Cayenne. The brothers Verreaux have lately received several skins of this species from their collector at Santa Martha, which is on the coast-line some distance to the east of Carthagena and on the opposite side of the Magdalena. I expect, therefore, that the northern coasts of the New Grenadian republic will be found to constitute its true *habitat*, and should rather doubt its extending so far as Mexico, whence Wagler's specimens were said to have come.

In general distribution of colours it rather resembles *B. macrodactylus*, but is twice the size. It may be easily recognized by the large rufous patch in the middle of the throat and well-defined black breast-band.

9. Bucco bicinctus (Gould).

Tamatia bicincta, Gould, Pr. Zool. Soc. 1836, p. 80.
Tamatia bitorquata, Sw. An. in Men. p. 327.
Bucco bicinctus, Gray's Gen. p. 74; Gray's List of B. M. p. 48.
Capito bicinctus, Bp. Consp. p. 146.

B. nigro-fuliginosus, fulvo mixtus: fronte auribus mentoque albidis: subtus ochraceo-albus, vitta gutturali lata, pectorali angusta et maculis ventris lateralibus, cum rostro et pedibus nigris.

Long. tota 8·0; alæ 3·5; caudæ 3·3.

Hab. Venezuela (Dyson); Trinidad (Lord Harris).

The specific name *bicinctus* is quite sufficient to distinguish this species from all others at present known of this family. Trinidad specimens are among the fine collection of birds from that island presented to the Zoological Society by Lord Harris. Examples in the British Museum were collected by Mr. Dyson in Venezuela.

10. Bucco radiatus, Sclater.

Bucco radiatus, Sclater, Pr. Zool. Soc. Dec. 13, 1853.

B. supra clare ferrugineus, nigro transversim radiatus: nucha et dorso summo pæne omnino nigris: corpore subtus et cervicali torque pallide fulvescenti-albis; capitis lateribus pectore et ventris lateribus lineis nigris transversim radiatis: loris gula et ventre medio cum crisso albis: pedibus nigris: rostro plumbeo.

Long. tota 8·0; alæ 3·4; caudæ 3·0.

Hab. in Nova Grenada.

On first seeing this *Bucco* I took it for an immature state of *B. chacuru*, but a more accurate examination has convinced me that it is quite distinct. The present species may be at once distinguished by its lead-coloured bill and radiated under-plumage, as well as by the entire absence of the large black blotches on each side of the neck, which form one of the characteristic features of the latter species. Of two examples in the British Museum, one is labelled as having been received from Santa Fé di Bogota in 1843.

The upper plumage is clear ferruginous brown crossed with regular black bars which are narrower on the head: on the neck and upper back the feathers are nearly wholly black. The under surface of the remiges is buff-coloured; the inner web of the apical half of the primaries is pure pale black. The rectrices are uniform clear brown, paler below and regularly crossed by seven or eight black bands.

11. Bucco chacuru, Vieill.

Chacuru, Azara, no. 261.
Bucco chacuru, Vieill. Nouv. Dict. d'H. N. iii. 239; Vieill. Enc. d'H. N. p. 1420; Gray's Gen. p. 74; Gray, List of B. M. p. 48.
Capito melanotis, Temm. Pl. Col. 94; Wagl. Syst. Av. sp. 5; Max. Beit. z. Nat. iv. 359; Tsch. Av. Consp. p. 301; Tsch. F. P. p. 259.
Bucco strigilatus, Licht. Verz. d. Doubl. p. 8.
Capito chacuru, Hart. Syst. Ind. Azara, p. 17; Bp. Consp. p. 146.
Capito leucotis, Sw. Orn. Draw. pl. 10; Bp. Consp. p. 147.
Bucco leucotis, Gray's Gen. p. 74.

B. supra brunneo-rufescens nigro conferte fasciolatus; capite nigricantiore: capitis lateribus omnino nigris: loris, regione auriculari, vitta collari postica et corpore toto subtus albis: subtus ad latera subobsolete nigro radiatus: rostro rubro, culmine ad apicem nigro: pedibus nigris.

Long. tota 8·0; alæ 3·3; caudæ 3·0.

Hab. in Brasilia; Bahia (Max.); S. Paolo (Licht.); Peruvia reg. sylv. (Tsch.); Porto Imperiale (Cast. et Dev.); Paraguaya (Azara).

This *Bucco* appears to range farther south than any other species, being the only one included by Azara in his account of the birds of Paraguay. Prince Maximilian of Neuwied says that he "met with it in the bush and wood valleys of the province of Bahia, yet not often. It is a still, solitary bird, and he never heard its voice. Generally it sits upon a low bough, or hops in the thick bush upon the ground."

The form of the bill in this species is very much compressed, in other respects the general habit of the bird is not far removed from that of the more typical *Buccones*.

12. Bucco lanceolatus, Deville.

Bucco lanceolatus, Deville, Rev. et Mag. de Zool. 1849, p. 56.

B. supra brunneus: subtus albus nigro longitudinaliter striatus: fronte anguste albo: crisso rufescente.

Long. tota 5·5.

Hab. Pampa del Sacramento in Peruv. (Dev.); Rio Napo (Jardine).

I noted down the preceding short description (which, however, I think is sufficient to identify this peculiar species) when I examined the type-specimen in the Paris Museum. M. Deville's account of it is as follows (see Rev. et Mag. de Zoologie, *l. c.*): "Above reddish brown, rather brighter on the head, ears and upper tail-coverts; with a narrow terminal band more or less clear upon the back and coverts. Below spotted with white and black: tail brown above, gray below, with two black spots, one at the base and the other nearly at the extremity, which is gray: two medial rectrices brown and without spots: the outer pair of rectrices spotted only on the inner web, the outer web being gray. Crissum cinnamon colour. Length $10\frac{1}{2}$ cent."

Sir William Jardine has an example of this bird received in a collection from the Rio Napo.

13. Bucco maculatus (Gm.).

Alcedo maculata, Gm. S. N. i. p. 451.
Bucco somnolentus, Licht. Verz. d. Doubl. p. 8.
Capito maculatus, Wagl. S. A. sp. 7; Temm. Tabl. Meth. p. 41.
Tamatia somnolenta, Sw. Orn. Draw. pl. 9.
Le Tamajac, Le Vail. Ois. de Par. Suppl. t. F.
Tamatia tamajac, Less. Man. i. p. 168.
Tamatia maculata, Bp. Consp. p. 147.
Bucco maculatus, Gray's Gen. p. 74; Gray, List of B. M. p. 48.

B. supra nigrescens: singulis pennis irregulariter rufescente transversim vittatis; capite obscuriore: loris superciliis et vitta collari rufescentibus: subtus albus; collo antico clare rufescenti-fulvo: mento pure albo: pectore et ventris lateribus maculis rotundis nigris signatis: rostro rubro, culmine et basi nigro: pedibus plumbeis.

Long. tota 7·3; alæ 3·0; caudæ 2·7.

Hab. in Brasilia; Para; Bahia (Licht.).

This well-known Brazilian species may be recognized by its clear buff-coloured neck and upper breast, and the round spots on the belly. Specimens from Para are in the Derby Museum at Liverpool.

14. Bucco striatipectus, Sclater.

B. striatipectus, Sclater in Pr. Zool. Soc. Dec. 13, 1853.

B. supra nigrescens; alis caudaque magis brunnescentibus; omnino rufescente transversim striatus: capite nigro fere immaculato: mento albo, gutture toto et collo undique fulvo-rufis: pectore et ventris lateribus albis, nigro longitudinaliter striatis: ventre medio albo: crisso fulvescente.

Long. tota 7·8; alæ 3·5.

Hab. in Bolivia (Mus. Derb.).

I am rather doubtful, I confess, about this species, whether it is truly distinct from the preceding. The only difference is that the characteristic round black spots on the under surface are in this species replaced by longitudinal striæ. The two examples in the Derby Museum are labelled 'Bolivia.' I have seen several others. I described this and some of the other new species included in the present synopsis in a paper read before the Zoological Society on the 13th December, 1853.

D. *Cyphos* (Spix).

15. Bucco macrodactylus (Spix).

Cyphos macrodactylus, Spix, Av. Bras. i. t. 39. fig. 2. p. 51.
Capito cyphos, Wagl. S. A. sp. 4; Tsch. F. P. p. 259.
Capito macrodactylus, Bp. Pr. Zool. Soc. 1837, p. 119; Tsch. Av. Consp. p. 300; Bp. Consp. p. 146.
Bucco macrodactylus, Gray's Gen. p. 74.

B. fuliginoso-brunneus; capite rufescente; dorso summo nigrescente; dorsi singulis pennis margine clarioribus: vitta cervicali postica ochracea: mento ochraceo albido: vitta lata gulari nigra subtus albo marginata: ventre tenuissime nigrescente lineato: rostro nigro: pedibus plumbeis.

Long. tota 5·8; alæ 2·7; caudæ 2·4.

Hab. in sylvis fl. Amazonum (Spix); in prov. Peruviæ orientalibus (Tsch.); Rio Napo (Jard.); Nova Grenada.

This is certainly rather an abnormal species as regards the form of the bill, which somewhat resembles that of the next succeeding genus, but is much broader at the base. The broad gular bar is situated higher up than in the other species. I have some doubts whether I am right in placing it here—perhaps, in many respects, it is more nearly allied to *B. tamatia*, &c.

Spix's specimens came from high up the Amazons, I expect, as Tschudi found the bird in Eastern Peru. An example in my collection has every appearance of a Bogota skin.

[To be continued.]

XXXI.—*Observations on the Fauna of Barrackpoore.* By Capt. Robert C. Tytler, of the 38th Regiment Bengal Light Infantry.

Since the following observations will in all probability be uninteresting to most readers, I give them expressly for the assistance and guidance of those who visit Calcutta from foreign ports, and are desirous during perhaps a limited stay to procure specimens of natural history belonging to Bengal, and which frequently without their own personal exertions they are unable to do; I therefore select the fauna of Barrackpoore (a pretty military station) and its immediate vicinity, where I resided for upwards of two years, thus having ample opportunities to render myself tolerably familiar with the birds and small mammalia that belong to or occasionally visit this part of Bengal.

The distance from Calcutta to Barrackpoore is fifteen miles. The road is planted on both sides with tall superb trees, and it is chiefly on this road and its vicinity that I obtained or observed the specimens which form the subject of my observations; other genera and species besides those enumerated by me have been occasionally collected, but these I shall omit mentioning as they did not fall under my immediate observation, and solely confine myself to those that did.

I shall therefore begin with the *Palæornis torquatus*, the common ring-necked green or Mango Parrot of India; it is very common, as well as the elegant red-headed *Palæornis cyanocephalus*; the latter is difficult to obtain, from being so constantly persecuted by native bird-catchers; the females have a bluish-coloured head. The *Palæornis barbatus* is to be had, but very rarely; I only obtained two specimens; besides these three species, I have seen no other of this genus.

I shall now proceed to the Raptores, and commence with the *Hypotriorchis severus*, a beautiful little species and uncommon. *Tinnunculus alaudarius*, which is the same as the European Kestril, is common. The *Elanus melanopterus* is often met with, as well as *Hæmatornis cheela*; this latter is a noble crested bird, found near marshes, where abundance of the *Circus æruginosus*, the same bird as the English Marsh Harrier, is found. The *Circus cinerascens*, or Montagu's Harrier of England, is also sometimes obtained, as well as *Circus melanoleucus*, but the latter is rare. The species of Raptores most frequently obtained is the *Micronisus badius*, which is very plentiful. The *Spizaëtus limnaëtus* and *Pontoaëtus ichthyaëtus*, two fine species, are both uncommon; however I was fortunate in obtaining good specimens of both. The *Haliastur indus* and *Milvus ater* are very abundant, and found everywhere; the first is known as the Brahminee Kite, and the latter as the common Kite of all India.

The Vultures follow, and I shall first mention the *Otogyps calvus*; they are common, and recognised at once by their scarlet head and wattles from other vultures: the other two species are *Gyps indicus* and *Gyps bengalensis*; the former is of a brown and the latter of a black colour. I have seen no other vultures in this neighbourhood: all three are very common, the two last more so than the first, which latter is frequently called the King of the Vultures: these birds are so peculiarly filthy and disgusting in their habits, that few collectors bestow much attention or pains in procuring them.

I was rather unfortunate in my collection of Owls, but succeeded in procuring good specimens of *Scops aldrovandi* and the fine large Horned Owl, the *Ketupa javanensis*, as also *Ninox scutulatus*; all these three species may be considered uncommon; but the little *Athene brama* is very common, frequenting old trees and houses. The only other owl procured in this locality was the common *Strix javanica*, so closely allied to the *Strix flammea* of England (the Barn Owl).

The *Upupa epops*, the Hoopoe of England, is not common at Barrackpoore, though during the cold season a few may be procured.

We now proceed to the Kingfishers: the *Halcyon ghurial* and *Halcyon smyrnensis* are both very common, but the *Halcyon amauropterus* is rare; this latter abounds in the Soonderbunds, and occasionally visits Barrackpoore. This tribe of birds is easily found from their constant coarse shrill call; they frequent the neighbourhood of trees, whereas the common *Ceryle varia* of Strickland, which is the Asiatic variety of *Ceryle rudis*, abounds near streams of water and large rivers, where they may constantly be seen hovering in the air like a kestril in search of their prey. The *Alcedo bengalensis* is also very common, and found in retired shady places near water. We now come to the common and only Roller I have seen in this part of the country, the *Coracias indica*; there are but few Europeans who are not acquainted with the Indian Blue Jay, as this bird is called. The *Eurystomus orientalis* is also found, but is very rare.

Amongst the Bee-eaters I can only mention two species, the very common little green *Merops viridis*, and the less common large species *Merops philippensis*; this latter is a well-known cold-weather visitor. One of the most common Woodpeckers is the gay-coloured *Brachypternus aurantius*; it is very abundant; the male is easily distinguished from the female by its complete scarlet head, whilst the head of the female is speckled with white on the forehead. Another very common species is the small black and white *Picus macei*; in the male of this species the head is red, in the female black. The next species, *Micropternus phaioceps*, which is a brown Woodpecker, is not common; the males have red on their cheeks. I now conclude the Woodpeckers by mentioning my good fortune in obtaining a male and female of *Gecinus chloropus*; they are green and *very rare*. During the cold season numbers of the English Wryneck, *Yunx torquilla*, are found about orchards and gardens. There are only two species of Barbets found about Barrackpoore, the *Megalaima asiatica* and the small *Megalaima philippensis*, both very abundant; they are easily distinguished from each other, when concealed by the thick foliage of the trees they frequent, by their totally different constant call; the note of the *M. asiatica* sounds like *kootur, kootur, kootur*, constantly repeated, but the note of the *M. philippensis* is a simple *koot, koot, koot*; they are not easily distinguished from the leaves of trees, their colour being somewhat of the same hue.

I shall next mention the Cuckoos, and begin with a very common species, the *Cuculus varius*; it is found in gardens and orchards, as also the *Cuculus striatus*, or *Bhow kuttah kho* of the Bengalees: this latter is a rare bird; its call is very like the note of the *Pomatorhinus erythrogenys* of the Himalayas. *Bhow kuttah kho* signifies in Bengalee—*Daughter-in-law tell a tale*; the note sounds very like a double cuckoo, thus *cuckoo, cuckoo*. The *Cuculus tenuirostris* is also found, but is rather uncommon, and I obtained but few specimens. I now come to one of the most common species, the *Eudynamys orientalis*, or *Coel* of India; the male is black and the female brown, speckled with white; both have scarlet eyes; the young male though black is speckled with white, and the young of both sexes have dark eyes: the contrast in the colour of male and female has frequently misled people to suppose them to be different birds: this *Eudynamys* deposits its eggs in the nest of the common crow, *Corvus splendens*. The eggs of both species are very similar, with the exception that the Crow's is more pointed at one end; otherwise the similarity is great. The call of the *Coel* is well known: at daybreak they welcome the first rays of light by their wild attractive note; they call also during the day, and not unfrequently at night; in cloudy and rainy weather they make a clamorous noise; natives often keep them in cages expressly for their wild cheerful note. As the rainy season sets in, the *Oxylophus melanoleucus* begin to appear, and their call is heard in every direction; this is a fine black and white species with a crest: the handsome *Oxylophus coromandus* is also found, but is very rare. I now come to a very common bird, and the last species of this group I have found at Barrackpoore, the *Centropus philippensis*, or large Crow Pheasant of Europeans. I obtained only two species of the genus *Caprimulgus*, viz. *C. asiaticus* and *C. albonotatus*, the former is more common than the latter. The Swifts are limited to two, the *Cypselus affinis* and *C. balassiensis*; the latter is a most delicate, slight species, frequenting palm-trees and building their nests in the fronds of the *Borassus*; the former species build in houses, &c.

One of the most common birds in India is the *Corvus splendens* or common Crow, which occurs in abundance everywhere, both in country and town, and is mischievous to a degree; it is the nest of this bird that the *Coel* generally selects for her eggs: the only other Crow found here is the *Corvus culminatus*; these birds are common, and are called Ravens in India. After leaving the Crows, the next bird to be mentioned is the *Dendrocitta rufa*; they are common and soon attract attention by their constant call of *Chugul Khore*, or tell-tale; these birds are called Brown Magpies. We now come to the *Minas*; the first and most common is the *Acridotheres tristis*, or *Dassee mina* of the natives; they are very numerous and are often kept in cages, as they soon learn to imitate sounds and become docile. The *Acridotheres griseus* is also found, but rarely; this bird is known by its peculiar crest and yellow eye; it is not such a favourite cage-bird as the last-mentioned species. The *Sturnus contra* is very plentiful; I have seen some tame ones which could imitate sounds very well; they become very tame and are often kept by natives. The last of this group which I have seen in this part of Bengal is *Sturnia malabarica*; they are common, and build in the hollows of trees, keeping together in large flocks.

That interesting bird the *Ploceus philippensis*, is the only species of the Weaver-bird that I have seen at Barrackpoore; the long bottle-shape nest of this bird, hanging in numbers to the leaves of the palm and other trees, cannot fail to attract the notice of the most unobservant individual. The *Ploceus manyar* and *Ploceus bengalensis* have both been obtained in this neighbourhood, but I have never seen them. Amongst the little *Munias* are *M. rubronigra*, *M. undulata*, and *M. malabarica*, all equally common. The *Passer indicus*, or common House Sparrow, is plentiful everywhere, building in houses and quite tame in their habits.

I now come to a class of birds, which from their dull colours and obscure appearance seldom engage the attention of collectors; they are the Larks found about this station. I will begin with *Alauda gulgula*, which is common; *Mirafra affinis* and *Mirafra assamensis* are by no means uncommon: the genus *Mirafra* is easily distinguished from other larks by their thick-set appearance. The little *Pyrrhulauda grisea*, which is common, frequents open fields; the males have black underneath, but in every other respect so similar is the general colour of these little creatures to the ground they frequent that they are often passed unobserved, besides which they conceal themselves by lying flat on the ground. The *Dendronanthus maculatus* is not uncommon, and frequents groves of trees; the habits of this bird are very interesting; they are found amongst dry leaves, and when disturbed fly into the trees and conceal themselves among the branches. The *Anthus richardii* of England is also met with, but is rather rare; while the *Anthus rufulus* is very plentiful, and is caught by natives and sold for food to Europeans; in fact, all larks are called by them *Begarees*, by which term *Ortolans* are supposed to be understood; however there is scarcely a lark in India that does not possess its own peculiar native name. The most interesting of this group is the pretty *Nemoricola indica*, which seems to partake both of the habits of the lark and wagtails: it is not common.

The four species of Water Wagtails as they are termed, are all very common and cold-weather visitors, viz. *Motacilla luzoniensis, M. boarula, Budytes citreola* and *B. viridis*; as the three latter are yellowish and often cause confusion, I will simply mention that the genus *Motacilla* is easily distinguished from *Budytes* by the long lark-like nail on the hallux of *Budytes*; *B. citreola* and *B. viridis* are easily distinguished by the green hue on the back of the latter.

We leave these comparatively speaking attractive birds, and come to those of more sombre plumage, such as the *Sphenura striata*; this is an uncommon bird, found amongst bushes near water; the bristles at the base of the mandibles are curiously placed. The *Sat Bhya*, or as they are frequently called *Panch Bhyas*, which means "seven or five brothers," the *Malacocercus bengalensis*, are very common, and are found in gardens and jungle, hopping about in search of food; they are well known; their colour is of a dirty brown, and they have a peculiar white eye, which gives them a most uninteresting appearance. The little *Drymoica inornata* and *Cisticola cursitans* are found in great numbers amongst the long grass; the latter is so very minute that it frequently escapes all observation.

That wonderful little bird the *Orthotomus longicauda,* or Tailor-bird of India, is very common, and builds its nest in gardens and other suitable places; the nests are very peculiar, composed outwardly of from one to four leaves stitched together, enclosing a nest of the finest construction and materials within it: the eggs not only differ in number, but very much in colour and shape; I have some white and speckled with brown, others pure white, and so on; a bluish gray and speckled are the most common. The Indian variety of *Lanius superciliosus* is very common, but the *L. nigriceps* is rather uncommon and only met with at some little distance from cantonments. Occasionally great numbers of *Tephrodornis pondiceriana* make their appearance; and I have obtained a fine specimen of that beautiful bird *Pitta triostegus,* found amongst dry leaves under mango-trees; they are here very rare; so is the *Oreocincla dauma,* of which I obtained several good specimens. The *Turdus atrogularis* and *merula, houl houl,* sometimes make their appearance, but this is very rarely the case; I only saw one of each species. Of the genus *Geocichla* I obtained three species: *G. unicolor,* very rare; *G. citrina,* very common; and *G. dissimilis,* often found in groves of trees; it is very singular that, out of the numbers of *Geocichla dissimilis* shot, a male is seldom or never procured; this latter, when in fine adult plumage, is distinguished from the sombre colour of the female by the bright reddish streaks on its flanks. I procured two fine specimens of *Kittacincla macrourus,* the *Shama* of India; they were shot in rather thick jungle, and are very rare, whereas the *Copsychus saularis,* the *Dhial* of the natives, is very common; both these species are good songsters, particularly the first, but at all times are delicate birds unless well fed with worms, &c. A good singing *Shama* is a valuable bird, and not easily purchased; the natives are very partial to them and keep a great many; their cages are covered over with a white cloth to prevent their being disturbed, for they are very timid, besides which they sing better and oftener when covered over. The little *Cyanecula suecica* is a regular cold-weather visitor, as also the *Ruticilla indica*; this latter is not very common, which is rather singular, considering how plentiful they are in Bengal, whereas the beautiful red-throated *Calliope kamtschatkensis* are not uncommon; they occur in jungle near grass and water. The *Pratincola indica* is also found seated on hedges and bushes, and during the cold season in groves of trees. The *Erythrosterna leucura* is often met with; the males, though small, have a slight resemblance to the English Robin: the two most beautiful of this group found near Barrackpoore are the *Cyornis rubeculoides* and the *Staparola melanops*; they are however uncommon, but I was fortunate in getting several specimens of both.

I have now to add a most rare addition to my Barrackpoore collection, viz. three specimens of the *Hemichelidon fuliginosa*: mine appear to be the first specimens obtained here; they are very rare. The next birds we come to are dull species, though very sprightly and active in their habits: the first, *Arundinax olivaceus*, is rare; but the next, *Acrocephalus brunnescens* and *A. dumetorum*, are very common, as well as *Phyllopneuste rama*; these latter are found amongst the branches of high trees. Here the lively and pretty *Culicipeta burkii* is found during the cold season, as well as the *Reguloides modestus* and *R. trochiloides*; both of these latter species are rare. The most common of this group are the *Phylloscopus tristis*, *P. viridanus* and *P. lugubris*, all of which are very abundant, particularly the first two; these birds are so minute that they are scarcely sought for. I found the *Graucalus macei* rather scarce, as well as *Campephaga sykesii*, but *C. fimbriata* is very plentiful.

I now come to the beautiful *Pericrocotus peregrinus* and *P. roseus*; the first is very common, the latter is not so: few birds are more beautiful than the males of this elegant timid species; they are always found in small packs about trees, constantly on the move in search of insects. The Swallows seem limited to three, *Hirundo daurica*, *H. rustica*, which is the same as the English species, and the little river *H. sinensis*; the second of these named species is by no means common, the other two are often met with; the little River Swallows make their nests in holes in the banks of the river: the manner in which the banks are perforated with the holes these birds make is astonishing; several hundreds congregate together and live in perfect harmony. The *Artamus fuscus* is also common; they keep in small packs, frequenting jungles; their habits are very like swallows'; they are often seen perched in rows on a long thin twig, occasionally darting off in search of insects. During the cold season several *Chibia hottentota* are to be obtained; the gloss on the plumage of this bird, as well as on that of the common little *Chaptia ænea*, renders them objects of great interest, notwithstanding their black colour. The *Dicrurus macrocercus*, so commonly seen throughout the year in open fields, is also a very interesting species, as well as *D. longicaudatus*; both are very frequent, the former keeping to open fields and the latter near groves of trees. Besides the two mentioned I have obtained a specimen of a third and very rare species, *D. cærulescens*; they are found in groves of trees and have a white belly; the young of the former species are marked with white, but very different from the pure white belly of the *D. cærulescens.* The *D. macrocercus* is a larger and blacker bird than *D. longicaudatus,* which latter is of a more ashy hue, and is in size only a little larger than *D. cærulescens*: all the birds of this group are called King Crows.

The elegant *Tchitrea paradisi* is common; the young males are brown like the females, with black heads and with the two centre tail-feathers elongated like the adult male; they gradually change their plumage, become mottled with white, and by degrees assume the pure white of the adult male, but retaining the fine glossy black head, crest and neck: the females do not seem to change from brown to white, though old barren females are said to do so. I obtained the nest of this species; it was elongated and built in the fork of a branch like the nest of the *Dicruræ,* but more elegant in its formation: this species has been kept alive on shrimps, but it is very delicate and difficult to preserve. *Myiagra cærulea* is common; the delicate blue of the male is very beautiful; the female is of a brown hue, preserving in a slight degree the blue of the male, on the head in particular; they are found amongst the thick foliage of trees: I observed a singular peculiarity of this bird, which was, darting off a branch into water and catching small aquatic insects. There is another common cold-weather bird which appears about the same time as the last, the *Cryptolopha cinereocapilla*; they are of a delicate yellowish hue, with an ash-coloured crest, and are similar in their habits to the *Myiagra cærulea.* But one of the most elegant birds of this group is the *Leucocerca fuscoventris*; this little black-coloured Fan-tail is found in every grove of trees hopping about, with its long fan-shaped tail spread, and every now and then turning round in a sort of self-pride and vanity.

With this bird ends my list of the Flycatchers of Barrackpoore, and I shall now proceed to the well-known *Bulbuls,* or as many Europeans call them, the Nightingales of India: the first and most common species is the large *Pycnonotus bengalensis*; it has a scarlet vent, is very common and a well-known species; natives keep them for fighting. The only other species found here is the small red-cheeked elegant *P. jocosus*; these birds have a very sprightly gay appearance: *Bulbuls* frequent gardens and orchards, keeping in small flocks. Another very common bird is the pretty *Iöra typhia*; the males are blacker than the females; I have shot some males so very black about the head as to induce me to the belief that they were *hybrids.* Few birds attract the eye of strangers more than the gay colours of the very common *Oriolus melanocephalus*; their excessive gaudy colour and musical flute-toned note render them objects of great attraction. The little Sun-bird, as the charming *Nectarinia zeylonica* is called, is very common, and forms a beautiful addition to the fauna of Barrackpoore; early in the morning are these busy little creatures seen sucking the nectar from flowers: I had several of their nests; they are elegantly constructed, and are suspended to the branch of a creeper or other bush; I found a very pretty one suspended to some creepers inside of a bower over my bed-room window. The eggs vary in size and colour as well as in number. The little *Dicæum cruentatum* with its scarlet back, and the little sombre *D. minimum* are very abundant, but at all times difficult to obtain owing to their extreme minuteness, besides which they keep often in the upper branches of high trees. The Pigeons are limited to very few; the most beautiful found here is the *Toria nipalensis*, a very rare bird; but the *Treron phœnicoptera* and *T. bicincta* are pretty common: all three of these species are called Green Pigeons.

The Doves: *Turtur risorius* and *T. suratensis* are both very common, as well as the lovely Green Dove, *Chalcophaps indicus*; these latter are found in dense jungle and in retired places. The only other species of this order I have seen at Barrackpoore is a half-domesticated and evidently hybrid of *Columba livia*; they are very common and live in old temples and houses; they are often caught and shot for eating.

The only species of Rasores I have found here is the *Turnix bengalensis*, which is the small pale variety of *T. ocellatus*; the eggs of this species were brought to me. It is very singular that I did not obtain a single quail or partridge at this station.

I now close my list of land birds, and shall proceed to enumerate the so-called water birds, of which there is a large and extensive variety: my own collection, I regret to say, is very limited; but they were all I could procure during my residence, after every effort that could be bestowed in search of them. I shall begin by mentioning that the *Sarciophorus bilobus* is common, as well as *Lobivanellus goensis*; this is the true *Teetaree* of the natives; *L. cinereus* is also met with; all these three species are obtained in open fields or near water. The *Charadrius virginiacus*, a closely allied species to our English Golden Plover, is also found in great numbers; so is the little *Hiaticula philippina*. The *Totanus fuscus*, the Spotted Redshank of Europe, is not common, but the *Actitis glareola* (the English Wood Sandpiper), the *A. ochropus* (the English Green Sandpiper), the *A. hypoleucus* (the English common Sandpiper), as well as *Tringa minuta* and *T. temminckii* of England, are all very common species at Barrackpoore; there is scarcely a puddle of water that is not more or less resorted to by some of these birds.

Of the true Snipes of the sporting world, the first is the English species, *Gallinago scolopacinus*; they are very common, as well as the other well-known common species, *G. stenura;* the only observable difference between these two species is the curious pointed thin feathers under the tail of the latter. The Jack Snipe of England, *G. gallinula,* is also abundant. The next bird I have to mention is the pretty and beautifully marked *Rhynchea bengalensis*; they are called Painted Snipes: the habits of this bird partake more of that of the Woodcocks than the Snipe; I have often shot them in bush jungle at some distance from water; they are excellent eating. I was fortunate in obtaining the egg of this species. The *Metopidius indicus* is also common: the young of this bird differs much in colour from the adult, so much so that they might easily be taken for different birds. The next closely allied genus is the beautiful *Hydrophasianus chirurgus*; this elegant bird is known as the Water Pheasant; they are very plentiful in marshes, where they may be seen in company with the *Metopidius indicus,* running lightly over the surface of the lotus leaves and other aquatic plants; they are always a timid bird.

The curious *Threskiornis melanocephalus,* the black-headed white *Ibis* of sportsmen, is rare and is considered pretty good eating; the adults have a naked black head and neck, whilst the young are feathered in those parts. The *Tantalus leucocephalus* with its elegant pink feathers is also not uncommon; as also the common Spoonbill, *Platalea leucocephala*; this bird is the same as the English species. I obtained a great many *Anastoma oscitans*; the young of this singular bird alone have their mandibles entire, the edges of the mandibles of the adult being invariably destroyed from their constantly breaking shells of the *Ampullaria* and other things they feed on. I only procured one specimen of the *Mycteria australis*; they are very rare, and one of the finest birds we have of this group. The *Ciconia leucocephala* is also found, but rare. The next I have to mention are those well-known birds called Adjutants, from the circumstance of their frequenting the vicinity of barracks, picking up bones and offal thrown out to them; the most common species is *Leptoptilos argala*; they frequent towns and villages: Calcutta is full of them, and they constantly visit Barrackpoore. The next of this genus is *Leptoptilos javanica*; I only saw one of this small species, in a field near cantonments; they invariably keep in open country and seldom approach towns or villages; they are distinguished from the other species by their inferior size and the scale-like appearance of the feathers on their back.

The Herons found here are but two, *Ardea cinerea* and *A. purpurea,* both common and identical with the English species. We now come to the Egrets: *Herodias alba,* the largest species, is not common, but *Herodias intermedia,* the next in size, is more so, whilst *H. garzetta* and *H. bubulcus* are very common; the latter are found in fields following cattle, in search of insects: all these birds are called Paddy Birds by Europeans. I obtained another bird of the genus *Herodias*, but as it may prove to be a *hybrid*, I will make no particular mention of it. The next three species are common, viz. *Butorides javanica*, *Ardeola leucoptera* and *Nycticorax griseus*; this latter is the same as the Night Heron of England. The *Botaurus stellaris*, or common Bittern of Europe, is also frequently obtained, but the little *Ardetta cinnamomea* is rare. The marshes are abundantly tenanted by the *Porphyrio poliocephalus*; they are seen early in the morning and late of an evening venturing into fields to feed, but always in the vicinity of water; their gay colour and natural docility make them great favourites. The *Porzana phœnicura* and *P. pygmæa* are very common; the former I have frequently shot on trees. The *Rallus striatus* and *R. indicus* are also rarely met with, but the *Gallinula chloropus*, which is the same as the English Moor Hen, is not uncommon. During a very severe gale of wind we had at Barrackpoore, I saw a fine specimen of that splendid large Gull, the *Larus ichthyaëtus*, the only one I saw; it was flying along the banks of the river, unable to make any progress against the wind. The *Hydrochelidon indica* and *Sterna aurantia* are both common, the latter more so than the former. A large flight of Pelicans passed over Barrackpoore, but of what species I am unable to say, for they flew very high. The *Graucalus pygmæus* is a common species about ponds and marshes.

I was very unfortunate with my Ducks; but as my object is only to enumerate what I actually saw, I trust the reader will excuse my giving so small a list. The *Dendrocygna major* and *D. arcuata* are both common; they are known to Europeans as the Whistling Teal of India. The little Rice Teal, *Nettapus coromandelianus*, is very plentiful, as is also *Querquedula circia*, the English Garganey or Summer Duck. I likewise procured the *Fuligula nyroca*, the White-eyed Duck of Europe; they are not common; but the little common Grebe, *Podiceps philippensis*, is very abundant on all ponds and marshes.

This ends my ornithological list of birds actually seen wild and collected by me, at and in the neighbourhood of Barrackpoore during a period of two years: in the Calcutta bazaar a great many more species are exposed for sale, brought from the Soonderbunds and other places; all these are to be purchased at a very moderate price.

I shall now conclude by giving a brief sketch of the mammalia I saw at Barrackpoore, first mentioning that a Leopard, *Felis leopardus*, was shot in a garden; it had evidently strayed here from the Soonderbunds; they have been shot here before, but are not frequent visitors. A *Paradoxurus typus* just caught was brought to me for sale; the *Herpestes griseus*, or common large Mungoose, is sometimes found; the *Canis aureus* is very common, and in the park of Barrackpoore I have seen this animal (the Jackal of India) allow carriages to pass within a few yards of it, whilst they composedly sat down; the common Fox, *Vulpes bengalensis*, is also found.

Amongst the Rats I obtained *Mus indicus*, *M. flavescens*, *M. nemoralis*, *M. decumanus* and *M. manei*; also *Sorex murinus*, and another *Sorex* which may prove a new species or a very dark variety of the former; the *Sciurus palmarum* is very common.

Amongst the Bats I obtained *Nycticejus castaneus*, *N. luteus*, *Rhinolophus lepidus*, *Taphozaus longimanus*, *Megaderma lyra*, *Cynopterus marginatus* and *Pteropus edwardsii*, all very common; this latter is the Flying Fox of India. Thus ends my list of mammalia found at Barrackpoore: that several other species exist there can be no doubt, yet as I failed to obtain them I refrain from mentioning them. I must not omit mentioning that I received every assistance from my friends E. Blyth, Esq., and Jas. Curr, Esq., during my stay at Barrackpoore, to whom I offer my best thanks.

XXXII.—*Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites.* By Thomas Wright, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School.

[Concluded from p. 324.]

Ophioderma Gaveyi, Wright, 1852. Pl. XIII. fig. 1 *a–c*.

Diagnosis.—Disc large, upper surface not exposed, under surface with five pairs of heartshaped plates, above which the five rays pass; the median scutal plates of the rays form a ridge in the centre of each pair of plates; the mouth-opening is surrounded with five pairs of very prominent toothlike processes; the rays are slender and gently tapering; the central scutal plates on the dorsal and ventral surfaces of the rays are narrow, those on the ventral surface resemble the bodies of small vertebræ deprived of their neural elements.

Transverse diameter of the body-disc 1 inch and $\frac{2}{10}$ths, transverse diameter of the rays at their junction with the disc nearly $\frac{3}{10}$ths of an inch.

Description.—This Sea-star must have been rather abundant in the Liasic sea; we have seen many fine specimens of it, and numerous fragments of others in the locality where it was collected. The body-disc is large and pentagonal, it is composed underneath of ten thin, delicate triangular plates arranged in pairs, each pair forming a heartshaped shield, having an elevated rugose carina down its centre, formed by the median element of the ventral scutal plates which protrudes between each of the two plates forming a pair; the five shields are otherwise smooth on their under surface, and were united together in the living state by a membrane, but in the specimen before us they are quite separate from each other; at the apex of each of the ten triangular plates a sharp toothlike process projects downwards, which together form an imposing dental circle around the mouth-opening. The rays are long, slender, and gently tapering; we have not been able to measure the absolute length of one, as those which we have met with were always fractured; the dorsal median pieces of the rays are hexagonal and elongated transversely, the ventral median pieces are elongated in the direction of the length of the ray, and resemble the bodies of small vertebræ which had been deprived of their neural arches; the marginal plates are rounded and finely imbricated, their outward free border is toothed with five or six pectinated processes, which in the living state supported as many spines; the remains of these are sometimes seen attached to their supports; the lateral scutal plates clasp the rays firmly and securely, and overlap the median pieces both above and below.

Affinities and differences.—This elegant Sea-star somewhat resembles in its general contour *Ophioderma Milleri*, but it is distinguished from that marlstone species by having a proportionately larger body-disc, with more slender and more tapering rays: in the form and structure of the scutal elements of the rays themselves there is likewise a difference, those in *O. Milleri* are of a more elongated and regular form, whilst in *O. Gaveyi* they are shorter, more ridgy and vertebrate-like; the ten triangular ventral discal plates are smaller in *O. Milleri* than in *O. Gaveyi*; they want likewise, in the figures given by Mr. Charlesworth in the London Geological Journal, the toothlike spines at their apices which are so characteristic of our *Ophiura*.

Locality and stratigraphical range.—This Sea-star was collected by Mr. Gavey from the upper shales of the Lower Lias at Mickleton Tunnel near Chipping Campden, Gloucestershire, whilst making the Oxford, Worcester and Wolverhampton Railway; and we have found some fragments of a Sea-star much resembling in structure this species in a Liasic bed of the same horizon at Hewlitt's Hill near Cheltenham, during the excavation of the new reservoir of the Water Works Company of that town.

We dedicate this species to our friend Mr. G. E. Gavey, whose careful and minute investigation of the beds exposed in the section which he has so well described*, added to the discovery of new forms of Radiata and Mollusca in the same, has enriched our knowledge of the Liasic fauna of Gloucestershire.

Ophioderma Griesbachii, Wright. Pl. XIII. fig. 2 *a, b*.

Diagnosis.—Body-disc small, upper surface not exposed, under surface irregularly subpentagonal, formed of five pairs of heart-shaped plates; rays long, slender, and awl-shaped, prolonged beneath into the centre of the body-disc; inferior surface with median vertebrate-like elements, and lateral scutal plates in the form of oblique pyramidal pieces, which clasp the sides of the rays in an imbricated manner, and support at their terminal points short stout spines; mouth subpentagonal, surrounded by ten blunt spinous processes, formed by the development of the first lateral scutal plates of the rays, where they join each other around the mouth.

Diameter of the body-disc $\frac{7}{20}$ths of an inch, length of the rays from the mouth-margin to their apex $\frac{15}{20}$ths of an inch.

Description.—This beautiful Brittle-star of the Oolitic sea was discovered by our friend the Rev. A. W. Griesbach, of Wollaston, and we owe to his kindness and liberality the series of exquisite specimens before us, by which we have been enabled to complete the description of this new fossil. The body-disc is small, consisting of five pairs of heart-shaped plates; the union between the separate elements of the disc was very intimate, as it is only at one or two points that a suture is exhibited; so close is the union, that in other specimens the body-disc seems to be formed of a single circular element; each pair of plates has a heart-shaped form, and the ray corresponding thereto stands out in bold relief from the under surface of the disc. In none of the specimens found is the upper surface of the disc exposed, and we know not with certainty what kind of ornamentation adorned its dorsal surface; at one part, however, where a portion of one of the plates is weathered, we think we detected with our inch object-glass under the microscope, a series of small imbricated scales resting on the rock surface; the rays are long, slender, and gently tapering; their under surface, the only one exposed, exhibits, 1st, a central element having an elongated form, which resembles the body of a fish's vertebræ in miniature; 2nd, lateral elements more largely developed, consisting of triangular plates of a pyramidal form slightly twisted round, by which arrangement the apices of the pyramids are made to clasp

* Railway Cuttings at Mickleton Tunnel and Aston Magna, by G. E. Gavey, Quart. Journ. Geol. Soc. February 7, 1853.

each other, and thereby produce a regular imbricated structure; the points of the lateral plates support small, short, stout spines, which are only seen in one of the rays of the three specimens before us. Where the base of the ray crosses the under surface of the body-disc it is firmly attached thereto, and as they approach the centre, each of the lateral plates of the rays becomes greatly developed, and form by their union five channels, which extend into the mouth; this opening is in the centre of the disc, and has a subpentagonal form; it is of a moderate size, and is surrounded by ten stout spines formed by the development of the first lateral plates, which are much expanded and terminate at the oral border in short stout spinous processes; the lateral plates from the adjoining rays are here united together, so that two spines from the lateral plates of different rays are closely approximated, and the five rays are thereby united together round the mouth-opening like five Gothic arches, so that the mouth with its channels, formed by these arches, resembles a miniature starfish in the centre of the disc; the five pairs of spines may have served as jaws.

Affinities and differences.—Our knowledge of fossil *Ophiuridæ* is unfortunately so limited, and the details of those forms known are so meagre, that there is much difficulty in making a comparison between the extinct genera of this family. In our description of *Ophioderma Gaveyi* a diagnosis has been attempted between it and *O. Milleri*, Phil., both of these being Liasic species. The other forms hitherto published are those figured by Goldfuss, namely the *Ophiura prisca*, Münster, from the Muschelkalk of Baireuth; the *Ophiura loricata*, Goldf., from the Muschelkalk of Würtemberg; the *Ophiura speciosa* and *O. carinata*, Münster, from the Lithographic slates of Solenhofen; of these Goldfuss's figures are excellent, and leave nothing to be desired, as that able natural-history artist Herr Hohe, whose crayon has added such lasting value to the 'Petrefacta Germaniæ,' has given accurate details of structure which prevent the possibility of confusion regarding the identification of the species drawn by him.

The *Ophiura Egertoni*, Brod.*, found in nodules of micaceous sandstone at the base of the Inferior Oolite near Charmouth, is so entirely distinct from our fossil, that to mistake them is impossible; between *O. Griesbachii* and *O. speciosa* and *O. carinata*, the difference is likewise very great; *O. loricata* comes nearer to our Brittle-star than either of the others, but the great development of the lateral plates of the rays, and the clasping and imbricated character of the same in *O. Griesbachii*, forms a structural character which separates it widely from Goldfuss's species.

* Geol. Trans. 2nd series, vol. v. pl. 12.

If we seek further for resemblances to our Brittle-star, we must look for them more amongst the beautiful *Ophiocomæ* of our seas than among any forms we are acquainted with in the fossil state, but even between it and them the differences are many and distinct.

Locality and stratigraphical range.—This beautiful fossil was collected by the Rev. A. W. Griesbach from the Forest marble of Oundle, Northamptonshire, where it is rare. We have dedicated this species to that gentleman, to whom we are indebted for much valuable information relative to the stratigraphical distribution of Echinoderms in his county, and likewise for a liberal contribution of materials to aid us in the completion of these memoirs.

Pentacrinus Goldfussii, Wright. Pl. XIII. fig. 3.

Diagnosis.—Calyx composed of a central pentagonal plate, five small heart-shaped pieces, and five large triangular basal elements; rays thick, strong and bifurcated; total number of their subdivisions unknown; the five primary rays consist of two pieces, the basal piece is flat, and has a slightly elevated portion about the centre of the upper surface, the brachial piece is strong and triangular, its base resting firmly on the former; the sides of the triangle support two arms; the ten secondary rays consist of from ten to eleven circular pieces with smooth unequal undulated surfaces, whereby their thickness is rendered very unequal; the secondary rays support twenty tertiary rays, which have the same general character as the secondary rays; the number of pieces entering into the composition of each is unknown; from the fragmentary state of this part of the specimen the number may be estimated at from fifteen to twenty pieces. The column near the calyx is composed of thin, deeply divided five-rayed plates, with well-marked transverse articular impressions on their surfaces; every fourth plate is thicker, broader, and more prominent than the one above it or below it; the side arms are numerous, and composed of thin circular plates: the lower part of the column is unknown.

Description.—This beautiful Sea Lily is remarkable among its Liasic congeners for the comparative strength and thickness of its rays; the centrum of the calyx is simply a thickened and enlarged columnar joint to which the upper part of the column is articulated; around the apices of the rays of this centrum five small heart-shaped basal pieces are inserted, the points of which are directed outwards; they are very convex externally, projecting from the surface of the calyx, and have the appearance of five mammillary eminences disposed around the union of the column with the calyx.

The rays are short and robust; the primary portion consists of two pieces, a flat basal plate and a triangular brachial plate; the basal plate has a slight elevation on its outer and upper articular surface; the brachial plate has the form of an equilateral triangle, it is very convex externally, and has its base firmly planted on the flat basal plate, and its sides support the secondary rays; these are ten in number, and consist of from ten to eleven circular plates, each differing in form and thickness from the other, their articular surfaces being smooth and undulated in different directions, the elevations of the one plate always corresponding to the depressions of the other with which it is articulated; these inequalities are well seen in the specimen before us; from the various angles at which these plates lie in relation to each other, the ultimate brachial piece of each of the secondary rays has a triangular form externally, the sides of which support the tertiary rays; these, like the secondary rays, consist of unequal-sized plates with undulated articular surfaces, which are marked with fine lines that radiate from the centre to the circumference; the number of the elements in these tertiary rays cannot be accurately made out in consequence of the imperfection of this part of the skeleton; judging however from the remains of the plates in a part of the slab once occupied by a tertiary ray, we estimate their number to have been from fifteen to twenty. The inferior surface of the centre of the calyx exhibits a depression produced by the convexity of the brachial elements and the prominence of the heart-shaped basal pieces; into this depression the summit of the column closely fits. It is unfortunate that so small a portion of the column of this Crinoid is preserved, as it is possible that the lower part of the stem was different from that which is preserved; the upper part of the column before us consists of thin star-shaped plates, the rays of which are deeply divided, and their surfaces are sculptured with well-marked transverse articular processes; between every third plate a thicker and broader plate is introduced; the side-arms appear to have been numerous about the upper part of the column; they were composed of thin circular plates having undulated surfaces similar to those observed on the secondary and tertiary rays.

Affinities and differences.—Pentacrinus Goldfussii resembles in some points *P. tuberculatus*, Mill.: through the kindness of Major Austin and Mr. Etheridge we had the privilege of comparing our fossil with Miller's type specimen in the Bristol Museum, but the imperfection of that Crinoid makes a rigorous comparison impossible; one point of difference which Miller thought specific of *P. tuberculatus* he thus describes: "The column differs in its joints, being thinner, and their having been covered all over with a more conspicuous muscular coat, which shows itself in numerous minute tubercles the result of its contraction *:" this character is certainly absent in our fossil. It is distinguished from *P. briareus*, Mill., *P. subangularis*, Mill., and *P. scalaris*, Goldf., by the absence of lateral branches from the rays, and from all others of its Liasic congeners with which we are acquainted in the strength and thickness of the rays themselves.

Locality and stratigraphical range.—This remarkable Sea Lily was discovered by Mr. R. E. Gavey, C.E., in the Lower Lias of Mickleton Tunnel near Chipping Campden, Gloucestershire; it is imbedded in shale resting on a hard slab of limestone, and was associated with the remains of other Radiata.

We dedicate this fine Liasic Crinoid to the memory of the late Prof. Goldfuss, whose great work, 'Petrefacta Germaniæ,' has so much increased our knowledge of the Liasic and Oolitic fauna.

A Tabular View of the Stratigraphical Distribution of the New Species described in this Memoir.

Genera and Species.	Authority.	Lower Lias.	Marlstone.	Upper Lias.	Inferior Oolite.	Great Oolite.	Cornbrash.	Forest Marble.	Coralline Oolite.
Cidaris Edwardsii	Wright ...	*							
—— Bouchardii	Wright ...	...	...	...	*				
Hemicidaris minor	Agassiz ...	...	...	...	...	*			
Acrosalenia crinifera	Quenstedt	*							
Diadema Davidsoni	Wright ...	...	...	...	...	...	...	...	*
—— Mooreii	Wright ...	...	...	*					
Pedina Bakeri	Wright ...	...	...	...	*				
—— Etheridgii	Wright ...	...	...	*	*				
Polycyphus nodulosus ...	Münster ...	...	...	...	...	*	*		
—— Deslongchampsii ...	Wright ...	...	...	...	*				
Nucleolites Woodwardii ...	Wright ...	...	...	...	...	*			
—— Michelinii	Wright ...	...	...	...	*				
—— scutatus	Lamarck...	...	...	...	...	...	...	...	*
Ophioderma Gaveyi.........	Wright ...	*							
—— Griesbachii	Wright ...	...	...	...	...	...	...	*	
Pentacrinus Goldfussii ...	Wright ...	*							

* Miller's Crinoidea, p. 65.

EXPLANATION OF PLATES XI. XII. AND XIII.

PLATE XI.

Fig. 1. *Cidaris Edwardsii*: *a*, natural size, and restored to its globular form; *b*, portion of an ambulacral area magnified, showing the pedal pores and tubercles; *c*, primary tubercle, with its circle of areal granules, magnified; *d*, one of the jaws and its tooth, of the natural size; *e*, secondary spine, natural size and magnified; *f*, primary spines, natural size and magnified.

Fig. 2. *Cidaris Bouchardii*: *a*, *b*, natural size; *c*, primary tubercle and ambulacral area, magnified.

Fig. 3. *Hemicidaris minor*: *a*, natural size; *b*, magnified two diameters; *c*, primary tubercle and ambulacral area, magnified.

Fig. 4. *Pedina Bakeri*: *a*, natural size; *b*, magnified one and a half diameter; *c*, primary tubercle and ambulacral area, magnified.

Fig. 5. *Pedina Etheridgii*: *a*, natural size; *b*, upper surface and ovarial plates, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle and ambulacral area, magnified.

PLATE XII.

Fig. 1. *Acrosalenia crinifera*: *a*, natural size; *b*, upper surface, magnified three diameters; *c*, under surface, magnified three diameters; *d*, primary tubercle and lateral granules, magnified.

Fig. 2. *Diadema Davidsoni*: *a*, under surface and mouth-opening, natural size; *b*, upper surface and anal opening, natural size; *c*, side view, showing the tubercles of both areas; *d*, base of one of the ambulacral areas, showing the clustering together of the pedal pores in this region; *e*, primary tubercle, ambulacral area, and pedal pores, magnified.

Fig. 3. *Diadema Moorei*: *a*, natural size; *b*, upper surface and ovarial disc, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle, circle of granules, and pedal pores, magnified.

Fig. 4. *Polycyphus Deslongchampsii*: *a*, natural size; *b*, upper surface and ovarial disc, magnified one and a half diameter; *c*, outline of the mouth-opening; *d*, genital and ocular plates of the ovarial disc, magnified; *e*, primary tubercle, areal granules, pedal pores, and ambulacral area enlarged.

Fig. 5. *Nucleolites Woodwardii*: *a*, upper surface, of the natural size; *b*, side view, of the natural size; *c*, ambulacral area and pedal pores, magnified two and a half diameters; *d*, tubercles and areas, magnified; *e*, mouth-opening and ambulacral area, magnified one and a half diameter.

Fig. 6. *Nucleolites Michelini*: *a*, upper surface, reduced one-third in size; *b*, lateral view, reduced one-third in size; *c*, a portion of the ambulacral area and pedal pores, natural size.

PLATE XIII.

Fig. 1. *Ophioderma Gaveyi*: *a*, disk, with portion of the rays, natural size; *b*, part of the upper side of a ray, enlarged three diameters; *c*, under side, enlarged three diameters.

Fig. 2. *Ophioderma Griesbachii*: *a*, natural size; *b*, disk and a part of the rays, enlarged three diameters.

Fig. 3. *Pentacrinus Goldfussii*: natural size.

XXXIII.—*Observations on* "Prof. Sedgwick's *Reply to some Statements reflecting on the University of Cambridge.*" By J. S. Bowerbank, F.R.S., Hon. Sec. Palæontographical Society.

To the Editors of the Annals of Natural History.

Gentlemen,

In Prof. Sedgwick's "Reply to some statements reflecting on the University of Cambridge," there is a passage which I cannot allow to pass without a few observations. At page 283, line 1, in the number of the Ann. and Mag. Nat. Hist. for April 1854, Prof. Sedgwick writes, "I affirm, that *no application*, direct or indirect, was ever made to me, either by MM. Edwards and Haime, or by any member of the Palæontographical Society, for a loan of any part of the Cambridge Palæozoic Fossils." The best reply to this passage will be a short detail of the circumstances connected with the production of Prof. M.-Edwards and M. Jules Haime's work on the 'Fossil Corals of Great Britain.'

Previously to the publication of any portion of the work, it was felt necessary by Prof. M.-Edwards to visit London to collect materials for the proposed monographs, and immediately after his arrival we had several interviews, in the course of which I pointed out to him the various sources whence he might obtain the specimens to be figured and described in the series of Monographs to be produced; and from the first communication I had with him, I fully understood that his work was intended to embrace, not a part only, but the whole of the Fossil Corals of Great Britain.

Our supply of Tertiary and Oolitic Corals from the London collections was so complete and abundant as to render us very easy regarding that part of the subject; but our principal anxiety was on account of the Carboniferous, Silurian and Cambrian Corals. Fortunately I have preserved the rough notes made during the last conference we had on these subjects, and among these notes are the following:—

"P. M.-E. Letters to Pengelley and Battersby,—Coral from Museum, Dublin. Write Ball, E. W. Fletcher of Dudley, Gray of Dudley, and Sedgwick." The whole of these names, with which Prof. Sedgwick's is associated, are notorious as collectors of Palæozoic fossils. It is true that I have not the slightest recollection of the act of writing to any of these gentlemen, but it is equally true that every one of them, excepting Prof. Sedgwick, kindly and liberally forwarded considerable packages of Palæozoic fossils to Prof. M.-Edwards, at Paris, to aid him in the production of that portion of his work; and I therefore feel morally certain that, in accordance with my duty as Secretary of the

Society, I did make written application to the parties whose names are mentioned in the note quoted above, and among them to Prof. Sedgwick, but receiving no letter from him in reply, I recollect well solacing myself with the idea that I should very shortly see him at the Anniversary Meeting of the Members of the Ipswich Museum.

In the earlier part of my recent correspondence with Prof. Sedgwick, he expresses a total oblivion regarding the receipt of such a letter from me touching the loan of Corals, but subsequently the existence of such a letter, although entirely forgotten by the worthy Professor, is rendered apparent by a quotation from one of Prof. Sedgwick's notes to Prof. M'Coy, in which he deputes the latter gentleman to reply to my communication. What that letter may have contained, I cannot pretend to say with precision, but Prof. Sedgwick says it has reference only to Secondary Corals, and it is not improbable that I may have used that term in its oldest and most extended sense; but, let that be as it may, I am certain regarding my personal application at Ipswich to the Professor, and which application it appears he has forgotten as completely as he did the letter above alluded to, which it ultimately appears from his own evidence he received.

As I expected, I met Prof. Sedgwick at the house of a mutual friend, at Ipswich, on the evening preceding the Anniversary of the Ipswich Museum, but I had no opportunity during the evening of conversing with him; but on the following morning, shortly after breakfast, I applied to Prof. Sedgwick, in the name of the Council of the Palæontographical Society, for the loan of such Mountain Limestone and Silurian fossils as Prof. M.-Edwards might require from the Cambridge Museum, for the completion of his Monograph; and I recollect well the purport of his reply was, "That he could not himself do it—that such things were not permitted to leave the University—and that the proper course would be to make a formal application to the governing body of the University (I forget the term used), and that he did not think they would then grant the request."

I wrote to M. Edwards the result of my application, and afterwards told him personally what had occurred, and he agreed with me in considering it as a refusal. At the next meeting of the Council there was a general expression of regret at the result of the application, and a strong conviction that, had the Professor thought fit to have assisted us in the affair, there would have been but few difficulties to surmount.

In corroboration of the above statement, I may mention that in a note recently received from Prof. Milne-Edwards, he writes, "If I remember right, it was either you, Sir H. de la Beche or

Prof. Forbes that were so obliging as to ask M. S. to lend me the Cambridge specimens; at the same time that you presented a similar demand on behalf of the Palæontographical Society to Messrs. Fletcher, Battersby, the British Museum, Geological Society, &c. &c." The liberal supply that we received from other sources, if I recollect correctly, rendered an application to the British Museum unnecessary. In every other respect the recollection of Prof. M.-Edwards regarding the application to Prof. Sedgwick for Mountain Limestone and Silurian corals, is in perfect accordance with my own.

I cannot account for the impression made on Prof. Sedgwick's mind, that the Palæozoic corals were not intended to be published by Prof. M.-Edwards and M. Jules Haime, as in the Report made to the Annual Meeting, held on the 23rd of March, 1850, and subsequently printed and distributed to the Members, the following passage occurs :—" The Council have also the pleasure to announce, that the first work for 1850, Part I. of Prof. Milne-Edwards's Monograph of the '*Fossil Corals of Great Britain,*' containing twelve plates, is in the binder's hands, and will be delivered with the works for 1848 and 1849." The title of the work thus advertised before the issue of the first part distinctly embraces the whole of the fossil corals. In the Report of the following year, the work is again designated by the same comprehensive title. Nor is there any discrepancy in the statement made by Prof. M.-Edwards to Prof. M'Coy, quoted in his letter, p. 287, Ann. and Mag. Nat. Hist. April 1854, who writes, " They were highly complimentary on all the work that had been done, and stated that they were about preparing a monograph on the Tertiary, and subsequently one on the Oolitic corals for the Palæontographical Society, but had no *immediate* intention of touching the Palæozoic corals." Had the word *immediate* been left out, I could have perfectly comprehended the misapprehension that appears to have arisen in Prof. M'Coy's mind regarding the limitation of the work; but the introduction of that word appears to me distinctly to imply that the Palæozoic corals were not excluded, but simply deferred until their turn for publication should arrive.

Of the two modes of application, I am more surprised that the written one should have been so completely forgotten until recalled by Prof. M'Coy's extract from Prof. Sedgwick's letter to him; while the personal one, made a very short time previously to a public meeting in which the learned Professor took a deep interest, and at which he delivered one of those eloquent and brilliant addresses which it is his habit to pour forth on such occasions, may naturally be supposed, under the excitement of the period, to have been totally obliterated by passing events.

XXXIV.—*Monograph of the British* Graphideæ. By the Rev. W. A. Leighton, B.A., F.B.S.E.

[Continued from p. 279.]

3. *Hymenodecton.*

Apothecium lirellæform, immersed; perithecium a very thin black cartilaginous membrane, entire or surrounding the sides and base; disk broad, plane, surrounded with a very slender proper margin and an accessory thallodal margin. Thallus crustaceous or membranaceous.

Name from ὑμὴν, *a membrane*, and δεκτικὸς, *fitted to receive*, in allusion to the membranous structure of the perithecium.

1. *Hymenodecton dendriticum.* Thallus tartareous, pulverulent, determinate; lirellæ immersed, branched in a pedato-radiate manner; proper margin very thin; thallodal margin prominent, rugose; disk plane, dilated, pruinose; sporidia in asci, eight, linear, margined, rounded at the ends, containing about eight transversely oval margined spores.

Opegrapha dendritica, Ach. Meth. 31. t. 1. f. 10 (1803) (bad); Sm. E. Bot. 1756 (excellent); Fries, L. Ref. 372; Hook. Br. Fl. 2. 147.
—— *dendritica α*, Tayl. Fl. Hib. pt. 2. 106 (1836); Schær. Enum. 152; Exs. 585!
Graphis dendritica, Ach. L. Univ. 271. (1810) t. 3. fig. 16; Syn. 83.
"*Arthonia dentritica*, Dufour, Journ. Phys. 87. 206." (1818) (fide Fries et Chevallier); Chevallier, Fl. de Paris, 1. 294.
Opegrapha scripta, ζ. dendritica, Schær. Spic. 47. 323 (1823–1836).
Platygramme dendritica, Meyer in Sprengel Syst. Veg. 4. 1. 254 (1827).
Graphis pulverulenta, β. syngrapta, Wallr. Crypt. 331 (1831).

α. Smithii. Lirellæ ramifying at an obtuse angle, extremities acute, thallodal margin prominent.—E. Bot. t. 1756.

On beech. Sussex! *Mr. Borrer.* New Forest, Hampshire! *Mr. Lyell.* Cors-y-gedol! *Rev. T. Salwey.* Castle Bernard Park, Bandon, Ireland! *Rev. Prof. Hincks.*

Thallus thin, tartareous, pulverulent and cracked, forming large, whitish or pale yellow patches, often with a reddish tinge or glow, circumscribed by a pale watery wavy brown margin or line, the central portion very rugged from the confluent thallodal margins, entirely covered by the crowded lirellæ which cease before reaching the margin, leaving a naked space between them and the wavy line. *Lirellæ* very densely crowded in the centre, appearing there through partial obliteration, by reason of compression and confusion, as mostly simple or only slightly branched, lanceolate acute at both extremities, towards the margins becoming less crowded and more distant from each other, repeatedly branched in a distinct and very elegant pedato-radiate manner, wavy, curved and flexuose, the extremities very acute, immersed and sunk. *Disk* broad, plane or concave, clothed with a grey pruina, the proper margin very thin and delicate, scarcely discernible, flanked by the raised, prominent, broken, rugose thallodal margins. A vertical section shows that the ascigerous disk is contained in a very thin brown membranous perithecium, which entirely subtends the base, and forms one of the characteristic distinctions between this and *Chiographa* and *Graphis Smithii* (*O. scripta*, E. Bot.).

Specimens of this in herb. Borrer! named *Opeg. dendritica* by Acharius himself are identical with the E. Bot. figure, though the figures and descriptions in the works of Acharius agree better with our var. *γ. obtusa.*

β. acuta. Lirellæ ramifying at a very acute angle, nearly parallel, extremities simple, acuminate; thallodal margin prominent.

On beech. St. Leonard's Forest, Sussex! *Mr. Borrer.* Upton, Pembrokeshire! *Rev. T. Salwey.*

γ. obtusa. Lirellæ ramifying at an obtuse angle in a furcate manner, extremities very obtuse, frequently furcate; thallodal margin nearly obliterated.

On beech. St. Leonard's Forest, Sussex! *Mr. Borrer.* Tunbridge Wells! *Mr. W. Thompson.* Pembrokeshire! *Rev. T. Salwey.* Castle Bernard Park, Bandon, Ireland! *Mr. I. Carroll.*

Plate VII. fig. 23. *a*, Vertical section of thallus and lirella; *b*, sporidium.

4. *Chiographa.*

Apothecium lirellæform or subdisciform, sessile; perithecium carbonaceous, entire or surrounding the sides and base; disk plane, broad, surrounded with a proper margin and an accessory thallodal margin. Thallus membranaceous.

Name from *χιὼν*, *snow*, and *γραφὴ*, *writing*, in allusion to the white powdery thallodal margin.

1. *Chiographa Lyellii.* Thallus membranous, smooth and waxy, determinate; lirellæ prominent, sessile, oblong or linear-oblong, simple, curved; proper margin narrow, prominent; thallodal margin elevated, white, pulverulent; disk plane, broad, pruinose; sporidia in asci, eight, linear, margined, rounded at the ends, containing about 7–8 transversely oval margined spores.

Opegrapha Lyellii, Sm. E. Bot. 1876 (good) (1808); Fries, L. Ref. 373 (excl. E. Bot. 1813); Hook. Br. Fl. 2. 147 (excl. E. Bot. 1813); Schær. Spic. 323; Enum. 152.
Graphis Lyellii, Ach. Syn. 85 (1814).

"*Arthonia marginata*, Dufour, Journ. Phys. 87. 205." (1818) (fide Fries et Schærer).
Platygramme Lyellii, Meyer in Spreng. Syst. Veg. 4. p. 1. 255 (excl. E. Bot. 1813) (1827).

New Forest, Hampshire! *Mr. Lyell in herb. Borrer.*

Thallus thin, membranous, of a dull dirty yellow or olive colour, smooth and waxy in appearance, very similar to some states of *Verrucaria nitida*, Schrad., limited by a dark brown wavy irregular line. *Lirellæ* numerous, scattered irregularly, more or less crowded, prominent and sessile, oblong or linear-oblong, rounded and obtuse at each extremity, for the most part simple, straightish, the margin variously waved and curved, occasionally branched, though apparently in general the result of confluence; —there are also smaller lirellæ of an irregular rounded form interspersed. Disk broad, flat or concave, of a dull dark brown, more or less pruinose, surrounded by a narrow prominent elevated wavy black proper margin, and encompassed by an elevated rounded spurious thallodal margin, very conspicuous by its white colour and pulverulent appearance. A vertical section shows the perithecium to subtend the base of the disk, just as in an *Opegrapha*, not at all resembling the fig. 2 of the genus *Leiorreuma* in Eschweiler's Syst. Lich. 13, though the author remarks, "anatomiam optime repræsentat Ill. Sowerbyus icone *Opegraphæ Lyellii* ejus (Eng. Bot. vol. 27. tab. 1876)," where the structure is identical with our Plate VII. fig. 24 *a*.

The structure of the lirella distinguishes it from *Graphis Smithii* (*Opeg. scripta*, E. Bot.), and that together with the sessile lirellæ with their white thallodal margin and its general habit from *Hymenodecton dendriticum*.

PLATE VII. fig. 24. *a*, Vertical section of thallus and lirella; *b*. sporidia.

5. *Aulacographa.*

Apothecium lirellæform, subimmersed, prominent; perithecium carbonaceous, dimidiate or confined to the sides, palmatifid, the base naked; disk rimæform, closed, surrounded with a proper longitudinally furrowed margin and an accessory thallodal margin. Thallus membranaceous.

Name from *αὖλαξ*, *a furrow*, and *γραφὴ*, *writing*, in allusion to the furrowed proper margins.

1. *Aulacographa elegans.* Thallus membranaceous, subtartareous, orbicular, granulated or rugose, determinate; lirellæ erumpent, prominent, sessile, oblong or lineari-elongate, simple, straight or curved; proper margin thick, tumid, prominent, longitudinally furrowed; thallodal margin thin, membranous; disk rimæform; sporidia in asci, lineari-elongate, with a broad mem-

branous border, containing 11–13 transversely oval margined spores.

Opegrapha elegans, Sm. E. Bot. t. 1812 (1807); Fries, L. Ref. 370; Hook. Br. Fl. 2. 146; Schær. Enum. 152; Exsic. 515! Bohler, Lich. Brit. 27!
—— *scripta*, *η. elegans*, Schær. Spicil. 323 (1823–1836).
Graphis elegans, Ach. Syn. 85 (1814); Spreng. Syst. Veg. 4. 1. 250.
—— *pulverulenta*, *δ. geminata*, Wallr. Crypt. Germ. 331 (1831).
Opegrapha sulcata, Moug. & Nestl. Stirp. Vog. 360! (1813); "DeCand. Fl. Franç. 6. 171." (fide Fries); "Duf. Journ. de Phys. 87. p. 222. n. 22." (fide Schær.); Tayl. Fl. Hib. pt. 2. 107.
Aulacographa elegans, Leight. Lich. Brit. Exsic. 68! (1852).

Sussex, on various trees, finest on holly! *Mr. Borrer.* Near Ashbourne, Derbyshire! Scotland! *Dr. R. K. Greville.* Oxfordshire! *Mr. Baxter in herb. Greville.* Crafnant, Shropshire! *Rev. T. Salwey.* East and north sides of Bardon Hill, Leicestershire! Gracedieu, Leicestershire! *Rev. A. Bloxam.* St. Leonard's Forest, Sussex! Tunbridge Wells! *Mr. W. Thompson.* Berrow Wood! and Holly-bush Hill! Malvern Hills, Worcestershire, *Mr. E. Lees.* Thorndon Hall Park, Essex! *Mr. H. Piggot.* Riverstone! and Ballymartle! co. Cork, *Mr. I. Carroll.*

Gloddaeth near Conway, Caernarvonshire! Haughmond Hill, Shropshire!

Thallus forming large roundish uninterrupted patches of several inches extent, with a pale irregular border, except when it meets with other lichens, when a narrow brownish line or border makes its appearance, of a pale cream colour or whitish, or whitish gray, sometimes somewhat shining, generally dull, either thin, membranaceous, continuous and covered with minute granular protuberances, or thicker and subtartareous, rugose and cracked. *Lirellæ* numerous, scattered in all directions, mostly simple, but by confluence, or more correctly speaking, by contact, appearing branched, sometimes so thickly congregated in groups as to be radiate, and on the birch affecting a subparallel arrangement, in size as various as in direction and arrangement, short and stout, oblong or linear-oblong, obtuse at the ends, or very elongate, linear and slender, straightish or wavy and curved, and slightly tapered towards each extremity, all erumpent and prominent, bursting upwards through the crust which remains as a thin accessory border appressed along the sides and base of the lirellæ, and also as a film investing and filling up the furrows of the prominent proper margins, giving them in contrast with their full black colour a variegated pulverulent aspect. *Disk* very narrow, merely a simple chink, almost closed by the incurvature of the thick stout prominent rounded *proper margins*, which are marked by deep distinct uninterrupted longitudinal furrows. The number of these furrows is very variable, sometimes only a single one on each side the disk, sometimes 2, 3 or even 4.

With a single furrow the plant is as represented in E. Bot. t. 1812, with many furrows it becomes *Op. sulcata*, Pers., Tayl. Fl. Hib. 107, but as these variations with every intermediate gradation are all clearly traceable abundantly on almost any patch of considerable size, they seem to be too inconstant to constitute distinct varieties, evidently being only different states. The singular structure of the perithecium when seen in a vertical section will be sufficiently intelligible by reference to our Pl. VII. fig. 26 *a*, *a* 1. The *sporidia* are very large and peculiar, of a linear-elongate form, slender and narrow, consisting of about 11–13 transversely oval pale yellow spores with white margins, connected together, the central one the largest, the others gradually diminishing in size towards each extremity, the whole invested with a thin hyaline membranous sac, which under the microscope appears to form a broad white articulated border to the sporidium.

Plate VII. fig. 26. *a*, Vertical section of lirella with a single furrow on the proper margins; *a* 1, vertical section of lirellæ with many furrows on the proper margins; *b*, sporidium.

6. *Lecanactis*, Eschw.

Apothecium lirellæform, or subdisciform, immersed; perithecium carbonaceous, entire or surrounding the sides and base; disk plane, open, pruinose, surrounded with a proper margin. Thallus crustaceous.

Name from λεκάνη, *a dish*, and ἀκτὶν, *a ray*, probably from its affinity to the genus *Lecidea*, whose apothecia are *patellulæ*.

The structure of the perithecium would have led me to arrange this with the genus *Opegrapha*, but it is retained in deference to the authority of Eschweiler and Fries, the latter of whom, speaking of its affinity to *Opegrapha*, remarks, "meo sensu præter vegetationem diversam essentialiter differunt excipulo semper aperto, margine jam primitus erecto (tenui) disco planiusculo, habitu Lecideæ v. c. *L. corticolæ*. Forma apotheciorum magis polygona quam lirellæformis. Excipulum valde differt. Opegraphæ genuinæ Verrucariarum instar incipiunt, nunquam vero Lecanactides. . . . . . Paucis, si Graphidearum tribus dissolveretur, neglecta apotheciorum forma, a qua pendet, Opegraphæ ad Limborieas, Lecanactides ad Lecideas pertinerent. Hanc quoque cum Lecideis affinitatem generis nomen imponens in mente occulte habuisse videtur Auctor." L. Ref. 374.

1. *Lecanactis lyncea*, Eschw. Thallus tartareous, pulverulent, white; lirellæ immersed, oblong or lineari-oblong, rounded at each end, simple, curved; proper margin stout, elevated, wavy; disk plane, dilated, pruinose; sporidia in asci, eight, fusiform, 7-septate, pale yellow.

Lichen lynceus, Sm. E. Bot. t. 809 (1800).
Lecidea lyncea, Ach. Meth. 52 (1803).
Opegrapha cæsia, DeCand. Fl. Fr. 2. 309 (1805) (fide Fries); Cheval. Hist. Graph. t. 20. fig. 3 *c*, 4, 5; Flor. Paris, 531.
Arthonia lyncea, Ach. in Schrad. N. Journ. Bot. 1. st. 3. p. 11 (1806); L. Univ. 147; Syn. 7; Moug. & Nestl. Stirpes, 1158!
Opegrapha notha, var. cæsia, Ach. Syn. 76 (1814) (fide Fries, Borrer et Martius).
—— *cymbiformis, var.*, Schær. Spicil. 51. 553 (1823–1842).
Graphis cæsia, Meyer in Spreng. Syst. Veg. 4. p. 1. 252 (1827).
Lecanactis lyncea, Eschweil. Syst. Lich. 14. fig. 7 (1824); Fries, L. Reform. 375.
Leiogramma lynceum, Martius, Fl. Brasil. 1. pt. 1. 99 (1833).
Opegrapha lyncea, Borr. in Hook. Br. Fl. 2. 144 (1833); Bohler, Lich. Brit. no. 93!; Schær. Enum. 158.

On old oaks, and oak timber long exposed to the weather. Sussex! *Mr. Borrer*. New Forest, Hampshire! *Mr. Lyell in herb. Borrer*. Oswestry, Shropshire! *Rev. T. Salwey*. On the 'Bear's Oak' at Penshurst, Kent! *Mr. W. Thompson*. Northamptonshire! *Rev. Churchill Babington*. Hartshill Wood near Atherstone, Warwickshire! Donnington Park, Leicestershire! *Rev. A. Bloxam*. Thorndon Hall Park, Essex! *Mr. H. Piggot*. Great Malvern, Worcestershire! *Mr. E. Lees*. Haughmond Hill, Shropshire!

Thallus diffuse, thin, tartareous, white, pulverulent, cracked. *Lirellæ* numerous, scattered irregularly over the whole thallus, more or less crowded, very various and variable in shape and size, of an orbicular, oval, oblong, or linear-oblong, or elongate form, rounded and obtuse at both extremities, straightish or curved and wavy, chiefly simple, but sometimes compound or branched apparently from confluence, imbedded in the thallus, and either level with or elevated above its surface. *Disk* broad and expanded, flat, rough with minute points or elevations, cæsious, or pale bluish-grey with pruina, surrounded by a stout rounded elevated black wavy proper margin, often inconspicuous from excess of pruina or age, but with care always to be detected. In vertical section, the receptacle of which the proper margin is the upper edge is seen to subtend the whole of the sides and base of the pale brown hyaline ascigerous disk, and to be expanded below into a sort of torus, which penetrates the thallus down to the bark on which the plant grows.

Not to be confounded with *Lecidea albo-atra, β. corticola*, Schær. Exs. 445! to which it bears some general resemblance, the structure of that plant being different, and the sporidia small, broadly oblong, dark, 3-septate. Nor again with *Opegrapha cymbiformis γ. hebraica, A. corticola*, Schær. Exs. 98! in which the lirellæ in an old state are of somewhat similar appearance. Nor to be regarded as a variety of *Opeg. cymbiformis*, Schær., as in Schærer's opinion (Spicil. 51), the sporidia in that plant (Schær. Exs. 97 ! and 98 !) being of a subclavate form, 5-septate, pale yellow.

The plant named *Spiloma fuliginosum*, Turn. and Borr. Lichen. Brit. 37 (*Spiloma microclonium*, E. Bot. 2150, not of Ach.), which consists of small conglomerations of minute irregularly rounded dark olive-green globules, has, as I think, no connection with *Lecanactis lyncea* further than being parasitical upon its thallus.

Eschweiler (Syst. Lich. 14) describes the sporidia correctly, "thecæ fusiformi-cylindricæ, annulatæ," but figures them incorrectly in fig. 7.

PLATE VII. fig. 25. *a*, Vertical section of thallus and lirellæ; *b*, sporidia. [The engraver has made the sides of the sporidia *angular*, which is incorrect.]

7. *Platygramma.*

Apothecium lirellæform, subsimple or radiate; perithecium none; lamina proligera free; disk plane, open, naked, without any margin. Thallus crustaceous.

Name from πλατὺς, *broad*, and γράμμα, *a letter*.

1. *Platygramma Hutchinsiæ*, Leight. Thallus crustaceous, minutely cracked; lirellæ immersed in elevated thallodal verrucæ, oblong or elongated, simple or branched, straight or flexuose; disk plane, dilated, naked; sporidia eight, in asci, fusiform, 5- or 7-septate, pale yellow.

Platygramma Hutchinsiæ, Leight. Lich. Brit. Exsic. 130 ! (1853).

On shady rocks near the ground, Ireland ! *Miss Hutchins in herb. Borrer.* Keswick, Cumberland ! *in herb. Borrer.* Newton Rocks, Cleveland, Yorkshire ! *Mr. J. G. Baker.*

Thallus thin, crustaceous, spreading over the face of the rock apparently to some extent, bordered by a raised tubercular black serpentine line, especially visible in young plants, or smaller portions of the plant, of a dull or dirty pale yellow on the exterior, white within, continuous and smooth to the naked eye, under a lens cracked into very minute areolæ, which are minutely verrucose. *Lirellæ* very numerous, scattered without order over the entire surface of the thallus, each imbedded in a separate elevated thallodal wart, the smooth sides of which form a narrow margin to it, of a paler yellow than the thallus, infinitely variable in shape and size, round and minute, oblong, linear, branched into two, three, or many and multiform ramifications, straight or curved, and wavy and flexuose, dark brown. *Disk* on a level with the surface of the thallodal wart, concave without any proper border. In section each side of the upper portion of the nucleus is brown, dense, and thickened, but of the same consistence, not carbonaceous, which sometimes is altogether wanting, and sometimes gradually tapers off into merely a brown film subtending the base. *Nucleus* pale yellow, consisting of asci and paraphyses. The *sporidia* sometimes with môre septa than seven.

PLATE VII. fig. 28. *a*, Vertical section of thallus and lirellæ; *b*. sporidia; *c*, upper surface of thallus and lirellæ.

2. *Platygramma elaborata.* Thallus tartareous, turgescent, smooth; lirellæ immersed, branched, flexuose, with a thallodal margin; disk rounded, dilated, naked; sporidia eight, in asci, acicular, 13-septate, pale yellow.

Opegrapha venosa, Sm. E. Bot. t. 2454 (1812)—(not *Opeg. venosa*, Pers., which, according to Eschweiler, Syst. Lich. p. 13. fig. 3, is a true *Graphis*); Hook. Br. Fl. 2. 148.
Opegraphæ atræ var., Schær. Spicil. 326 (1836) (in part).

On beech trees. New Forest, Hampshire! *Mr. Lyell in herb. Borrer.*

Thallus in small, more or less turgescent patches, variable in shape and extent, on the bark of old beech trees (in our specimens entirely surrounded by *Sagedia aggregata*, Fries, and like that plant), apparently limited by a blackish or dark brown margin, irregular and wavy, and variable in breadth, of a dirty cream-colour, smooth, continuous, only slightly cracked here and there, tartareous and of considerable thickness, somewhat depressed between the lirellæform apothecia, but forming a pale spurious thallodal margin on a level with and around them. *Apothecia* imbedded in the thallus in variously branched, flexuose, wavy, slender, very elegant, lirellæform figures, obtuse at the extremities, somewhat rounded and prominent on the surface which is on a level with the thallus, of a dark red-brown, nearly black, entire and without any proper margin or disk, and therefore not an *Opegrapha*. A vertical section shows a pale hyaline *nucleus* without any apparent tunic or perithecium, slightly darkened on the surface, imbedded in the tartareous thallus. *Sporidia* eight, in asci, very slender and elongated, more or less acute at each extremity, pale yellow, 13-septate.

Differs from *Sagedia aggregata*, Fries, by the sporidia and lirellæform apothecia; and from *Graphis serpentina*, of which a state, generally similar, occurs on the same bark, by the different structure of the lirellæ and the sporidia.

Schærer's Exsic. 587! *Opegrapha crassa, var. venosa*, according to the very imperfect specimen in Mr. Borrer's copy, and which is altogether wanting in mine, is not identical with *Platygramma elaborata*, but is a state or variety of *Sagedia aggregata* in which the apothecia have become confluent, and which is frequently observable together with the usual state of *S. aggregata* on many of the numerous specimens gathered by Mr. Lyell in the New Forest, Hants, existing in Mr. Borrer's herbarium. The sporidia at once show to which plant it belongs, being identical with those of *S. aggregata*. See Leight. Brit. Angioc. Lich. t. 8. fig. 1.

PLATE VII. fig. 27. *a*, Vertical section of thallus and apothecia; *b*, sporidia.

I here introduce a plant which exists in Mr. Borrer's herbarium from "Loughlinstown, Ireland," but from whom received he is ignorant, and which I have also detected growing with *Opegraphæ* on young ash near the Sharpstones Hill, Shropshire. I am doubtful whether it should be referred to *Platygramma* or to *Chiodecton*, with which latter genus the structure of the apothecia greatly assimilates it. I call it provisionallly *Chiodecton graphidioides*: its description is as follows:—

Thallus thin, white, tartareous, evanescent. *Thallodal verrucæ* large and prominent, clustered in groups, round, thick and tartareous, of a dirty white or cream colour, smooth, scarcely pulverulent, marked with irregular rugosities, often from compression in a crowded state forming a cracked continuous crust, very much resembling that of some *Graphideæ*. *Apothecia* generally one in each verruca, very variable in size and shape, lirellæform, simple or branched, straight or wavy, either acute at the extremities or obtuse and rounded, broad and expanded, blackish-brown, somewhat convex, prominent on the upper surface, slightly shining, but without any trace of pruina or proper margins or disk, though surrounded with a sort of spurious thallodal margin narrow and whitish. A vertical section shows an erect irregularly quadrangular dark brown torus penetrating the thallodal verruca, and resting on the thallus or epidermis, bearing on its summit a pale hyaline disciform, flattened or depressed nucleus of paraphyses and erect narrow obovate asci, surmounted by the dense dark brown veil or disk. *Sporidia* eight, in each ascus, fusiform, elongated, more or less curved, 3-septate, pale yellow.

PLATE VII. fig. 29. *a*, Vertical section of thallodal verrucæ and apothecia; *b*, sporidia.

[To be continued.]

XXXV.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq.

[With two Plates.]

[Continued from vol. ix. p. 387.]

662. *Agaricus* (Amanita) *strobiliformis*, Fr. Ep. p. 5; Bull. t. 593.

On the ground on the grassy borders of woods. Laxton Park, Norths., Sept. 1852. Abundant.

Pileus when young subglobose, bulb of the stem conical below, rooting, its border sometimes incised all round, sometimes even, floccose above to the edge of the pileus; scales of pileus large, wart-like, with a brown disc and white floccose border, at length falling off. Pileus when expanded 8 or 9 inches across, at length quite smooth; margin extending beyond the gills. Stem 6–7 inches high, $1\frac{1}{2}$ inch thick, firm, solid; bulb not properly scaly; veil large; gills rounded behind, the shorter ones denticulate at the base. Smell and taste at first slight, at length disagreeable.

This is undoubtedly the species of Vittadini and Bulliard. Too much stress must not be laid upon the incision of the bulb or its scales, for neither character is constant.

663. *A.* (Amanita) *Ceciliæ*, n. s. Pileo primum semielliptico, volva murina crassiuscula rimosa, demum basi irregulariter circumscissa marginata operto, dein campanulato; margine sulcato; stipite sursum attenuato spongioso farcto; annulo nullo.

On the ground in woods, King's Cliffe, Aug. Sept.

Pileus at first semielliptic, densely and uniformly clothed with the thick mouse-coloured volva which at length splits irregularly below from a slight prominence at the base of the stem, but by no means vaginate; then campanulate, obtuse, 3–4 inches across, margin sulcate, dingy yellow, either quite smooth or more or less clothed with the depressed or even acutely warty remains of the volva. Stem 4 inches or more high, $\frac{3}{4}$ of an inch thick, attenuated upwards, above silky, transversely or obliquely rimose, below squamulose from fragments of the volva, spongy within with occasional cavities, but by no means filled with floccose down, not truly bulbous; ring none. Gills thick, sometimes forked or anastomosing, the shorter ones abruptly truncate behind, quite free, at length remote; interstices venous. Smell none. Taste sweet.

Allied to *A. vaginatus*, but without a distinct sheathing volva, and with the stem merely spongy within and not filled with delicate cottony fibres. In full-grown specimens there is only a slight mark showing where the edge of the pileus rested. It is allied to the veil-less species from the Himalayas. The name is intended to record the services which have been rendered to Mycology by many excellent illustrations and in other ways by Cecilia E. Berkeley.

664. *A.* (Lepiota) *Badhami*, n. s. Pileo primum campanulato obtuso, dein expanso l. depresso umbonatoque squamis minutis velutinis ermineis hispido; stipite deorsum bulboso albo sericeo fibrilloso-farcto; annulo firmo submobili; lamellis remotis ventricosis; totus vulneratus croceo-sanguineus.

Under yew trees. Apethorpe, Norths., Sept. 1852. East Bergholt, Suffolk.

Pileus 2–4 inches across, at first campanulate obtuse, at length expanded, often depressed and umbonate, hispid, with minute velvety fuliginous scales, but sometimes entirely fuliginous without any distinct scales. Stem 2–3 inches high, $\frac{1}{4}$–$\frac{1}{2}$ inch or more thick, attenuated above, bulbous below, white, silky or floccoso-squamose, stuffed with cottony threads; ring firm, erect and deflexed, more or less moveable beneath, frequently clothed with dingy granules; gills truly remote, ventricose, rather broad; spores elliptic, ·0003 inch long, flesh tolerably compact. The whole plant when wounded assumes a rich red tint.

A splendid Agaric resembling some forms of *A. clypeolarius*, but more robust. In some specimens the surface is decidedly scaly, in others simply velvety. The margin often projects beyond the gills and is delicately silky and fimbriated. The stem, though bulbous, is by no means marginate. Smell rather disagreeable.

**A. melleus*, Vahl. A ringless form of this species occurs in Suffolk and Northamptonshire.

665. *A.* (Tricholoma) *equestris*, L. Suec. no. 1219. In fir plantations. Stapleton, Gloucestershire, C. E. Broome, Esq.

666. *A.* (Tricholoma) *portentosus*, Fr. Ep. p. 26. In woods, King's Cliffe, Sept. 7, 1852. Exactly according with a drawing transmitted by Fries.

667. *A.* (Tricholoma) *nictitans*, Fr. Ep. p. 28. In woods. Suffolk, Rev. Dr. Badham, Sept. 1851.

668. *A.* (Tricholoma) *acerbus*, Bull. t. 571. fig. 2. In woods. East Bergholt, Rev. Dr. Badham. A very fine species, remarkable for its bitter taste and involute sulcate margin.

669. *A.* (Tricholoma) *subpulverulentus*, Pers. Myc. Eur. iii. p. 221. In grassy pastures. Abundant, as at King's Cliffe, Oct. 24, 1851; Kent, Mrs. Hussey, Oct. 1851. The same species apparently occurs at Tibet, on the river Shayuk, at Sassar, not far from the Karakoram Pass, at a height of 16,000

feet, and a very similar species has been gathered in Nova Zembla.

670. *A.* (Clitocybe) *cerussatus*, Fr. Ep. p. 61. Fir woods, Norths. Abundant, forming very large rings. Sometimes producing a merulioid hymenium on the top of the pileus.

671. *A.* (Collybia) *atratus*, Fr. Ep. p. 98. On charred ground in woods. Rockingham Forest, Norths.

We have been enabled to determine this from copies of the drawings of Hymenomycetous Fungi in the Museum at Stockholm, kindly transmitted by M. Fries.

672. *A.* (Mycena) *crocatus*, Schrad. Amongst leaves in woods.

This beautiful species is figured in the last edition of the 'Journal of a Naturalist,' under the name of "the Stainer," as found in Gloucestershire.

**A.* (Pleurotus) *fimbriatus*, Bolt. East Bergholt, Jan. 3, 1852, Rev. Dr. Badham. On dead wood. Most beautifully and repeatedly lobed and fimbriated.

673. *A.* (Pleurotus) *acerosus*, Fr. Ep. p. 135. On decayed wood, on soil, gravel, &c. Hitcham, Suffolk, Dec. 1849, Prof. Henslow.

674. *A.* (Pleurotus) *atrocæruleus*, Fr. Ep. p. 137. On dead wood. Penzance, J. Ralfs, Esq.

675. *A.* (Volvaria) *Taylori*, n. s. Pileo conico-campanulato obtuso livido ex apice striato-rimoso tenui; stipite solido pallido; volva spadicea lobata sublaxa, lamellis antice latis postice valde attenuatis roseis. On the ground, Jersey, Mr. M. A. Taylor. Pileus $1\frac{3}{4}$ inch high and broad, beautifully pencilled and cracked; margin lobed and sinuated; stem $2\frac{1}{2}$ inches high, $\frac{1}{4}$ inch thick, slightly bulbous at the base. Gills uneven.

This beautiful species is described from an excellent drawing by Mr. M. A. Taylor, and is clearly quite different from every other species; the dark volva, campanulate pileus and uneven attenuated gills are marked characters. The habit is rather that of some *Entoloma* than of its more immediate allies.

676. *A.* (Pluteus) *nanus*, P. Syn. p. 357. On fallen sticks, Wothorpe, Norths., Aug. 23, 1853. The yellow-stemmed variety. Spores subglobose, even, ·0002 inch long.

**A.* (Pluteus) *phlebophorus*, Ditm. in Sturm's Deutschlands Fl. i. t. 15. On dead sticks, Wothorpe, Aug. 23, 1853.

The plant of Greville is certainly not the true species of Ditmar, which has occurred as above, exactly according with the figure in the 'Deutschlands Flora.' The pits of the pileus are very deep and the reticulations very distinct; in one plant the stem is slightly flocculose. Spores subglobose, ·0003 inch long.

**A.* (Entoloma) *repandus*, Bull. t. 423. f. 2. This species is placed by Fries in *Hebeloma*, but the plant of Bulliard has certainly rose-coloured, irregular stellate spores, studded with very large processes, ·00044 inch long, ·00025 broad, and large urn-shaped cystidia.

677. *A.* (Entoloma) *Bloxami*, n. s. Pileo compacto campanulato obtuso basi sublobato udo atro-cæruleo subsericeo; carne alba; stipite sursum leviter attenuato basi obtuso, lamellis latiusculis attenuato adnexis.

In pastures, Twycross, Warwickshire, Rev. A. Bloxam; Leigh Down, near Bristol, Nov. 1853.

Pileus 1 inch or more across, campanulate, very obtuse, moist, of a dark, dingy blue or purple, or sometimes slate-coloured tinged with lilac, slightly silky, inclined to be lobed below; flesh very thick in the centre, white, except near the edge, where it partakes of the hue of the pileus. Stem $1\frac{1}{2}$ inch high, $\frac{1}{2}$ an inch thick, attenuated upwards, of the same colour as the pileus, solid. Gills moderately broad, pale pink, attenuated behind or slightly annexed. Spores irregular, subglobose, with a large globose nucleus.

A figure of this will appear in the 'History of Leicestershire.'

678. *A.* (Entoloma) *frumentaceus*, Bull. On the ground under a hedge, Woodnewton, Sept. 1852. Somewhat cæspitose; pileus $3\frac{1}{2}$ inches across, plane with the margin arched and sinuated, dry, buff tinged with red, marked with fine streaks which are sometimes slightly raised, fleshy, firm, rather brittle. Stem 2 inches high, 1 inch thick, of the same colour as the pileus, streaked and slightly cracked, sometimes compressed, blunt at the base with a little white down stained with the spores. Gills broad, moderately distant, sinuated and toothed, rounded behind, sometimes emarginate, adnate, cinereous, with a reddish yellow tinge; spores elliptic, minute, ·0002 inch long, rose-coloured. Taste agreeable; smell farinaceous with a slight taint of Amadou.

This is undoubtedly the plant of Bulliard, which is not described by him as viscid. The spores are decidedly rose-coloured and not white.

679. *A.* (Entoloma) *costatus*, Fr. Ep. p. 147. A very common species in grassy pastures, as at King's Cliffe, Oct. 23, 1851.

Readily distinguished by the distant broad gills, which are rounded behind and nearly free, traversed at length by waved ribs, and with their margin undulate and not discoloured. Smell none. Spores irregular, subglobose, with a globular nucleus.

680. *A.* (Nolanea) *Babingtonii*, Blox. Pileo conico campanulato cinereo spadiceo-sericeo nitente fibrillis apice liberis subfasciculatis; stipite æquali fistuloso spadiceo-tomentoso substrigoso; lamellis ventricosis distantibus cinereis postice obscu-

rioribus adnatis ex antheridiis candidis micantibus. Twycross, Warw., Nov. 21, 1851, Rev. A. Bloxam.

Pileus scarcely half an inch across, conico-campanulate, cinereous, shining, with dark brown silky subfasciculate hairs, the ends of which are free; disc subsquamulose, margin straight. Stem about an inch high, not 1 line thick, equal, fistulose, spadiceo-tomentose, substrigose; gills ventricose, distant, cinereous, darker behind, adnate, glittering with the white antheridia. Spores oblong, ventricose on the outer side, rather irregular, sometimes with a distinct septum.

A very curious little species, which also occurs in North America. The form of the spores is peculiar, resembling that of some *Eunotia*. The species will be figured in the 'History of Leicestershire,' about to be published, but without the analysis which is given in our plate.

PLATE XV. fig. 1. *a*. Sporophore and spicules magnified; *b*. sporophores with their spicules and spores; *c*. spores highly magnified; *d*. hair from surface of pileus.

**A*. (Pholiota) *aurivellus*, Batsch. On ash, Woodnewton, Sept. 1852.

This species was introduced into the English flora on the authority of the quotation of Bolton's figure by Fries. We are glad therefore to confirm its claims to a place in our flora.

681. *A*. (Pholiota) *Mycenoides*, Fr. Ep. p. 170. On a lawn amongst moss, Apethorpe, Norths., Oct. 12, 1853.

682. *A*. (Hebeloma) *obscurus*, P. Syn. p. 347. Pine plantation, East Bergholt, Nov. 13, 1851.

Remarkable for its violet-coloured stem or flesh, and its uncinate adnexed gills; spores obovate, ·0004 inch long, ·0002 wide.

683. *A*. (Naucoria) *Pediades*, Fr. Ep. p. 197. On cultivated ground, Cranford, Nov. 2, 1847, J. F. Graham, Esq.

684. *A*. (Naucoria) *siparius*, Fr. Ep. p. 201. On wood, the cases of caddice worms, &c., East Bergholt, Rev. Dr. Badham, who has both forwarded specimens and shown them growing.

685. *A*. (Crepidotus) *alveolus*, Lasch, in Linn. vol. iv. no. 582. On dead wood and on the ground, King's Cliffe and Fineshade, Norths., Sept. 1852, Aug. 1853.

Closely allied to *A. mollis*, but not at all gelatinous. Spores ·0003 inch long.

686. *A*. (Crepidotus) *Byssisedus*, P. On the bare soil, Fineshade, Sept. 1852; Bowood, C. E. Broome.

Some of the specimens were furnished with a distinct slender stem, and two deeply umbilicate occurred on the same day at

Laxton, which we could not distinguish, though possessing all the characters of *Eccilia*. Spores angulato-stellate, ·0004 inch long, ·00028 wide.

687. *A.* (Crepidotus) *cheimonophilus*, n. s. Totus albus pileo convexo crassiusculo villoso; stipite brevissimo vel obsoleto; lamellis distantibus postice attenuatis. On small dead branches of *Pyrus torminalis*, Benefield, Norths., Dec. 18, 1851.

Pure white. Pileus $\frac{1}{4}$ of an inch across, convex, clothed with villous down; margin inflexed. Stem extremely short or obsolete; gills few, distant. Spores very pale yellow, brown, oblongo-elliptic, with a distinct lateral nucleus.

Resembling at first sight young specimens of *A. platypus*, but differing totally in character. We do not know of anything closely allied.

688. *A.* (Psalliota) *stercorarius*, Fr. Ep. p. 220. In pastures on dung as at Apethorpe, Norths.

Distinguished from *A. semiglobatus* by the distinct medullary substance with which the stem is stuffed. It is doubtful whether the Cobham plant is the same species.

689. *A.* (Psilocybe) *coprophilus*, Bull. t. 566. f. 3. On dung, as at Morehay Lawn, Norths.

Pileus when very young white and downy, subhemispherical, clothed with little white superficial scales, brown, at length smooth and pale umber, darker at the obtuse apex, slightly fleshy. Stem flexuous, slightly attenuated upwards, whitish shining, at first scaly like the pileus, within which it is pruinose. Gills nearly plane, ventricose, adnato-arcuate or subdecurrent, umber brown.

690. *A.* (Psilocybe) *Physaloides*, Bull. t. 366. f. 1.

Abundant on the walls of the sewage filtering apparatus at Croydon, Sept. 1852: see Gard. Chron., Sept. 25, 1852, Mr. W. Marshall. Spores ·0005 inch long, ·0003 broad.

691. *Cortinarius* (Phlegmacium) *caperatus*, Fr. Ep. p. 256; Johnst. East. Bord. tab. 9. Berwick, Sept. 19, 1845, Dr. Johnston.

One of the finest of the Hymenomycetes. Pileus, ring and stem presenting deeper or lighter shades of ferruginous orange, dusted with pulverulent particles, which consist of obovate pedicellate cells, the sides of which are sometimes proliferous. Spores bright ferruginous, ·0004 inch long.

692. *C.* (Phlegmacium) *anfractus*, Fr. Ep. p. 262. In woods, King's Cliffe.

Our species agrees exactly with a drawing transmitted by Fries, but the pileus is completely covered by a close white volva when young, which is not mentioned by authors.

693. *C.* (Inoloma) *Bulliardi*, P. Syn. p. 289. Leigh Woods, Bristol, H. O. Stephens, Esq.

Remarkable for the brick-red of the base of the stem.

694. *C.* (Telamonia) *periscelis,* Fr. Ep. p. 300. West of England, Mr. Broome; near Eltham, F. Currie, Esq.

695. *C.* (Telamonia) *psammocephalus,* Bull. t. 531. f. 2. In woods, King's Cliffe.

696. *C.* (Hygrocybe) *armeniacus,* Schæff. t. 81. In fir woods, Bristol, H. O. Stephens, Esq.

697. *Paxillus atrotomentosus,* Batsch, fig. 32. Compton Bassett, Wilts, Miss Dalby.

Of this we have seen only a very characteristic drawing, which leaves no doubt as to the species.

698. *Gomphidius gracilis,* n. s. Pileo conico-subhemisphærico glutine fuliginoso hic illic in maculas atras transeunte vestito; stipite flexuoso gracili squamuloso; lamellis aquose fuligineis. In fir plantations, Llanberris, July 26, 1842.

Pileus 1 inch across, conico-subhemispherical, of a pale vinous brown, when dry clothed with dirty fuliginous slime, which dries especially round the margin into black spots, or forms a narrow irregular black border. Stem 2 inches high, $1\frac{1}{2}$ line thick, flexuous, pale, especially above, where it is sprinkled with minute white scales, virgate below, with the remains of the slime, yellow at the base; gills arched, decurrent, forked, thick, obtuse, clothed under a lens with short tomentose hairs, of a washy bistre. Spores oblong, elliptic, ·0009 inch long, ·0003 inch wide, with a nucleus at either end.

Resembling in some respects *Gomphidius stillatus,* Strauss, but distinguished from that and every other species by its slender stem and delicate habit.

699. *Hygrophorus mesotephrus,* n. s. Pileo convexo subhemisphærico viscoso striato candido centro brunneo; stipite gracili apice granulato farcto; lamellis decurrentibus candidis.

On the ground in woods, Bowood, C. E. Broome.

Pileus about 1 inch across, convex, subhemispherical, white with the disc brown, viscid striate, the extreme margin often remaining quite even, flesh white, hygrophanous. Stem about 2 inches high, 2 lines thick, flexuous, attenuated at the base, white, viscid, floccoso-granulated at the apex, stuffed with a fibrillose pith. Gills pure white, moderately broad, rather distant, ventricose, shortly decurrent. Spores ·00035 inch long.

A very delicate species allied to *H. fusco-albus,* but with a very different habit. In age the lower part of the stem is slightly stained, but by no means squamose.

Plate XV. fig. 2. *a. H. mesotephrus,* nat. size: *b.* spores magnified.

700. *Hygrophorus leporinus,* Schæff. t. 313. On open pastures at Durdham Downs, Gloucestershire, Sept. 29, 1848, C. E. Broome; Kent, Mrs. Hussey.

The spores of this species have a pale umber tint; they are nearly globose and about ·0002 inch in diameter.

701. *Hygrophorus Colemannianus,* Blox. Pileo subcarnoso umbonato umbrino, centro excepto expallente, lævi, udo striato viscidulo; stipite subæquali subsericeo albido; lamellis latiusculis pileo subconcoloribus distantibus; interstitiis rugoso-venosis. In grassy pastures, Twycross, Warwickshire, Rev. A. Bloxam.

Pileus 1–2 inches broad, at first subcampanulate, at length expanded, strongly umbonate, reddish umber, paler when dry, except in the centre; when moist striate and very obscurely viscid. Stem 1 inch or more high, 1–2 lines thick, brittle, fibrous, nearly equal, white, very slightly tinged with umber, somewhat silky; gills umber, but paler than the pileus, strongly decurrent, broad, distant; interstices strongly veined and rugose. Spores ·00025–·0003 inch long, obovate.

This may possibly be the supposed form of *H. sciophanus,* figured by Batsch under the name of *A. fragilis,* f. 215; but if so, it can scarcely be the same species with that which is figured in 'Flora Danica,' t. 1845. f. 2. A figure will appear in the 'History of Leicestershire.'

702. *H. lætus,* Fr. Ep. p. 329. Open commons, Hanham, near Bristol, C. E. Broome.

Spores ·0003 inch long, nearly globose.

703. *Lactarius turpis,* Weinm. Syll. 2. p. 85. In or about fir woods, as at East Bergholt, Suffolk, Leigh Down near Bristol.

Growing to a very large size, and remarkable for its yellow, olive or umber hue. This is *A. necator,* P., but not of Bulliard, which appears to be exclusively *L. torminosus.*

704. *Lactarius theiogalus,* Bull. t. 567. f. 2. King's Cliffe, Sept. 1852.

This is now separated from the more common form, to which Fries gives the name of *L. chrysorheus.* The milk of *L. theiogalus* does not assume so bright a yellow tint as that of *L. chrysorheus.*

**Lactarius chrysorheus,* Fr. Ep. p. 342. *A. theiogalus,* Eng. Fl. Extremely common.

705. *Lactarius pallidus,* Pers. Syn. p. 431. In woods, Bowood, C. E. Broome.

706. *Lactarius camphoratus,* Fr. Ep. p. 346. On the ground in woods. Leigh Wood, near Bristol, H. O. Stephens, C. E. Broome.

707. *Russula ochroleuca,* Pers. Syn. p. 443. Abundant in fir plantations, Apethorpe, Sept. 2, 1852.

708. *Marasmius Stephensii,* n. s. Fasciculata; pileo depresso centro rugoso vinoso-maculato stipite cavo torto apice farinaceo albo deorsum nitido nucicolori; lamellis distantibus albidis. Amongst dead beech leaves, near Dursley, Oct. 17, 1845.

Fasciculated. Pileus $\frac{1}{2}$–1 inch across, depressed and wrinkled in the centre, opake, tough, cream-coloured, stained with vinous red, especially when bruised; flesh white, thin. Stem 1–2 inches high, hollow, twisted, white and mealy above, quite smooth and shining below, of a rich light nut-brown. Gills few and distant, rather broad, of the same colour as the pileus. Taste and smell exactly like that of *M. oreades.*

**Marasmius Hudsoni*, Fr. The whole of the outer surface of the pileus is clothed with echinulate processes, and the spores are fusiform, ·0004 inch long, with a central nucleus, very different from those of any other Agaric or *Marasmius.*

PLATE XV. fig. 3. *a.* Echinulate processes and base of a hair; *b.* young hair; *c.* spores. All highly magnified.

709. *Polyporus* (Pleuropus) *Rostkovii*, Fr. Ep. p. 439. On the dead stump of a tree, Apethorpe, Norths., June 16, 1853.

Thin, flaccid, 6 inches across, infundibuliform, but often lateral, smooth, even, pale ochraceous, mottled below with darker spots and virgate, dark brown at the base, margin lobed, involute. Flesh white, tough. Stem connate, black, tough, reticulate from the decurrent pores. Pores large, 2 lines or more long, elongated; edge obtuse, or very thin and torn. Spores with two nuclei, ·0005 inch long, ·0002 broad, narrower than in *P. squamosus*, to which it is closely allied.

710. *P.* (Anodermei) *fragilis*, Fr. El. i. p. 86. On dead fir trees, Penzance, J. Ralfs, Esq.

711. *P.* (Anodermei) *adiposus*, n. s. Albus; pileo ceraceo-molli breviter reflexo vario obscure tomentoso; hymenio crassiusculo; poris parvis acie obtusis. On the ground amongst *Marchantia*, Twycross, Nov. 1851, Rev. A. Bloxam.

Very variable in form, sometimes fixed by the apex, sometimes resupinate, white, waxy, thickish when fresh, but losing much of its substance in age, here and there acquiring a foxy tinge, substance not zoned within. Pores when horizontal with the edges even, but often elongated and irregular, not stratose. Surface scarcely tomentose, uneven. Turning brownish in drying.

Allied to *P. amorphus*, but a very distinct species.

**Dædalea confragosa*, Fr. On willow, Apethorpe, Norths., Jan. 1853.

It appears to us very doubtful whether *Trametes rubescens* be really distinct; but if so, there is no doubt that Bolton's plant and the English specimens, amongst which is *Boletus angustatus*, Sow. t. 193, as appears from the original specimens, all belong to the same plant with that of Schweinitz. The resupinate plant on oak, which we supposed, from the inspection of named specimens, to be *Merulius rufus*, Pers., is probably only a form of this species. It appears to be the same with *P. bathyporus*, Rostk.

712. *Merulius molluscus*, Fr. Syst. Myc. i. p. 329. Near Penzance, J. Ralfs, Esq.

713. *Hydnum Weinmanni*, Fr. El. i. p. 136. On dead branches with the bark still adherent. Bristol, H. O. Stephens, Esq.

714. *Hydnum alutaceum*, Fr. Ep. p. 516. On old stumps, Collyweston, Norths.

715. *Corticium nudum*, Fr. El. p. 221. On branches of elm, yew, &c., common. Intermediate between *C. incarnatum* and *C. cinereum*. On the same branch individuals occur very thin, quite smooth and effused, while others are thicker, more cinereous and tuberculate. Spores oblong, slightly curved, ·0005 of an inch long, ·00015 broad.

716. *Corticium confluens*, Fr. El. p. 218. On ash branches, Wothorpe, Norths. Distinguished from the last more especially by its white tomentose margin. In our plant the spores are oblong, ·0008 inch long, ·0004 broad.

The more perfect specimens have a few scattered papillæ.

717. *Cyphella muscigena*, (Pers.) Syn. p. 572. On moss, especially Polytrichum, or even on the bare ground. Hanham, Oct. 1852, C. E. Broome. White with a slight ochraceous tinge. At first flabelliform, fixed by a little down, at length laterally confluent, downy above, often spathulate. Hymenium slightly corrugated.

718. *C. galeata*, (Schum.) Fl. Sæll. p. 371. On mosses, common. This is the *Cantharellus lævis*, Eng. Fl., and differs from the former species in its dingy hue and bullate pileus.

719. *C. ochroleuca*, n. s. Membranacea cupularis sursum villosa ochroleuca; margine demum fisso; hymenio lævi pallide ochraceo. On decayed bramble twigs. Batheaston, Oct. 1851.

One line or more broad, at first cup-shaped, but mostly irregular, then lobed or fissured, villous above, white tinged with yellow; hymenium even ochraceous, brighter than the pileus.

A pretty little species allied to *C. Goldbachii*.

720. *C. Goldbachii*, Weinm.! Ross. p. 522. On dead leaves of *Aira cæspitosa*. Spye Park, Wilts., C. E. Broome.

This is very near *C. cuticulosa*, from which it differs in its villous coat, which Mr. Forster could scarcely have overlooked, as it is almost visible to the naked eye. A *Cyphella* occurred in the same locality on dead leaves of *Carex paniculata*, which we cannot distinguish from *C. griseo-pallida*.

721. *Clavaria Botrytis*, P. Bowood, Nov. 18, 1843, C. E. Broome.

722. *Clavaria aurea*, Schæff. t. 287. Leigh Wood, Bristol, H. O. Stephens.

723. *Clavaria crispula*, Fr. Syst. i. p. 470. At the base of

decayed trunks of elder and ash. Woodnewton, Norths., Dec. 7, 1852. Forming large fascicles with a creeping white root.

724. *Tremella vesicaria*, Bull. t. 427. f. 3; Eng. Bot. t. 2451. On the ground amongst grass.

This species was omitted in the 'English Flora,' because no specimen had been seen, and it was asserted by Fries to be an Alga. We have, however, lately received the species as collected in Pennsylvania by Dr. Michener, and the structure is that of a true Tremella with globose sporophores and broad oblong spores, ·0004 inch long, ·00025 broad. We have also a fragment of the specimens figured in 'Eng. Bot.'

725. *Tremella indecorata*, Sommerf. Lapp. p. 306. Bursting through the bark of fallen branches and pea-sticks. Penzance, J. Ralfs, Esq.

Dark pitchy brown when dry; dirty cinereous when swollen with moisture. This is, we believe, Bonorden's *T. albida*. We have not seen the true fruit.

726. *Tremella versicolor*, n. s. Minuta guttæformis aurantia demum fuscescens.

Parasitic on *Corticium nudum* on decorticated trees. Thame, Dr. Ayres; Apethorpe, Feb. 23, 1850; Batheaston. Forming minute, orange, tear-like, convex spots on the hymenium of the *Corticium*, paler when young, at length assuming a rufous tinge. In young plants the delicate hyaline threads are terminated by four globules which ultimately branch, forming moniliform threads as in Bonorden's *Hormomyces*. Obovate vesicles also occur in parts, but we have not seen the perfect spores. The general appearance is like that of *Tremella guttata*, Bonorden.

727. *Tremella viscosa*, (P.) *Corticium viscosum*, P. Obs. 2. p. 18. This species, which is not uncommon, has the true structure of a Tremella and cannot remain in the genus *Corticium*. We find globose sporophores bearing three or four elongated sterigmata and oblong, obliquely attached spores, which sometimes contain one or two nuclei.

Plate XV. fig. 4. Portion of the hymenium with the globose sporophores, one of which bears three, and another four fertile sterigmata surmounted by oblong spores.

728. *Dacrymyces deliquescens* (Bull. t. 455. fig. 3). On dead boughs of holly, Batheaston, Jan. 1851; on larch, Wothorpe, Norths., Aug. 23, 1853.

Our plant has at present occurred only with the septate spores figured by Tulasne and the strong threads from which they rise, without any of those which break up into distinct oblong articulations. It is, in fact, exactly what Bonorden figures under the name of *Septocolla adpressa*, p. 152, fig. 247. Our *Ditiola nuda* is the same thing, but with the sporophores perfectly continuous and of the same colour with the parent threads, as represented in our figure, the correctness of which we have verified by a fresh examination. In all, we find the minute bodies which Tulasne calls spermatia attached to the spores.

729. *Hymenula punctiformis*, n. s. Gelatinosa punctiformis pallida subundulata sporis ellipticis.

On decorticated fir poles. Batheaston, Sept. 12, 1853.

Punctiform, gelatinous, dirty white or very pale umber, slightly tinged with yellow, $\frac{1}{4}$ of a line broad, slightly undulated, consisting of erect simple threads; spores minute, elliptic, ·0002 inch long.

This has somewhat the appearance of minute specimens of *Peziza vulgaris*, but there is no trace of asci.

**Ditiola radicata*, Fr. Syst. Myc. ii. p. 170. On fir. East Bergholt, Rev. Dr. Badham.

[To be continued.]

XXXVI.—*Descriptions of new species of Ceylon Reptiles.* By Dr. Kelaart.

Eumeces (?) *Taprobanensis*, n. s.

Above dark brown, with six lines of black dots on the back; sides of neck and body of a darker brown colour, minutely dotted white; a few white dots also on the limbs; beneath whitish; upper surface of tail of the same colour as the body; under surface gray, each scale with a blackish spot. Head short, subtriangular; muzzle narrow, rounded. Nostril pierced on the upper edge of nasal plate. Eyes large; eyelids scaly, edges slightly granular; lower lid with a series of larger scales. Ears small, circular, dentated anteriorly by two or three projecting scales. Body rather short, subcylindrical. Tail elongated, rounded, tapering, pointed. Limbs four, small, *not* wide apart. Toes 5–5, short, unequal, tubercular beneath, clawed. Palms and soles granular.

Head and body $1\frac{7}{10}$ inch; tail $2\frac{6}{10}$ inch.

Hab. Nuwera Elia (6000 feet).

This Skink is distinguished from *Riopa albopunctata* of Gray by its dark brown colour, and the limbs being placed nearer each other.

Polypedates (?) *Schmarda*, n. s.

Above brownish gray; beneath white, posterior half of abdomen marked with black. Eyebrows armed with spines. Back and sides tuberculated. Limbs armed with tubercular sharp-pointed spines.

About $1\frac{1}{2}$ inch long.

Hab. Adam's Peak (5600 feet).

This novel form of Tree-frog was found by Professor Schmarda of Prague in his late visit to Ceylon, in company with Chevalier Fridau and Baron Konigsbrun.

Ceylon, Galle, January 28, 1854.

XXXVII.—*A Revision of the Arrangement of the Families of Bivalve Shells* (Conchifera). By John Edward Gray, Ph.D., F.R.S., V.P.Z.S.

I have lately had occasion to examine the animals of several genera of Bivalve shells, and to consult and compare all the figures and descriptions of the animals of the different genera I have been able to find in the various works and essays on this subject, for the purpose of preparing for the press the text of the fifth and concluding volume of Mrs. Gray's work, 'Figures of Mollusca.' With these materials before me, I was led to consider, as I have done on several other occasions, the characters which have been used to separate the various families, and those which unite them into larger groups,—a subject surrounded with difficulties, when we consider the very great uniformity which exists in the animals of this class, and the modifications which habitation and modes of life produce in genera which are evidently nearly related to each other, as shown in a former communication (Ann. & Mag. N. H. 1853, vol. xi. p. 402).

After repeated comparison, and forming lists of the families according to the various characters, after the example of Adanson, and thus obtaining those which appear to be least variable in the greater number of the families, I am induced to believe that the division of the Class into Orders, according to the presence, absence, and number of the siphonal openings, as proposed by Poli, and followed by Cuvier, Gardner, and many other naturalists, but without paying any attention to the length or shortness, the retractility or contractility of these organs, as was done by those and most of the authors who have succeeded them,—is decidedly the best and most natural*.

* M. Deshayes' 'Traité élémentaire de Conchyliologie,' 1843–1850. A conchologist, wedded to the Lamarckian school, has asked, with considerable critical acrimony, "Et d'abord pourquoi M. Gray commence-t-il la classe des Conchifères par la famille des Vénérides? Nous avouons ne pouvoir le deviner. Jusqu'ici tous les classificateurs, quelques soient les principes de leurs méthodes, ont toujours été entraînés par la nature des choses à placer

I am not aware of any attempt having been made to improve the systematic distribution of Bivalve Mollusca formed on the actual examination of the animals, or to embody the observations which have been recently made by other naturalists, since my arrangement of the families, published in the Synopsis to the British Museum in the year 1840, and its revision in 1842. Yet, during the last twelve or fourteen years, we have been furnished with some most important observations on the subject by Messrs. Alder, Hancock, Clark, and Edward Forbes in our own country, and by M. Philippi, Deshayes, Valenciennes and others on the continent of Europe.

I consider such a periodical revision of the labours of others, especially when accompanied by personal observation, to be very important, as bringing together, and putting into a connected form and systematic order, the discoveries which have been made in the meantime, or observations the importance of which may have been overlooked by myself or others when previously occupied on the subject; and they evidently have considerable effect, as is shown by the complete manner in which my revision of the system of Gasteropoda, in the fourth volume of the 'Figures of Mollusca,' and the more recent improvements suggested in it, have been adopted by Messrs. Adams, in their very useful work on the 'Genera of Mollusca,' and the partial adoption of it in Philippi's 'Handbuch der Conchyliologie und Malacozoologie.'

I now proceed to give the arrangement proposed.

Class I. Conchifera.

Subclass 1. Siphonophora. *Mantle leaves connected, with two siphonal openings behind.*

In many of these animals, especially in those which have a small pedal opening, there is a minute (4th) aperture with an internal valvular protuberance in the mantle under the lower siphon.

The gills in most families hang down on each side of the foot.

In *Anatinidæ*, *Solenomyadæ*, and *Pandoridæ* they have been described by some authors as single, folded on itself, and by others as the two gills soldered together; they appear to be attached

la famille des Vénus vers le milieu de la série des Mollusques acéphales Dimyaires." The reply is easy. They are placed at the head of the class for the very reason M. Deshayes has assigned, that they appeared to me to be the most perfectly developed, and consequently the most typical animals of the class; and as it is our habit to place the *Primates*, *Insessores* and *Percidæ* at the head of the respective classes of animals to which they belong, so it appears legitimate to place the family *Veneridæ* at the commencement of the Bivalves, the other families diverging from it in two or more series.

by a central line, and what is usually the outer dependent gill is bent up against the upper part of the side of the body, the striæ radiating from the central attachment; hence in *Solenomya* they have been called pinnate. See Hancock, Ann. and Mag. N. H. 1853, vol. xi. t. 3 & t. 11. In *Lucinidæ* there is only a single gill on each side, the outer being absent, or the two are soldered into one.

The gills of *Nuculæ* and *Pandoræ* are somewhat intermediate in appearance between the pinnated gills and the more common form, and the transition from the *Nuculæ* to the *Arcæ* is easy.

Order I. Veneracea.

Mantle with two more or less elongated siphonal openings. Gills short, not produced into the inhalant or lower siphon. Siphons often more or less separate, under the hinder adductor muscle.

I. *Foot compressed*: animal crawling.

1. *Cardinal teeth diverging, central bifid.*

A. *Siphons more or less united, short; cartilage of hinge external, marginal.*

1. *Veneridæ*, Syn. B. M. 1842, 74; P. Z. S. 1847, 183; Ann. and Mag. N. H. 1853, 36.

2. *Cyprinidæ*, Ann. and Mag. N. H. 1853, 36.

3. *Glauconomidæ*, Ann. and Mag. N. H. 1853, 36. Siphons united at the base; pedal opening small.

4. *Petricolidæ*, Ann. and Mag. N. H. 1853, 36. Siphons separate nearly to the base, pedal opening small. Perhaps allied to *Tellinidæ*.

5. *Corbiculadæ*, P. Z. S. 1847, 184; Ann. & Mag. N. H. 1853, 36. Cyrenadæ, *Syn. B. M.* 1842, 75.

6. *Cyrenelladæ*, Ann. and Mag. N. H. 1853, 37. For the characters of these families see the 'Annals.'

6*. *Mysiadæ*. Pedal opening moderate, inferior. Siphons none; anal opening linear, with two semilunar lateral valves, inhalant small, round, fringed. Gills two on each side; lips four, moderate. Foot compressed, lanceolate. Hinge with two diverging bifid teeth; no lateral teeth. Cartilages linear, marginal.

1. Mysia = Diplodonta.

7. *Astartidæ*, P. Z. Soc. 1847, 19. Crassinadæ, *Syn. B. M.* 1842, 80. Pedal opening elongate. Shells covered with a thick brown periostraca. Cardinal teeth broad, triangular, hinder lateral; of the left valve double.

1. Astarte. 2. Cypricardia, sp. according to D'Orbigny.

B. *Siphons separate, elongate, slender.*

8. *Tellinidæ,* Syn. B. M. 1842, 75; P. Z. S. 1847, 186. Pedal opening elongate. Shell oblong, cartilage internal or external.

2. *Cardinal teeth diverging, central laminar, folded; cartilage internal, in a triangular pit.*

9. *Mactradæ,* Syn. B. M. 1842, 75; P. Z. S. 1847, 185; Ann. and Mag. N. H. 1853, 38.

10. *Paphiadæ,* P. Z. S. 1847, 186; Ann. and Mag. N. H. 1853, 38. Mesodesmidæ, *Syn. B. M.* 1842, 75. Mantle lobes united. Pedal opening small, anterior. Gills truncated behind. Siphons short, separate, anal largest.

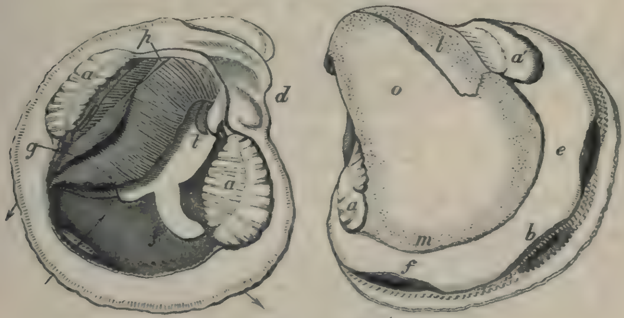
11. ?*Anatellidæ,* Ann. and Mag. N. H. 1853, 38. Animal unknown.

3. *Cardinal teeth very oblique, hinder nearly parallel with hinge-margin; cartilage external, marginal; umbones subspiral.*

12. *Glossidæ,* P. Z. S. 1847, 195. Isocardiadæ, *Syn. B. M.* 1842, 80. Foot compressed, truncated, short, small; pedal opening rather contracted; lips simple; shell free.

13. *Chamadæ,* Syn. B. M. 1842, 79; P. Z. S. 1847, 193. Foot very small, rather produced in front; lips foliated; pedal opening very small; shell irregular, attached by the outer surface of one valve.

Fig. 1.



Animal of *Chama* from Torres' Straits.

a, a, adductor muscles; *p,* pedal muscle; *d,* dental membrane; *t,* labial tentacle; *g,* small outer gill; *e,* anal siphon; *b,* branchial siphon; *f,* pedal orifice; *m,* pallial line; *o,* portion of left mantle lobe occupied by ovarium; *l,* liver.—*S. P. Woodward.*

4. *Hinge tooothless; cartilage internal, in a pit, with a shelly appendage in front.*

14. *Anatinidæ,* Syn. B. M. 1842, 77; P. Z. S. 1847, 190. Siphons elongate, generally separate. Gills pinnate, apparently

one on each side the upper part against the side of the body. Mantle with a small valvular hole under the siphons. Hinge-teeth rudimentary. Cartilage internal, in a pit in each valve, with a peculiar shelly plate before it or covering it. Shell inequivalve, umbo with a cartilage slit. Periostraca often hispid.

a. *Siphons united. Valves equal. Clavicle linear.* Laternula.

b. *Siphons separate at the end. Valves unequal. Clavicle flat, covering the cartilage.* Lyonsia, Byssonia.

c. *Siphons separate. Valves unequal. Clavicle small, subcylindrical.* Thracia, Periploma, Cochleodesma, Myodora, ? Poromya, Neara.

d. *Siphons separate, one valve attached. Clavicle large.* Chamostrea, Myochama.

5. *Hinge toothed or toothless. Cartilage external, marginal. Shell pearly. Periostraca hard, polished.*

15. *Muteladæ*, P. Z. S. 1847, 197. Iridinidæ, *Syn. B. M.* 1842, 80. Foot large, compressed, angular in front; pedal opening very long. Gills large. Shell scarcely to be distinguished from *Unio* or *Anodon*, but the hinder submarginal impression is rather more truncated.

II. *Foot conical, acute, angularly bent behind* (for leaping).

16. *Cardiadæ*, Syn. B. M. 1842, 75; P. Z. S. 1847, 185; Ann. and Mag. N. H. 1853, 37. Gills narrow, elongate, floating, only attached at the upper end. Cardinal teeth conical, forming a cross when the valves are closed. Cartilage external, marginal.

III. *Foot truncated and dilatile at the end* (for crawling and anchoring).

17. *Ledadæ.* Nuculidæ §, *P. Z. S.* 1847, 190. Gills small, oblong, subpinnate, formed of separate threads; lips large. Palpi very long, subulate. Siphons small, united. Hinge-teeth two, nearly parallel with hinge-margin, each divided into numerous transverse hook-like plates. Siphonal inflection distinct.

α. *Cartilage internal, triangular.* Leda, Yoldia. (See fig. 2.)

β. *Cartilage external, marginal.* Solenella.

17*. *Modiolarcadæ.* Gills four, thick, subtrigonal, truncated in front, narrow, produced and united together behind the foot. Lips four, moderate. Palpi obsolete. Siphonal apertures distinct, anal moderate; inhalant very large, inferior, simple-edged. Foot oblong, truncated, lanceolate, acute in front, with subposterior central hole for byssus. Shell equivalve. Hinge-teeth none or rudimentary. Cartilage linear, external. Periostraca hard, polished. Living attached to floating seaweeds.

1. Modiolarca. Modiola trapezium, *Lamk.* This is the animal I described as *Crenellidæ*, Syn. B. M. 1841, 177; it is very distinct from *Crenella* or *Modiola.*

2. ?Mytilimera.

Fig. 2.

Yoldia australis.

The figure, from a drawing by Albany Hancock, Esq., represents the animal as seen through its transparent mantle, on the removal of the right valve.

a, a, adductor muscles; *p, p,* pedal muscles; *x, x,* lateral muscles of the foot; *f,* foot; *t, t,* labial palpi and appendages; *g,* gills; *s,* siphons; *m,* pallial line; *i,* a convolution of the alimentary canal, lying close to the right side, and producing an impression in the shell; *l,* ligament.

IV. *Foot elongate, slender, strap-like, byssiferous* (for anchoring the animal).

18. *Dreissenidæ*, Syn. B. M. 1842, 82; P. Z. S. 1847, 199. Foot conical, small; anterior adductor muscle small, on a transverse subumbonal internal plate. Mantle edge double. Valves subtrigonal, keeled. Hinge toothless. Cartilage external, marginal. Fluviatile.

19. *Galeommidæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 192. Foot very small, ligulate, flattened beneath. Mantle edge double, outer more or less expanded and reflexed, covering (perhaps all) the shell, inner covering the gape of the shell. Gills two pair, dependent, united together behind the foot; lips elongate. Shell oblong, gaping beneath. Hinge toothless. Cartilage internal, in a triangular pit.

V. *Foot very small, rudimentary, byssiferous; hinder adductor muscle large, placed forward in the centre of the lower edge of the shell. Pedal opening small, in front near umbo; anal opening apparently behind and above the adductor muscle.*

20. *Tridacnidæ*, Syn. B. M. 1842, 82; P. Z. S. 1847, 198.

Foot small. Anterior adductor muscle very small. Mantle double-edged, inner edge expanded. Gills small, thick, pinnate, united behind.

Order II. Pholadacea.

Mantle with two close, more or less elongate siphonal openings under the hinder adductor muscle. Gills two pair, produced into the inhalant or lower siphon. Pedal opening generally small. Siphons united (except in *Pharus*).

Suborder 1. Orthoconchæ. *Body symmetrical. Valves equal, gaping at each end. Mantle partly exposed. Cartilage external or none.* Living perpendicularly in holes in rock or sand.

A. *Cartilage none, replaced by muscles.*

1. *Pholadidæ*, Syn. B. M. 1842, 76; P. Z. S. 1847, 187. Foot clavate, truncated, anterior. Gills two on each side.

B. *Cartilage external, marginal.*

2. *Gastrochænadæ*, Syn. B. M. 1842, 77; P. Z. S. 1847, 188. Foot small, cylindrical, anterior, not byssiferous. Gills two on each side. Shell gaping in front. Cartilage small, weak. Living enclosed in or imbedded in a shell-case.

3. *Saxicavidæ*, Syn. B. M. 1842, 79; P. Z. S. 1847, 193. Foot small, cylindrical, inferior, byssiferous. Gills two on each side; lips small. Siphons moderate. Shell solid. Hinge-teeth rudimentary. Cartilage thick. 1. Saxicava. 2. Cypricardia.

4. *Pholadomyadæ*, P. Z. S. 1847, 194. Foot short, compressed, with a small bifurcate pedal appendage behind. Siphons united. Pedal opening small. Gills two on each side, thick, united behind the body. Shell oblong, gaping at each end. Hinge-teeth rudimentary or none. Cartilage exterior, marginal.

5. *Solenidæ*, Syn. B. M. 1842, 77; P. Z. S. 1847, 189. Foot very large, clavate or truncated in front, not byssiferous. Pedal opening anterior. Gills two on each side. Shell cylindrical or oblong, gaping at each end. Hinge-teeth distinct. Cartilage very large, on a distinct fulcrum. Living sunk in the sand.

Suborder 2. Heteroconchæ. *Body not symmetrical. Valves unequal. Cartilage internal, in a pit; hinge simple. Pedal opening inferior.* Living lying on the side in sand or mud.

6. *Myadæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 190. Siphons elongate, united, covered with a horny periostraca. Gills two on each side, dependent; lips small. Shell porcellanous. Hinge toothless. Cartilage-pit in a hollow in one and a concavity in the umbonal surface of other valve.

7. *Corbulidæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 192. Siphons moderate. Foot small. Gills two on each side, dependent, separate, moderately prolonged; lips long. Shell porcellanous. Hinge with a conical tooth and a cartilage-pit on each valve.

8. *Pandoridæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 192. Siphons large. Foot moderate. Gills subpinnate, one on each side, greatly prolonged; lips long. Shell pearly. Hinge with two diverging teeth and a triangular pit on each valve. Valves very unequal.

Subclass 2. Asiphonophora. *Mantle lobes mostly free, bearded behind or on the whole edge, sometimes with a separate siphonal opening for the vent.*

Order III. Lasiacea.

Mantle lobes united, with an anal aperture under the hinder adductor muscle, and a pedal aperture.

1. *Solenomyadæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 192. Pedal opening anterior. Foot large, oblong, clavate, truncated at the end. Siphonal opening in a disc, surrounded with long beards. Gills pinnate, appearing only one on each side, broad, of separate threads. Palpi small, slender. Shell gaping, thin. Periostraca hard, polished, dilated beyond the shell; cartilage internal. Animal, leaps and swims about by suddenly drawing in the umbrella-shaped foot, at the same time the water is expressed from the hinder opening by the closing of the valves.

2. *Lasiadæ*, Syn. B. M. 1842, 78; P. Z. S. 1847, 192. Pedal opening inferior, moderate, front edge sometimes produced into a hood (or united and forming an anterior aperture for an inhalant siphon?). Gills two, laminar, dependent, unequal, oblong, on each side; lips cylindrical, outer pair small, inner very broad. Foot compressed, with a central inferior groove, byssiferous. Mantle double-edged, inner dilatile.

Order IV. Unionacea.

Mantle lobes free, slightly united behind, forming a separate anal siphonal opening placed under the hinder adductor muscle.

Suborder 1. Lucinacea. *Foot cylindrical, elongate, inferior; anterior adductor muscle generally elongate.*

1. *Lucinidæ*, Syn. B. M. 1842, 80; P. Z. S. 1847, 195. Anal siphons elongate, cylindrical, retractile into the mantle-cavity. Pedal opening inferior, moderate. Gills lamellar, only one on each side the body, oblong, broad, united behind the base

of the foot. Foot cylindrical, elongate, inferior, not byssiferous; lips none. Mantle doubled-edged, inner dilatile.

a. Normal. *Lucina, Thyasira, Fimbria. **Codakia, Loripes.

b. *Gills two on each side, lips moderate.* ?Ungulina.

Suborder 2. SUBMYTILACEA. *Foot large, compressed, anterior adductor muscle nearly as large as the hinder.*

A. *Shell free. Periostraca brown, hairy.* Marine.

2. *Carditidæ,* Syn. B. M. 1842, 79; P. Z. S. 1847, 193. Foot compressed, conical, rather angulated behind. Cartilage external, marginal. Hinge-teeth diverging, very oblique. Gills two pairs, free, behind the body.

3. *Crassatellidæ,* Syn. B. M. 1840, 141; 1842, 91; P. Z. S. 1847, 194. Gills two pair, dependent, produced, acute, and united behind the base of the foot. Lips four, rhombic. Foot short, compressed, triangular, with a deep groove. Mantle lobes free, hinder end bearded, anal opening separate. Cartilage internal, in a triangular pit. Hinge-teeth diverging.

B. *Shell free. Periostraca hard, smooth.* Fluviatile.

4. *Unionidæ,* Syn. B. M. 1842, 80; P. Z. S. 1847, 196. Foot compressed, subquadrate, angulated behind. Mantle edge smooth, generally bearded behind. Gills two pair, large, dependent. Shell pearly within; hinge variable, toothed or toothless. Periostraca hard, polished.

a. *Unionina.* Foot moderate.

b. *Mycetopedina.* Foot elongate, enlarged at the end. Shell gaping at each end. Mycetopidæ, *Syn. B. M.* 1842, 81; *P. Z. S.* 1847, 197.

C. *Shell attached by the outer surface of one valve.* Fluviatile.

5. *Etheriadæ,* Syn. B. M. 1842, 79; P. Z. S. 1847, 193. Mantle edge bearded. Gills large, two pair. Foot moderate, anterior adductor muscle small, linear. Gills two pair, dependent. Shell pearly and blistered within. Hinge toothless. Cartilage subinternal, curved. Young shell free, like *Unio*?

Suborder 3. MYTILACEA. *Foot small, ligulate, byssiferous; anterior adductor muscle small.*

6. *Mytiladæ,* Syn. B. M. 1842, 82; P. Z. S. 1847, 198. Anus simple. Gills two on each side, dependent.

α. *Mytilina.* Hinder part of mantle only slightly produced; anterior muscle small.

β. *Crenellina.* Hinder part of mantle produced, forming false siphons. Crenellidæ, *Syn. B. M.* 1842, 82.

γ. *Lithodomina.* Hinder part of mantle more or less produced; anterior muscle moderate-sized.

7. *Pinnadæ,* Syn. B. M. 1842, 83; P. Z. S. 1847, 199. Anus furnished with a long ligulate valve.

Order V. Pectinacea.

Mantle leaves free all round, without any separate opening for the outgoing current and vent.

Suborder 1. Arcacea. *Shell oblong or roundish, the anterior and posterior adductor muscles subequal. Mantles bearded behind. Hinge-teeth deeply grooved or divided into transverse interlocking plates.*

a. *Foot lanceolate, subulate, angulated* (for leaping).

1. *Trigoniadæ,* Syn. B. M. 1842, 81; P. Z. S. 1847, 197. Shell pearly within. Hinge-teeth two, diverging, deeply cross-grooved.

b. *Foot truncated or dilatile at the end, often byssiferous* (for anchoring).

2. *Arcadæ,* Syn. B. M. 1842, 81; P. Z. S. 1847, 197. Foot rather compressed, truncated, often secreting a laminal byssus. Gills subpinnate. Shell subquadrate or roundish. Hinge-teeth two, each divided into numerous transverse interlocking teeth. Gills formed of fibres.

α. *Arcaina.* Foot byssiferous. Gills subpinnate, separate from each other behind. Hinge-teeth straight, even with the hinge-margin. Cartilage in small marginal pits.

β. *Pectunculina.* Foot securiform, simple, not byssiferous; gills dependent. Cartilage in small marginal pits.

γ. *Nuculina.* Foot compressed, end of disc bearded. Gills pinnate; lips broad, triangular, large, striated internally. Cartilage in a small, central, internal pit.

Suborder 2. Malleacea. *Shell subtrigonal; anterior adductor muscle small, rudimentary, hinder large, subcentral; gills laminar.*

3. *Pteriadæ,* P. Z. S. 1847. Aviculidæ, *Syn. B. M.* 1842, 83.

Foot slender, cylindrical, grooved in front. Shell internally pearly; hinge toothless or nearly so.

α. *Pteriacna.* Foot byssiferous. Mantle lobes fringed. Shell eared, with a byssal notch in front. Cardinal teeth rudimentary, horny, attached by byssus.

β. *Crenatulina.* Foot not byssiferous; mantle fringed behind. Shell not eared, without any anterior byssal groove; hinge toothless. Living in sponges.

Suborder 3. OSTRACEA. *Shell suborbicular; anterior adductor muscle obliterated, hinder large, central. Cartilage internal. Mantle often bearded on the whole edge.*

A. Pectinina. *Foot distinct, small, byssiferous or appendaged. Gills disunited medially. Tentacles separate from gills.*

4. *Spondylidæ*, Syn. B. M. 1842, 83; P. Z. S. 1847, 201. Foot short, thick, end with an enlarged truncate radiating disc, with a central pedicelled ovate body; lips foliaceous, pinnately lobed. Mantle with bright ocelli. Hinge with two large interlocking teeth.

5. *Pectenidæ*, Syn. B. M. 1842, 83; P. Z. S. 1847, 200. Foot long, cylindrical, often byssiferous at the base. Mantle with bright ocelli. Hinge of shell not, or only obscurely toothed.

6. *Limadæ.* Pectenidæ, *Syn. B. M.* 1842, 38; *P. Z. S.* 1847, 200. Foot compressed, not byssiferous. Mantle without any ocelli on the edge. Shell gaping; hinge toothless.

B. Ostreina. *Foot none. Tentacles separate from the gills.*

7. *Ostreidæ*, Syn. B. M. 1842, 84; P. Z. S. 1847, 201. Shell attached by the outer surface of one valve. Hinge toothless. Tentacula short.

8. *Placentadæ*, P. Z. S. 1847, 201. Placunidæ, *Syn. B. M.* 1842, 81. Shell free when adult. Hinge with two diverging teeth. Animal —— ?

C. Anomiaina. *Foot small, cylindrical, truncate at the end, forming a laminal horny or strong byssus. Tentacles very long, not distinct from the gills.*

9. *Anomiadæ*, Syn. B. M. 1842, 81; P. Z. S. 1847, 201. Foot passing out through a slit in one of the valves and permanently attaching the animal to marine bodies. Shell with two or three subcentral scars.

XXXVIII.—*On the Reproduction of a lost part of an Operculum, and of its probable Restoration when entirely destroyed.* By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

It is to be expected that an operculum of a Gasteropodous Mollusk might be sometimes broken or injured, but I have never been able to find any very distinct example of the kind, so as to study how the repair of the lost part would be effected. That such an occurrence would most probably be rare, is easily explained from its situation, as the operculum is protected by the last whorl of the spire of the shell when the animal is expanded, and by the mouth when it is contracted into the cavity of the shell.

I have lately met with a very distinct example in a specimen of *Fusus* in the British Museum collection. In this specimen the apical half of the operculum has been broken off (see fig. 1), and the lost part has been renewed by an irregular roundish process, nearly of the size of the lost part, not quite as thick as the original portion, and formed of rather irregular horny plates; the smaller or first-formed portion being in the centre of the broken line, so that the restored part bears some similarity to the annular operculum of a *Paludina*. This restoration is exactly like that which would have taken place in a shell under similar circumstances, and is a further proof of the truth of the theory which I have long advocated, that the operculum is a rudimentary valve, and is homologous to the second valve of the Bivalve Mollusks.

Fig. 1.

In examining two specimens of *Pleurotoma babylonica*, preserved in spirits, with the opercula attached, I was much surprised to observe that the opercula of the two specimens were exceedingly different in structure and belonged to two distinct modifications of that valve, one (fig. 2) being subannular, with the nucleus apical, like the other species of the genus, and the other (fig. 3) annular, with the nucleus subcentral, somewhat like the operculum of *Paludina*.

Fig. 2.

Fig. 3.

The examination of the restoration of the lost half of the operculum of the *Fusus* before referred to has solved the difficulty, and I have no doubt that one of these animals had by some accident lost its operculum, and that it had gradually restored it; commencing, as in the case of the restored part of the operculum of the *Fusus*, by a small nucleus in the centre of the opercular mantle, on the back of the foot, and gradually adding new layers round the edge of it, until it formed an annular operculum nearly of the size of the original, but differing from it in shape, being less acute in front and nearly similar in form at the two ends. A more minute examination has strengthened this theory, for the operculum of this specimen is less regularly developed than is usual in the annular operculum of the kind, and is much thinner than the normal operculum of the genus, as is the case in both these particulars with the restored part of the operculum of the *Fusus*.

This change in the formation of the operculum when it is reproduced, is just what one might have expected. The animal, when it has to form its operculum at its birth, begins its formation at the tip, and increases its size, as the animal requires a larger operculum for its protection, by the addition of new layers to the outer edge of its larger and last-formed end: but when it has to reproduce this organ, the opercular mantle having reached a certain size, it proceeds to cover its surface with a new protection in the most easy and rapid manner, and, commencing from a more or less central spot on the surface, enlarges the surface covered by adding new matter to the entire circumference of the first-formed part; it continues this process without waiting to make the operculum as thick and solid as the one which was lost, until it reaches the size of the original, moulding itself on the opercular mantle, and adapting its form to the form of the throat of the aperture of the shell which it has to close. The change of form in the front of the restored and mended operculum is caused by the parts being moulded on the existing opercular mantle—consequently they have not the narrow front part which is found in the normal form, caused by that part having been formed when the animal had this part of a small size; and as it increases in size the whole opercular mantle moves forward, leaving the small tip of the operculum free, and useless to the animal, and therefore not necessary to be reproduced when the operculum is re-formed in the adult age of the animal.

In the British Museum collection there is also a specimen of *Cominia maculata* with the operculum almost entirely reproduced, with the same alteration of the general form and position of the nucleus. These mended or reproduced opercula are always known from the normal operculum of the animal by being more or less irregularly formed and thinner in consistence.

PROCEEDINGS OF LEARNED SOCIETIES.

LINNÆAN SOCIETY.

November 1, 1853.—Thomas Bell, Esq., President, in the Chair.

Mr. James Yates, F.L.S., offered some observations on the inflorescence of *Cycas revoluta* and *Macrozamia spiralis*, illustrated by specimens.

Cycas revoluta.

Prof. Miquel of Amsterdam, to whom we now look for the best systematic arrangement and description of Cycads, remarks, that male specimens are rarer in Europe than female. "Specimina culta," says he, "omnia ferè feminea. Masculinum in Horto Petropolitano exstat, ubi bis floruit (Otto u. Dietr. Gartenz. vii. 1839, p. 24)." See his 'Monographia Cycadearum,' 1842, folio, p. 24, and his "Genera et Species Cycadearum viventium" in the 'Linnæa' for 1843, p. 683. This observation is certainly true in regard to Great Britain. Since the first example of the female at Farnham, described by Sir J. E. Smith in the 'Linnæan Transactions,' vol. vi., not less than six other plants have borne fruit, and some of them two or three times, viz. at Chatsworth, Ravensworth Castle, Laurel Mount and Knowsley near Liverpool, Kew, and Lauderdale House, Highgate. The plant last alluded to (Mr. J. Yates's) flowered in 1845, and subsequently produced four magnificent crowns of leaves, the finest of them consisting of fifty-three leaves. In October 1852, the first appearance of another cone was indicated by scales, covered with their soft yellow tomentum; but it remained long doubtful whether this would turn out to be another crown of leaves, or a head of fruit-bearing fronds. In April last the question was determined, as the peculiar palmate fronds were clearly seen, and were closely folded over one another, having the form of a somewhat flattened spheroid and the size of a moderately large melon. In May these fronds or *spadices* increased rapidly and vigorously. They expanded and remained open three days, so that the young drupes, also covered with down and nearly the size and form of horse-beans, were easily discernible. They then closed again, and the whole spheroid became as compact and solid as before. It was conjectured that this temporary disclosure of the drupes, supposing it to be the habit of the plant, might be a provision for their fecundation, admitting of the access of the pollen. The fronds, which are crimson shaded by their thin covering of yellow down, are now spread in all directions and have attained their full development, except that the drupes, perhaps in consequence of the cold, wet, and dull season, fall without having come to perfection. It is also to be observed, that these fronds, about 110 in number, are closely set and spirally arranged upon a very short axis. The distance between them and the fronds of 1845 is about 8 inches or 20 centimetres, showing an elongation of the trunk of 1 inch for each year.

Miquel mentions only one *male* plant, viz. that at St. Petersburg; and in this country it cannot be ascertained that more than two males have produced cones, to wit, those in the Botanic Garden at

Sheffield, and that belonging to Henry Ricketts, Esq., at the Grove, Brislington, near Bristol. The Sheffield plant has now flowered thrice. Its first cone, produced in England, is preserved in the Museum at York; its second belongs to the Royal Botanic Society in the Regent's Park; its third appeared this year, and, that it might be suitably displayed, the whole plant was transported to York last summer and was there publicly exhibited. It is now taken back to Sheffield. It appears that this male was purchased by the late Earl of Derby, formerly President of the Linnæan Society, about A.D. 1825, together with the female already noticed, which is a noble specimen, still preserved at Knowsley, and which bore fruit in 1850. The Brislington specimen has been in the possession of its present owner about half a century, and may be between fifty and sixty years old. In 1847 it raised a cone or spike 58 c. (*i. e.* 23 in.) long, which is agreeable to the ordinary size and form of this production; and now it has raised a second, but with a remarkable anomaly in its development. This is not half the length of its predecessor, and, instead of being drawn to a point, is curtailed and terminates abruptly in a tuft of barren scales, resembling those, which, as intimated above, always precede the rise either of a crown of leaves or of a fruit-bearing cone. A check in the development of the cone appears to have been sustained, preventing the further prolongation of its axis, and at the same time causing its scales to be no longer dilated and antheriferous.

MACROZAMIA SPIRALIS.

Mr. Yates next exhibited a small, but perfect specimen of the cone of a male plant, which he lately imported from Sydney. This is probably the first time that a *Macrozamia* has produced a cone in this country. Together with the recent cone Mr. Yates showed also two old specimens, which had been sent with the living plant by W. S. MacLeay, Esq., F.L.S., and which that gentleman obtained near his own residence at Elizabeth Bay. One of these two specimens is very remarkable in consequence of being double. At the top of a peduncle of the usual size and appearance are fixed two equal, parallel and perfect male cones. Mr. Yates showed, that some approach to this double formation is occasionally found in the genus *Encephalartus*, inasmuch as the axis of the cone is sometimes bifid near the summit.

It was also remarked, that the peduncle of *Macrozamia* bears leafy appendages, and that these have not been found in any other recent genus, but are very conspicuous on the peduncles of the fossil *Zamites gigas*, which is found in the Oolitic strata near Whitby.

Read some "Observations on the parasitic habits of *Rhinanthus Crista-galli*, and its injurious effects on the growth of Barley." By Joshua Clarke, Esq., F.L.S. &c.

These observations were made during the last summer in the parish of Debden, in the county of Essex. The field contained four acres of barley, the soil a stiffish clay; the *Rhinanthus* was growing in patches at different parts of the field, some of which were much larger than others, and occupying at least half the surface, by which about two acres of the barley were completely destroyed, and the remaining part of the crop very much injured, both in quantity and quality. The farm consisted of 170 acres, principally clay soil, such as is usually called heavy land; thirty acres of it were of barley, about ten of which were destroyed by this plant.

In regard to the mode by which the *Rhinanthus* effects the injury, Mr. Clarke states that the fibres of the roots attach themselves to the fibres of the barley, on which they form small round tubers, or what perhaps may be more properly called spongioles, which embrace the fibres so effectually, that they suck the juices of the plant so as to starve it, and in most instances ultimately destroy it; these spongioles are formed of cellular tissue. A correct knowledge of the habits and natural history of a plant may lead to its eradication, but in this instance it is a matter of considerable difficulty, the ordinary method of destroying weeds by a summer fallow being of no avail, as the *Rhinanthus* does not grow in clean earth. Mr. Clarke has for some years been trying to raise it from seed in clean earth, but has never succeeded. The other method of destroying weeds by green crops in rows is equally unsuccessful, as it does not grow among green crops. As it is annual, it certainly should be pulled up before it seeds; and as it grows on a clay soil, and to no great extent except in a wet season, the land should be effectually drained.

Read also a Note "On the Reproduction of Lost Parts in Earthworms." By George Newport, Esq., F.R.S., F.L.S. &c.

The author exhibited three specimens of Earthworms, which have had parts of their bodies reproduced,—an occurrence which was formerly proved, by the experiments of Bonnet and Spallanzani, to take place in these animals. One of the specimens exhibited was still living, the others were preserved in spirit. In each of them more than one-third of the posterior division of the body had been restored. The new parts in all were much smaller in diameter, and the segments much shorter than in the original anterior portion of the body. Although the reputation of Bonnet and Spallanzani requires no defence, the author thought it might be interesting to the Fellows to examine these specimens, since the fact of reproduction in Earthworms and other Annelids has recently been denied. In a "Report on the British *Annelida*," by Dr. F. Williams, published in the Report of the British Association for the Advancement of Science for the year 1851, that gentleman, after mentioning the experiments of Bonnet and Spallanzani, as quoted by Prof. Owen, makes the following statement:—"On the authority of hundreds of observations, laboriously repeated at every season of the year, the author of this report can declare, with deliberate firmness, that there is not one word of truth in the above statement" (Rep. Brit. Assoc., 1851, p. 247). Dr. Williams, Mr. Newport added, must have been singularly unfortunate in his observations, since it is no uncommon thing, at this season of the year, to find Earthworms which have had a large portion of the body restored; as is easily seen by the much lighter colour, more delicate texture and smaller dimensions of the new parts, as compared with the original parts of the animal.

November 15.—Thomas Bell, Esq., President, in the Chair.

Read a Notice "On *Hodgsonia*, Hook. fil. et Thoms., a new and remarkable genus of *Cucurbitaceæ*." By Dr. J. D. Hooker, F.R.S., F.L.S. &c., and Dr. Thomas Thomson, F.L.S. &c.

HODGSONIA.

CHAR. GEN.—FL. MAS. *Calycis* tubus elongatus, post anthesin deciduus, 5-gonus, angulis dentibusve incrassatis recurvis. *Petala* 5, flavida, gamopetala, calycis limbo adnata, obovato-cuneata, patentia, apice truncata, fimbriato-lobata; lobis longissimis tortis, pendulis. *Stamina* 5, triadelpha. *Antheræ* monadelphæ, extrorsæ; loculis linearibus contortis.

FL. FŒM. *Calyx* basi ovario sphærico adhærens, supernè longè tubulosus, mari omninò similis, intùs disco spongioso. *Corolla* maris. *Ovarium* 1-loculare. *Placentæ* 3, parietales, basin versus utrinque 2-ovulatæ; *ovulis* ascendentibus, anatropis. *Stylus* elongatus, tubum calycis æquans. *Stigma* 3-lobum, lobis supernè emarginatis. *Bacca* depresso-globosa, magna, obscurè 5-sulcata, pulpâ induratâ demùm siccâ repleta. *Semina* per paria in nuces 6 arctè accreta, altero minore plerumque effœto. *Testa* lignosa, basi fissa (rimâ elongatâ), profundè longitudinaliter reticulatim sulcata; epidermide vasculari in sulcos penetrante tecta. *Endopleurum* crassissimum, suberosum. *Embryo* exalbuminosus; cotyledones magni, plani; plumula lobata.

Frutex *altè scandens.* Caulis *ramosus, sulcatus, succo aqueo copioso scatens, vasis magnis aëre repletis percursus.* Folia *alterna, sempervirentia, coriacea, 3–5-palmatiloba.* Flores *magni, extùs rufobrunnei puberuli, intùs pallidè straminei villosi*; masculi *spicati basi bracteati*; fœminei *axillares solitarii* (v. ex cl. Roxburgh) *in racemum brevem dispositi.* Petioli *elongati, basi versus axillam gemmâ? corneâ conicâ stipulæformi suffulti.* Cirrhi *laterales, 2–3-fidi.*

HODGSONIA HETEROCLITA, *Hook. fil. et Thoms.*
Trichosanthes heteroclita, *Roxb. Fl. Ind.* iii. p. 705; *Wall. Cat.* no. 6684!
T. grandiflora, *Wall. Cat.* no. 6685! *non Blume.*
An T. hexasperma v. T. macrocarpa, *Blume, Bijdr.* p. 935?
Hab. in sylvis densis montium inferiorum Sikkim Himalayæ (ad 5500 ped. ascendens); Assam; Mont. Khasia, Silhet, Chittagong, Penang, Java? —*v. v. n.*

A very remarkable plant, one of the handsomest and most curious of the whole natural family, with the inflorescence and flower of *Trichosanthes*, but in fruit widely different from any of the extensive Natural Order to which it belongs. It has been extremely well described by Roxburgh as a species of *Trichosanthes*, and was cultivated many years ago in the Calcutta Botanic Garden, where it is now lost. A figure of the female flower is also in the Museum of the India House. *Root* branching. *Stem* climbing for 80 to 100 feet, festooning lofty trees. Wood of very remarkable structure. The almost axillary conical bodies, referred to buds, but generally described as stipules, are most remarkable and deserve careful study. *Flowers*, very handsome, appear in May, and the fruit ripens in autumn and winter; female flowers are rare, and from being solitary, are less conspicuous than the males. *Ovarium* covered with small warts that project through the dense, almost velvety, rusty pubescence, 1-celled with three parietal placentæ, that project into the axis, and clearly show the normal structure of Cucurbitaceous fruits to have a parietal placentation; cavity of the ovarium filled with watery pulp, that hardens as the fruit advances to maturity and becomes of the consistency of a hard turnip, full of watery fluid that escapes in large drops when the fruit is pierced. *Ovules* suberect, in pairs, each pair collateral and at right angles to the radius of the ovary; of these the ovule next the axis ripens, and that next the circumference of the ovary becomes accrete to the outer one and seldom ripens. This position and œconomy of the ovules is quite unique in the order. *Flowers* about 4 inches long; the limb 3 inches in diameter, inodorous; fringes of the petals 5–6 inches long. *Calyx* with several deep brown polished tubercles or warts towards each angle or tooth. Tube of the calyx lined with a thickened disc, which surrounds the style and is in contact with it; it lines the staminal tube of the male flower. Berry 6–10 inches across, of a fine deep red-brown colour, covered with a very short tomentum; pulp whitish. *Seeds* erect, very large, each double, resembling a 2-celled nut, covered with an adherent vascular pulpy coat, which penetrates deep fissures in the free face of the larger seed. *Testa* hard, somewhat porous; the free surface of the larger seed deeply grooved in anastomosing channels; outer surface rather corky or spongy, inner hard, smooth, polished. The testa is slit longitudinally down its base towards the hilum for one half or one inch in the larger seed, and has a smaller corresponding slit on the smaller nut. A compressed prolongation of the endopleurum (which is very soft, thick and corky) projects a little through this fissure, and the radicle points towards it. *Embryo* flat, of the form of the seed, occupying a narrow slit in the centre of the endopleurum, nearly as broad as the cavity of the testa, surrounded by a delicate membrane. *Cotyledons* plain, white, very oily; radicle small, conical; plumule 2-lobed, lobes notched. The seeds are eaten by the natives of Sikkim, who call the fruit Kat'hior pot. An original specimen is in Sir William Hooker's herbarium, from Buchanan Hamilton, labelled as from Penang, with the MS. name of "*Trichosanthes Theba*." Roxburgh's trivial name of *heteroclita* has been retained, for though it was intended by its illustrious author to imply that the plant varies from its congeners of the genus *Trichosanthes*, it will apply sufficiently well in future for a plant which is heteroclite in respect of the natural family (*Cucurbitaceæ*), to which it undoubtedly belongs. Blume's descriptions are quite insufficient to determine whether it belongs to his *M. macrocarpa* or *hexasperma*, or either. These plants are no doubt congeners of *Hodgsonia*, and considering that the *H. heteroclita* ranges from the level of the sea at Penang, lat. 6° north to alt. 6000 feet in Sikkim, lat 27° north, the probabilities are great that it is also found in Java. The leaves vary from 2-lobed to 5-lobed, usually the latter, and the lobes are much acuminate, rarely blunt, coarsely serrated towards the tips or quite entire.

The genus is named in honour of B. H. Hodgson, Esq., F.L.S., Resident at Darjiling, where the plant was discovered, and whose scientific services in the Himalaya justly merit the honour of so splendid a plant.

December 6.—Thomas Bell, Esq., President, in the Chair.

Read a "Notice of several species of Bats, captured in England during the present autumn." By G. B. Buckton, Esq., F.L.S. &c.

The species referred to are *Vespertilio serotinus*, Daub., *V. Daubentonii* var. *emarginatus*, and the typical *V. Daubentonii*. Of *V. serotinus* three specimens were obtained in August last at Chartham, about three miles from Canterbury, and captured in rather a singular manner. On returning late from a fishing expedition, the author was interested in watching several large bats hawking for beetles and the white moth (*Porthesia chrysorrhœa*), which was then plentiful. The idea occurred to him of roughly imitating the last insect by drawing a shred of white paper through the top ring of his rod and vibrating it; and this manœuvre, under the thick trees, had the effect of a decoy, and in a few minutes he switched down two specimens almost unhurt. On another evening he procured a third individual, and might easily have obtained more, as it appeared to be the common bat of the neighbourhood; although Mr. Jenyns, to whom the specimens were submitted, states that he has seen but two other English specimens, which (as appears from Mr. Bell's 'British Quadrupeds') were taken in the neighbourhood of London. Mr. W. Borrer has, however, found it not of unfrequent occurrence in the chalk excavations in Dover Cliff. When handled, these bats uttered a shrill chatter, and showed their teeth, with a strong disposition to bite. Their flight is graceful but somewhat heavy, and appeared to be limited to about an hour after sunset. They seem to affect the vicinity of high trees and shady places.

Vespertilio Daubentonii var. *emarginatus* was knocked down while flitting in company with another, over the water, under some willows on the banks of the river Stour; and three specimens of *V. Daubentonii* were obtained from the church-tower of Christchurch, Hants, where they may be found in plenty. Mr. Buckton describes the differences between *V. emarginatus* and *V. Daubentonii* as follows. *V. emarginatus* is nearly an inch larger in expanse of wings and half an inch longer from the nose to the tail*. The ears are somewhat narrower and more deeply notched; the thumb is stouter, and with reference to the size of the bat not so long. The fur is more of an ash-gray, and the flying membrane and fur of the under side more cool in colour. It appears to have much of the habit of *V. mystacinus*. On falling into the water it swam well to the bank, notwithstanding some current in the stream. Mr. Couch, in a paper published in the 'Zoologist,' has recorded the occurrence of *V. emarginatus* in the neighbourhood of Falmouth; but Mr. Newman, in the same

* The actual measurements are as follows:—

	V. emarginatus.	*V. Daubentonii.*
	inches.	inches.
Expanse...............	$10\frac{1}{4}$	$9\frac{1}{2}$
Nose to tail	3·7	3·1
Fore-arm	1·6	1·6 nearly.
Tail	1·4	$1·2\frac{1}{4}$
Thumb	·4	·3

periodical for September 1852, has expressed a doubt (which is shared by others) of the existence of the continental *V. emarginatus* in this country. On this subject Mr. Buckton read part of a letter from Mr. Couch addressed to Mr. Borrer, to the following effect. Mr. Couch regrets that he has no specimens, it being his custom to send away his specimens as soon as he has made such an examination as he deems necessary. The last he had were sent to Mr. Heysham at Chester, and the little Horse-shoe Bat travelled all the way from Cornwall thither alive. He is preparing a paper on the subject of Bats for the 'Zoologist,' in which he has collected many particulars which he thinks interesting; but with regard to the disputed identity of his species he refers to the 'Naturalist' for November 1851, where will be found a paper on this species, with a figure, by Mr. Cocks of Falmouth. The specimen which Mr. Couch examined, and to which he assigned this name, agreed with the characters there pointed out; and appeared to differ widely from any other British Bat. The notch in the ears was much more decided than in Mr. Bell's figure.

Read also a "Notice of the appearance of myriads of a species of *Aphis* in the North of England, during the present autumn." By J. Hogg, Esq., F.R.S., F.L.S. &c.

These insects not only abounded in immense numbers in country places, but also in vast swarms in the very centre of the town of Stockton. As these insects appeared just at the time when the cholera had broken out in that portion of England, many people considered that they were connected with that disease; and that they were forerunners, or at least indicative of the presence of the cholera. This Mr. Hogg considers to be fabulous and absurd, but he thinks that some of the same causes which might promote cholera, might likewise assist in the rapid increase of these *Aphides* at the same season; such as warm, moist weather, the absence of wind, and other like causes. Or indeed the excess, or it may be the want of electricity in the atmosphere, might tend to account for the presence of cholera, and the extraordinary multitudes of these insects in the same localities; but that the existence of the cholera was in any way influenced by the *Aphides*, or the converse, he altogether disbelieves. Mr. Hogg exhibited some of these insects in the hope that the species might be determined. He had not examined them minutely, but believed that they might prove to be the *Aphis Rumicis*. They were taken by him at Norton, in the county of Durham, in the latter part of September in the present year. He added that he has no recollection of having witnessed before such multitudes of these black, or dark-coloured, flies with light wings; and that they were extremely troublesome by flying into the eyes and mouth.

Read, further, a paper entitled "Remarks on Sarsaparillas." By Berthold Seemann, Esq., Ph.D., F.L.S. &c.

After quoting a remark of Sir W. Hooker, that those plants which are most useful to mankind are frequently the least known botanically, and the testimony of the late Dr. Pereira as to the unsatisfactory nature of our knowledge of the botanical sources of the various sorts of Sarsaparilla, Dr. Seemann proceeds to endeavour to elucidate the facts connected with this perplexing subject. He refers first to specimens collected by Dr. Warszewics, during his last visit to the Volcano of Chiriqui in Veraguas, and transmitted by him to Mr. Daniel Hanbury, and which Dr. Seemann pronounced to belong to the *Smilax officinalis* of Humboldt and Bonpland; a view which was confirmed by a tracing made in Paris by Mr. Hanbury, from the original imperfect specimens of that plant, and subsequently by specimens collected by Dr. Warszewics at Bajorque in New Granada, the locality where Humboldt and Bonpland obtained their *Smilax officinalis*, and which are completely identical both with the plant of the two distinguished travellers above named and with the specimens collected by Dr. Warszewics at Chiriqui. The author then extended his inquiry to other so-called species supposed to be allied to *Smilax officinalis*, and states that having examined the specimens of *Smilax papyracea* of Poiret, in the possession of Mr. Bentley, on which that gentleman had published an able article in the Pharmaceutical Journal for April 1853, he became convinced of the identity of that plant also with *Smilax officinalis*. He next refers to *Smilax medica* of Schlechtendal and Chamisso, well described and tolerably figured by Nees von Esenbeck, which he believes to be also identical with the plants previously examined; the supposed differences having originated in the extreme variableness in this genus of the roots, stems, branches and leaves, from which the principal characters of the three supposed species were derived.

The following is the description given by Dr. Seemann of the plant which unites under the name of *Smilax officinalis* the synonyms of *Sm. papyracea* and *Sm. medica*. It grows in the lower coast region as well as on the mountains at an elevation of 5000 feet above the sea, and is confined (as far as at present known) to the continent of America, where it is found between 20° N. and 6° S. latitude, and 110° and 40° W. longitude. Jamaica, from whence so large a quantity is annually obtained, has been well ascertained not to produce any itself, the article known as "Jamaica Sarsaparilla" being imported into that island from the Spanish Main; nor is it authentically proved to occur in any of the other islands of the West Indies. The rhizoma is cylindrical, and the roots (*Sarsaparilla of Commerce*), abounding more or less in starch, according to age and locality, are as many as 10 feet in length, and generally furnished with branched rootlets (beards). The plant itself is glabrous in every part, and averages 50 feet in length. The stem is quadrangular, furrowed or striated, and on the edges furnished with flat prickles, which are occasionally curved upwards. The branches are either quadrangular or multiangular, and either with or without prickles. The petiole, sheathing at the base, is furnished with two spirally-twisted tendrils, which are often 10 inches long, and either furnished with prickles or destitute of them. The leaves are extremely variable; at times they are broadly cordate, almost trilobed, gradually tapering to an acumen; at others they are ovate-oblong, and even lanceolate, and rounded at the apex, but always mucronate; they are generally 5-nerved, the two outermost nerves being mostly bifurcated, and all the nerves prominent on the under surface, acutely edged and often furnished with prickles; the colour of the leaves is of a dark green, the under surface being a shade paler than the upper, but never glaucous; as in many other species of *Smilax*, their length varies from 2 inches to a foot, and their breadth at the base from 1 to 6 inches; in thickness also they vary considerably, being either coriaceous or more or less paper-like, and in the latter case furnished with transparent lineolar dots. The peduncles are axillary and solitary, somewhat flattened, and bear an umbel composed of about sixteen flowers. The flowers are still unknown. The berries are round, red, and of the size of a small cherry or less; and each contains two or three plano-convex seeds of a light brown colour.

Dr. Seemann does not expect that botanists will object to the union of the three supposed species; but he fears that pharmacologists may be disinclined to adopt his views, inasmuch as regarding the different commercial sorts of Sarsaparilla as essentially distinct, they lay great stress upon certain superficial characters of little botanical importance. Thus the so-called Lisbon or Brazilian Sarsaparilla, which comes in rolls about 3 feet long, is chiefly distinguished from the Jamaica Sarsaparilla, by having fewer rootlets or beards, and inasmuch as the beards contain a greater amount of mealy matter, is on that account of less value in the market. But the author states, that, if the Lisbon Sarsaparilla be carefully examined, it will be plainly seen that the rootlets have been removed by some rough mechanical process, and that when gathered they had as much beard as the Jamaica kind, making it probable that if the merchant who buys up this Zarza in various parts of Brazil, would instruct the collectors that the preservation of these rootlets would not only save them trouble but also increase both the weight and commercial value of the roots, we should soon have from Brazil the same valuable Sarsaparilla which we now obtain from Jamaica. The distinction, however, on which pharmacologists lay the greatest stress is into "mealy" and "non-mealy," according as the mealy coat immediately below the outer cortical layer is of greater or less thickness, or entirely wanting. This distinction, which is at once seen to be by no means well-defined, depends moreover on the age of the roots and the locality in which they were collected, the formation of starch being probably entirely regulated by physical circumstances. In a bundle of Jamaica Sarsaparilla many roots may be found mealy at one end and non-mealy at the other. Again, the form of the cells of the nucleary sheath of the roots has been considered as furnishing good marks of distinction between the Sarsaparillas of Central and South America; and Schleiden declares that he can readily distinguish them microscopically. But this theory, as appears from Mr. Bentley's paper before referred to, does not rest on any safe foundation.

Dr. Seemann believes therefore that he may safely conclude that the greater part of the Sarsaparilla of Commerce is the produce of one and the same species of *Smilax*; but he does not wish to infer from the identity of the three supposed species, that the commercial distinctions, now so universally acknowledged, ought to be given up.

He believes that so long as the Brazilians continue to strip the roots of their beards, there will be in the market the so-called Lisbon Sarsaparilla, and as long as the inhabitants of the Spanish Main preserve these rootlets, there will be Jamaica Sarsaparilla; and further, that as long as the climate and other physical conditions of Guatemala remain unchanged, we shall receive from thence Sarsaparilla distinguished by its abundance of mealy matter.

MISCELLANEOUS.

RUNCINA HANCOCKI.

When in company with Mr. William Thompson, I observed *Runcina Hancocki* in considerable abundance in the pools left between the rocks at low tide in Belmont Cove, Weymouth, but only on the tufts of *Hypnea purpurascens* which were infested with *Diatomacea,* which induces me to believe that they feed on these parasitic plants. I brought several of them to London, and have since sent some to Mr. Alder, who verifies the determination. Messrs. Alder and Hancock (Ann. and Mag. Nat. Hist. xviii. 289. t. 4), when they first described the animal, referred them to the genus *Limapontia,* order *Inferobranchiata.* Mr. Edward Forbes (Brit. Moll. iii. 611. t. CCC.) formed them into a genus, placed provisionally at the end of the *Eolididæ,* observing that in all probability it represented a distinct family.

The examination I have been able to bestow on the animal induces me to agree with Mr. Forbes on this point, and I should be inclined to arrange the *Runcinidæ* in the order *Pleurobranchiata,* near *Bullidæ* and *Pleurobranchidæ.* It has the armed gizzard and gills of *Aplysiadæ.* To the excellent description of Messrs. Alder and Hancock, I may add, that the tongue-membrane is covered with three longitudinal series of large transparent teeth, like some of the *Bullidæ.* The central tooth is broad, tranverse, with the upper edge reflexed, notched in the middle, and with three unequal denticles on each side of the middle line. The lateral teeth are rather large, versatile, conic, arched, compressed, with an acute tip. The prehensile collar is horny, large, rugose, with roundish tubercles. I am somewhat inclined to consider the front part of the back, enclosing the eyes, which are rather bent up on the sides and separated from the other part of the back by a paler colour, as the frontal lobe of the *Bullidæ,* which is united at this paler part to the true mantle, giving the animal the appearance of having a single oblong shield-like mantle. The mantle is very hard and tough, but without any appearance of a shell or spicula.—J. E. Gray.

Note on the Coloration of the Waters of the Chinese Sea. By M. Camille Dareste.

In this note M. Dareste informs us that the *Trichodesmium erythræum,* described by Ehrenberg as the cause of the red colour assumed by the Red Sea at certain periods, has been brought from the Chinese sea, in a sample of water taken at a time when a great extent of the ocean was coloured red and yellow. The coloration was not continuous, but formed patches separated by transparent intervals. The red colour predominated in that portion of the sea which washed the southern portion of China, to the south of the island of Formosa, whilst the yellow colour was observed principally to the north of this island, in the sea known as the Yellow Sea. The water was taken from the portion of the sea which was of a red colour.

The same plant was received some years since from Ceylon by M. Montagne, so that it appears to range throughout the Indian Ocean from the coast of Africa to that of China. M. Dareste also refers to the description of an atmospheric dust by Mr. Piddington, published in the Journal of the Asiatic Society of Bengal for 1846, which he thinks contained minute forms of vegetation similar to, if not identical with, the *Trichodesmium erythræum*.—*Comptes Rendus*, March 6, 1854, p. 461.

METEOROLOGICAL OBSERVATIONS FOR MARCH 1854.

Chiswick.—March 1. Frosty: very fine: clear, with sharp frost at night. 2. Frosty: very fine: hazy. 3. Very dense fog: foggy: partially overcast: frosty. 4. Frosty, with slight fog: overcast. 5. Overcast: clear: dense fog. 6. Dense fog: foggy throughout. 7. Foggy: fine: overcast. 8. Cloudy: overcast: clear. 9. Overcast: very fine: overcast. 10. Cloudy: slight rain. 11. Fine: clear. 12. Slight fog: very fine. 13. Clear and fine. 14. Cloudy: slight rain. 15. Foggy: cloudy. 16. Cloudy and fine. 17. Clear throughout: frosty at night. 18. Slight haze: rain. 19. Rain: overcast. 20. Clear and cold. 21, 22. Fine. 23. Cloudy and cold. 24, 25. Overcast. 26. Cloudy. 27. Overcast: very fine. 28. Cloudy: very fine. 29. Clear: very fine. 30. Overcast: fine. 31. Clear throughout.

Mean temperature of the month	42°·54
Mean temperature of March 1853	37 ·41
Mean temperature of March for the last twenty-eight years	42 ·23
Average amount of rain in March	1·36 inch.

Boston.—March 1—3. Fine. 4, 5. Cloudy. 6, 7. Foggy. 8, 9. Cloudy. 10. Fine. 11. Cloudy. 12, 13. Fine. 14. Cloudy: rain A.M. 15. Fine. 16. Cloudy: rain A.M. 17. Fine: rain A.M. and P.M. 18. Cloudy. 19. Fine. 20—26. Cloudy. 27. Fine: rain A.M. 28. Cloudy. 29. Fine. 30. Cloudy. 31. Fine.

Sandwick Manse, Orkney.—March 1. Cloudy A.M. and P.M. 2. Bright A.M.: cloudy P.M. 3. Clear, fine A.M.: clear, aurora P.M. 4. Clear, fine A.M.: clear P.M. 5. Bright A.M.: drizzle P.M. 6, 7. Cloudy A.M. and P.M. 8. Bright A.M.: clear P.M. 9. Rain A.M.: cloudy P.M. 10. Bright A.M.: showers P.M. 11. Rain A.M.: cloudy P.M. 12. Bright A.M.: clear P.M. 13. Bright A.M.: cloudy P.M. 14. Cloudy A.M.: fine P.M. 15. Clear A.M.: cloudy P.M. 16. Cloudy A.M.: clear P.M. 17. Cloudy A.M.: drops P.M. 18. Cloudy A.M.: showers P.M. 19, 20. Cloudy A.M.: clear, aurora P.M. 21. Bright A.M.: cloudy, aurora P.M. 22. Cloudy A.M. and P.M. 23. Cloudy A.M.: clear P.M. 24. Cloudy A.M. and P.M. 25. Cloudy A.M.: clear, aurora P.M. 26. Bright A.M.: clear, aurora P.M. 27. Showers A.M.: cloudy P.M. 28. Clear A.M.: cloudy, hazy P.M. 29. Cloudy A.M.: cloudy, drizzle P.M. 30. Clear A.M. and P.M. 31. Clear A.M.: cloudy P.M.

Mean temperature of March for twenty-seven previous years	40°·37
Mean temperature of this month	45 ·14
Mean temperature of March 1853	38 ·24
Average quantity of rain in March for thirteen previous years	2·59 inches.

The mean temperature of this month is higher than that of any March for the last twenty-seven years, and the barometer on the 4th was as high as on any day during the same period except on two, viz. 27th December 1840, when it was 30·72, and on 1st February 1841, when it was 30·76.

On the 30th, about 8 o'clock P.M., a comet with a long tail was seen N.W. about 7° above the horizon, and remained visible to the naked eye, and attracting attention for an hour and a half, but has not been seen since then, as the sky was too cloudy for several evenings.

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.
1854. March.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·702	30·677	30·34	30·16	30·30	54	18	34	47½	45	sw.	w.	s.	....	....	·03
2.	30·668	30·627	30·36	30·24	30·23	55	18	32	46	46	s.	s.	sw.	....	....	....
3.	30·628	30·509	30·32	30·42	30·61	54	18	30	44	43	e.	calm	w.	....	....	....
4.	30·752	30·705	30·44	30·71	30·60	50	33	42·5	44	42	e.	e.	w.	....	....	....
5.	30·714	30·570	30·37	30·52	30·46	45	20	36	46	45	se.	w.	w.	....	....	....
☽ 6.	30·636	30·437	30·20	30·36	30·19	44	24	28	47	40	e.	w.	sse.	....	....	·07
7.	30·424	30·377	30·10	30·05	29·83	50	44	30	47	46½	sw.	wsw.	s.	....	....	·10
8.	30·332	30·285	29·93	29·69	29·79	55	46	50	46½	45	sw.	wsw.	sw.	....	....	....
9.	30·258	30·195	29·83	29·60	29·48	62	47	52	48½	50	sw.	wsw.	sw.	....	....	·33
10.	30·101	29·991	29·56	29·35	29·52	56	40	55	44	41	sw.	ssw.	w.	·01	....	·19
11.	30·140	30·101	29·70	29·41	29·71	61	27	50	48	47	sw.	sw.	sw.	....	....	·53
12.	30·061	29·924	29·68	29·60	29·61	63	27	50	47	46	s.	sw.	s.	....	....	....
13.	29·960	29·881	29·60	29·57	29·22	64	43	43	47	48	sw.	ssw.	s.	....	....	....
○ 14.	30·019	29·851	29·47	29·45	29·75	64	27	49	47½	40	sw.	s.	se.	·02	....	....
15.	30·157	30·128	29·80	29·83	29·63	57	44	39	45	46	s.	s.	se.	·01	·06	....
16.	30·231	30·070	29·65	29·66	29·98	58	25	50	46	41	sw.	ssw.	sw.	·01	....	·09
17.	30·529	30·396	30·10	30·16	30·01	53	23	36	43½	44½	n.	e.	se.	....	·07	....
18.	30·212	29·957	29·80	29·75	29·97	53	35	43	46	41½	sw.	w.	se.	·19	·23	·09
19.	30·141	29·907	29·76	30·39	30·52	45	31	42	45½	37½	e.	ne.	n.	·15	....	....
20.	30·358	30·278	30·07	30·58	30·58	45	31	38	45	40½	ne.	e.	n.	·01	....	....
☾ 21.	30·404	30·321	30·06	30·61	30·61	49	27	40	43	43	ne.	ne.	wnw.	....	....	....
22.	30·498	30·419	30·20	30·52	30·44	49	42	42	45½	45	ne.	n.	wnw.	....	....	....
23.	30·399	30·349	30·10	30·40	30·37	52	23	44	46½	42	nw.	n.	wnw.	....	....	....
24.	30·271	30·203	30·00	30·29	30·01	48	23	41·5	47	45	ne.	n.	nw.	....	....	....
25.	30·106	29·954	29·72	29·81	29·82	48	40	42	44	37	nw.	w.	ne.	....	....	·06
26.	30·061	29·876	29·53	29·83	29·92	56	36	47	46	42½	nw.	nw.	w.	·02	....	....
27.	30·199	30·192	29·85	29·69	29·93	56	28	40	47	46	w.	sw.	w.	....	·06	·07
● 28.	30·379	30·295	29·93	30·00	29·97	61	28	51	50	46½	nw.	n.	wsw.	....	....	....
29.	30·387	30·312	29·94	29·81	29·81	60	31	49	53½	47	w.	......	sw.	....	....	....
30.	30·294	30·212	29·87	29·90	29·79	58	28	51	48½	44	sw.	ssw.	w.	....	....	·04
31.	30·401	30·354	30·00	29·98	29·83	57	29	45	46	48	w.	nnw.	w.	....	....	·05
Mean.	30·336	30·237	29·94	30·010	30·015	54·25	30·83	42·6	46·38	43·91				0·42	0·42	1·65

THE ANNALS

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XXXIX.—*On some new Genera and Species of Fossil Fishes.* By Sir Philip Grey Egerton, Bart., F.R.S. &c.

To the Editors of the Annals of Natural History.

Gentlemen,

In the early part of last year I was solicited to undertake the preparation of a second Decade of fossil fishes for the Memoirs of the Geological Survey of the United Kingdom. Having materials at hand I completed the task assigned to me, and delivered in the manuscript in the commencement of the month of July. In consequence however of a press of business in the Stationery Office, I have not yet received the proofs for correction, nor, as far as I have been able to learn, is there any likelihood of the matter being proceeded with for some time to come. The manuscript contains the detailed descriptions of twelve new species, comprising three new genera; most of them from the Purbeck beds and the Lias. The delay of publication of these materials having almost reached twelve months, I am induced to ask for a vacant space in your Magazine for the following short descriptions of the species, in order that Mr. Morris and others, who have works in progress on British Palæontology, may be put in possession of these additions to our fossil fauna.

Genus Asteracanthus, Agassiz.

A. granulosus, Egerton. An ichthyodorulite about 1 foot in length, characterized by the small size of the tubercles ornamenting the exposed portion of the spine.

Locality. Hastings sand, Tilgate Forest. Decade 8. pl. 1.

A. verrucosus, Egerton. An ichthyodorulite of common occurrence at Swanage. The surface is closely beset with stelliform tubercles rising from circular expanded pedestals.

Locality. Purbeck beds, Swanage. Decade 8. pl. 2.

A. semiverrucosus, Egerton. This species rests upon a single specimen in the Dorchester Museum. It is characterized by its short and falciform figure, and by the peculiarity of the surface ornament, consisting of an intermixture of coarse tubercles with raised lines, similar to those on the spines of the genus *Hybodus*.

Locality. Purbeck beds, Swanage. Decade 8. pl. 3.

A. papillosus, Egerton. Although not a British species, this is alluded to as completing the enumeration of the species of this genus. It is an ichthyodorulite of short and massive proportions, having its surface invested with large round papillæ.

Locality. Oolite, Caen.

Genus Pholidophorus, Agassiz.

P. granulatus, Egerton. This species more nearly resembles the *P. ornatus* of Agassiz than any other. It differs in the deeper proportions of the body and in the characters of the scales, which are more oblong and have the striations finer and more regular, and the posterior margins less deeply serrated. Those in the vicinity of the dorsal fin are granulated.

Locality. Purbeck beds, Swanage. Decade 8. pl. 4.

Genus Histionotus, Egerton.

This genus has some affinities to *Lepidotus* and *Semionotus*. It resembles the former in the outline of the head and trunk, and the latter in the large size of the dorsal fin. This organ however occupies a much greater extent of surface, commencing near the nape of the neck and reaching almost to the caudal fin.

H. angularis, Egerton. The species is characterized by the abrupt angles occurring at the occiput and at the insertion of the dorsal fin. The scales somewhat resemble those of a large *Pholidophorus* and are similarly articulated; they are finely serrated on the posterior margin. The teeth are fine and conical.

Locality. Purbeck beds, Swanage. Decade 8. pl. 5.

Genus Aspidorhynchus, Agassiz.

A. fisheri, Egerton. This is a slender species, differing in its proportions from any of the species figured in the 'Poissons Fossiles.' The scales along the dorsal line are curiously figured with irregular vermiform ridges running longitudinally. The teeth are sharp and numerous.

Locality. Purbeck beds, Swanage. Decade 8. pl. 6.

Genus Pholidophorus, Agassiz.

P. higginsi, Stutchbury. This *Pholidophorus* was named some years ago by Mr. Stutchbury of the Bristol Institution in honour of its discoverer Mr. Higgins, but has not been described. It is a diminutive species, remarkable for the large size of the scales and the thickness of the ganoine which covers them. Those on the anterior part of the trunk are deeply notched; the duct tubes of the lateral line are very prominent.

Locality. Lias, Aust. Decade 8. pl. 7. figs. 1–5.

P. nitidus, Egerton. This species differs from *P. higginsi* in the greater regularity and more even surface of the scales, which are also devoid of serrations. The body of the fish is more elongated.

Locality. Lias, Aust. Decade 8. pl. 7. figs. 6–8.

Genus Legnonotus, Egerton.

A small fish remarkable for the extent of the dorsal fin, which occupies the entire length of the back. The scales have considerable resemblance to those of *Pholidophorus*, near to which genus *Legnonotus* must be classified.

L. cothamensis, Egerton. Until a second species of this genus has been discovered, the generic characters will suffice to identify it. The scales are not unlike those of *Pholidophorus higginsi* in proportions and relative position and arrangement; they are more extensively notched at the free margin, and the serrations are shórter and more obtuse. The teeth are stronger and not so numerous as in the *Pholidophori*.

Locality. This fish was discovered with the two preceding species in a block of Cotham marble. Decade 8. pl. 7. figs. 9–12.

Genus Ptycholepis, Agassiz.

P. curtus, Egerton. This species is distinguished from the only other species of the genus, *Ptycholepis bollensis*, Agass., by its shortened body and the large proportions of the head.

Locality. Lias, Lyme Regis. Decade 8. pl. 8.

Genus Oxygnathus, Egerton.

A genus appertaining to the family of the *Sauroidei*, near *Eugnathus*, but distinguished from that genus by the sharpened form and thin texture of the dentigerous bones and the smallness of the teeth. The scales have more affinity with those of *Acrolepis*.

O. ornatus, Egerton. Under the designation of specific characters may be noticed the delicate striated surface ornament of the head bones of this fish, and the highly ornamental pattern on the scales.

Locality. Lias, Lyme Regis. Decade 8. pl. 9.

Genus Pycnodus, Agass.

P. liassicus, Egerton. This, the only specimen of the genus found so low as the Lias, is remarkable for the tuberculate ornament on the scales, and the variety in the size and form of the teeth.

Locality. Lias, Barrow on Soar. Decade 8. pl. 10.

Plates illustrative of the above species, beautifully drawn and lithographed by Mr. Dinkel, may be seen at the Meeting of the Geological Society on the 7th of June.

I have the honour to be, Gentlemen,
Your obedient servant,
P. de M. Grey Egerton.

6 Albemarle Street, May 15, 1854.

XL.—*Monograph of the British* Graphideæ. By the Rev. W. A. Leighton, B.A., F.B.S.E.

[Concluded from p. 395.]

8. *Arthonia,* Ach.

Apothecium (*ardella*) roundish, or difformed, tumid, innately sessile, covered with a subcartilaginous membrane, within subgelatinous, containing immediately under the surface a series of pyriform asci; perithecium none; disk nearly plane, not bordered, black, rough. Thallus cartilagineo-membranaceous.

"Name from ἄρθω to sprinkle, according to Acharius, because the numerous apothecia are as it were sprinkled over the crust: but M. Fée justly remarks that ἄρδω (and not ἄρθω) is to *sprinkle,* and that therefore the name ought to be *Ardonia.*" Hook. Br. Fl. 2. 142.

I propose to designate the apothecium by the term *ardella,* significant of its appearance as a sprinkled spot.

1. *Arthonia epipasta, β. microscopica.* Thallus thin, membranous, smooth, shining, grey or copper-coloured, irregularly circumscribed; ardellæ innate, scattered, oblong or elongato-

oblong, simple or branched; disk dark brown, plane, roughish; sporidia linear-clavate, 3-septate.

Graphis microscopica, Ehrhart, Crypt. 273 (1791 ?).
Opegrapha epipasta, *β. caraganæ*, Ach. Meth. 26 (1803); L. Univ. 258.
Opegrapha microscopica, Sm. E. Bot. t. 1911 (1808).
—— *epipasta*, *β. microscopica*, Ach. Syn. 75 (1814); Hook. Br. Fl. 2. 144.
Arthonia microscopica, *α. stenograpta*, Wallr. Crypt. Germ. 322 (excl. some syn.).

On young oaks and alder. Sussex! *Mr. Borrer*.

Thallus forming irregular transverse patches on the smooth bark of trees of a transversely oblong or elongated shape, well-defined by its colour, but not bounded by any dark line, very thin, smooth, somewhat shining, varying from pale greyish-yellow to a greyish-olive or even copper-colour. *Ardellæ* tolerably numerous, distantly scattered over the thallus in a parallel transverse direction, very variable in shape and size, minute and roundish or oval, or larger oblong or elongato-oblong, obtuse and rounded at the extremities, innate, but slightly raised above the surface, mostly simple, in a young state covered by the thallus which is ruptured by the emergence of the lirella, and is then apparently thrown back so as to form a sort of spurious thallodal margin closely appressed along the sides of the lirella. *Disk* dark brown, plane and open, tumid and convex when wetted, roughish, surrounded by what appears as a very slender black proper margin always visible, especially so in those ardellæ whose disk has been abraded, but when carefully examined found to be illusory, arising in reality from the black surface of the disk bending over the sides of the ardella and inserting itself under the membranous thallodal margin, which is in consequence somewhat thickened and upraised, and appears darker as a very narrow margin to the disk. The vertical section shows this structure, and also that of the nucleus which is gelatinous and hyaline, having imbedded in it in regular arrangement roundish-clavate asci, each containing eight sporidia of a linear-clavate form, 3-septate; the whole covered externally and laterally by the dark subpulverulent matter constituting the disk. There is no trace of any carbonaceous, horny or even membranous receptacle in the ardella.

Not to be confounded with *Verrucaria punctiformis* and *Verrucaria epidermidis*, *β. analepta*, which are very frequently found growing side by side with it on the same bark.

The specimens of *Opeg. epipasta* in Mr. Borrer's herbarium were in too imperfect a state to determine anything accurately concerning them. They were however evidently belonging to the genus *Arthonia*.

Plate VII. fig. 30. *a*, Vertical section of thallus and ardella; *b*, sporidium; *c*, asci imbedded in the nucleus.

2. *Arthonia punctiformis,* Ach., *α. olivacea,* Ach. Thallus thin, membranous, smooth, shining, copper-coloured, indeterminate; ardellæ subinnate, scattered, roundish or broadly oblong, simple; disk dark brown, plane or slightly convex, rough; sporidia linear-clavate, obtusely pointed, 3-septate.

Arthonia punctiformis, α. olivacea, Ach. L. Univ. 141 (1810); Syn. 4; Mart. Fl. Erlang. 283; Sommerf. Suppl. Lapp. 141.
Opegrapha punctiformis, Fingerh. Eiffl. 25 (1829).

On young oaks. Sussex! *Mr. Borrer.*

Thallus very thin, smooth, even and shining, somewhat scaly, pale brown or darkish copper-colour, forming irregular indeterminate patches. *Ardellæ* few, distantly scattered, larger than in the last, variable in size and shape, roundish or broadly oblong, simple, slightly raised above the surface, probably in a young state covered by the thallus, which in a later stage is cracked around the ardella, forming an inconspicuous spurious thallodal margin. *Disk* dark brown, plane or slightly convex, coarsely roughened by raised points or minute tubercles, which a vertical section shows to be thinner portions of the dark external disk, towards which the asci, which seem collected into sets, converge, and through which the sporidia are probably ultimately ejected. This peculiarity of structure I have not noticed in any other species. *Nucleus* gelatinous and hyaline, with broad rounded asci imbedded, each with eight pale yellow sporidia of a linear-clavate or obovate form, obtusely pointed at the extremities, 3-septate, covered externally by a darker layer constituting the disk.

Acharius doubts whether his *Opegrapha epipasta β. microscopica* may not be a form of his *Arthonia punctiformis,* but I incline to think them distinct.

β. galactina, Ach. Thallus pale yellow or cream-colour.—Ach. L. Univ. 141; Syn. 4.

On young oaks. Sussex! *Mr. Borrer.*

In all other respects, except the colour of the thallus, similar to *var. α.*

Plate VII. fig. 31. *a,* Vertical section of thallus and ardella; *b,* sporidia.

3. *Arthonia astroidea.* Thallus thin, membranous, smooth, scaly, white, cream-colour, or olive, limited; ardellæ innate, clustered, substellate or radiate; disk blackish, plane, rough; sporidia in asci, eight, linear-clavate, rounded at the extremities, 3-septate.

Opegrapha radiata, Pers. in Ust. Ann. st. 7. p. 29. t. 2. f. 3. B. b. (1794).
Lichen astroites, Ach. Prodr. 24 (1798).
Opegrapha astroidea, Ach. Meth. 25 (1803); Sm. E. Bot. t. 1847.

Arthonia astroidea, Ach. in Schrad. N. Journ. Bot. 1. B. 3 st. p. 17. t. 4. figs. 4 & 5 (1806); Johnston! Fl. Berw. 2. 101.
Arthonia radiata, α. β. γ. δ, Ach. L. Univ. 144 (1810).
—— *astroidea*, α. & β, Ach. Syn. 6 (1814).
—— *radiata*, Cheval. Fl. Paris, 540 (1826).
—— *microscopica*, γ. *asterograpta*, Wallr. Crypt. Germ. 1. 322 (1831).
—— *vulgaris*, *var. astroidea et radiata*, Schær. Spicil. 8.246 (1823–1836); Lich. Exsic. 16!
Opegrapha atra * *macularis*, Fries, L. Ref. 367 (1831); (in part) Hook. Br. Fl. 2. 145 (18·3).
—— *atra*, λ. *radiata et* μ. *astroidea*, Schær. Enum. 154, 155 (1851).

Sussex! *Mr. Borrer*. Berwick-on-Tweed! *Dr. G. Johnston*.

Thallus thin, membranaceous, smooth, continuous, sometimes slightly shining, frequently cracking and scaling off, either milk-white, or pale yellow or cream-colour, or of a paler or darker olive colour, slightly raised into a thin membranous spurious thallodal border around the ardellæ, which in a young state are entirely covered by this as by a thin veil, which bursting makes way for its emergence, circumscribed either entirely or partially by a watery wavy border or line, which is either pale and very indistinct, or distinct and of a darkish brown, forming irregular transversely elongated patches of an oblong form of various size and extent on the smooth bark of trees. *Ardellæ* slightly prominent above the surface of the thallus, very numerous, closely approximate and even crowded, yet each distinct and separate, of an irregular round or oblong or linear-oblong shape, congregated many together and forming minute clusters, which by confluence become pedato-stellate or radiate, and in a still later stage of confluence become indistinctly stellate, or rather irregular angular blackish-brown flattened spots. *Disk* blackish or dark brown, plane and expanded, tumid and convex when moistened, rugged or roughened on the surface, without any perceptible proper margin, except the pale very narrow thallodal membranous margin. In a rubbed state the lamina proligera disappears and the lateral receptacle becomes visible, giving the appearance at first sight of a margined disk. A vertical section shows the pale lamina proligera supported on either side by a dark brown perithecium which does not subtend the base, and appears of very little greater consistence than the dark surface of the disk.

The so-called "varieties" seem rather *states* of the same plant than varieties properly speaking.

Plate VIII. fig. 32. *a*, Vertical section of thallus and ardella; *b*, sporidia.

4. *Arthonia Swartziana*, Ach. Thallus thin, cartilagineo-membranaceous, scaly, cream-colour or ashy-gray, subdeterminate; ardellæ subsessile, clustered into irregular angular or

subradiate shapes; disk black, plane, cracked; sporidia in asci, eight, broadly obovate, 3-septate.

Arthonia Swartziana, Ach. Schrad. Journ. Bot. 1. 3. p. 13. t. 4. f. 1 (1806); Sm. E. Bot. 2079; Ach. L. Univ. 142; *α*. Syn. 5; Mart. Fl. Erlang. 285; Fingerh. Fl. Eiffl. 25; Johnst.! Fl. Berw. 101; Hook. Br. Fl. 2. 143; Tayl. Fl. Hib. pt. 2. 104; Leight. Lich. Brit. Exsic. 70!
Arthonia vulgaris, *β. Swartziana*, Schær. Spicil. 246 (1823–1836).
Opegrapha atra, *λ. Swartziana*, Schær. Spicil. 326; Exsic. 462!; Enum. 155.
—— *atra*, *γ. macularis*, Tuckerm. N. Amer. Lich. 75 (1848).
Arthonia microscopica, *β. arthograpta*, Wallr. Crypt. Germ. 322 (1831).

On ash, near the Retreat, Berwickshire! *Dr. G. Johnston*. On smooth bark of trees. Shropshire, generally!

Thallus forming small subdeterminate patches, of an irregular round or oblong shape, pale yellow or cream-colour with a tinge of ashy-gray, or altogether ashy-gray, thin and scaling off here and there. *Ardellæ* numerous, closely approximate, of a very irregular shape, with a substellate or radiate outline, arising as it were from the apparent confluence of many ardellæ into one dark blotch of a full dull black colour. *Disk* flat or convex, cracked irregularly. *Sporidia* of a very broad obovate form, 3-septate, pale yellow, eight in each ascus.

Plate VIII. fig. 33. *Opegrapha atra*, *λ. Swartziana*, Schær. Exs. 462: *a*, vertical section of ardella and thallus; *b*, sporidia.—Shropshire specimens of *Arthonia Swartziana*, Ach.: *a′*, vertical section of thallus and ardella; *b′*, sporidia.

5. *Arthonia impolita*, Borr. Thallus thin, subtartareous, cracked, indeterminate; ardellæ immersed, roundish or irregularly oblong; disk flat or slightly convex, brownish or lead-coloured, rough, pruinose; sporidia in asci, eight, obovato-linear, rounded at the extremities, 3-, 4- or 5-septate.

Verrucaria impolita, Hoffm. Fl. Germ. 2. 172 (fide Ach.).
Lichen impolitus, Ehrh. Crypt. 274 (fide Ach. et Schær.).
Patellaria pruinata, Pers. in Ust. Ann. st. 7. p. 28 (1794).
Lichen pruinatus, Pers. in Ust. Ann. st. 11. p. 19 (1797).
Parmelia impolita, Ach. Meth. 160 (1803).
Arthonia pruinosa, Ach. L. Univ. 147. t. 1. f. 3 (1810); Syn. 7; Wallr. Crypt. Germ. 321; Moug. & Nestl. Stirpes, 1159!
Arthonia impolita, Borr. in E. Bot. Suppl. 2692. fig. 1 (1831); Hook. Br. Fl. 2. 143; Tayl. Fl. Hib. pt. 2. 104; Schær. Enum. 242; Exsic. 506!; Leight. Lich. Brit. Exsic. 131!
*Parmelia impolita b**, Fries, L. Reform. 183 (1831).
Lecanactis impolita, Fries, Summa Veg. Scand. 118 (1846); Tuckerm. N. Amer. Lich. 77.

On ivy. Kenilworth Castle, Warwickshire! On oak, Henfield, Sussex! On worked timber, Livermore, Suffolk! all *in herb. Borrer*. Oswestry, Shropshire! *Rev. T. Salwey*. On oak, Udlington near Shrewsbury, Shropshire! On elm, Batchcot, Hey Forest near Ludlow, Shropshire!

Thallus thin, tartareous, cracked and uneven, somewhat powdery, whitish or pale yellow, spreading indeterminately over the rugged bark of trees. *Ardellæ* very numerous and crowded, covering nearly the whole thallus, and giving it at a little distance a blackish pruinose aspect, very variable in size and shape, roundish or irregularly oblong, or otherwise deformed by confluence, immersed, flat or slightly convex, brownish when the pruina is rubbed off, otherwise of a lead-colour, minutely roughened on the surface, which is covered with a white pruina; in section pale and semitransparent, subgelatinous, enclosing the asci which contain eight *sporidia*, of an obovate-linear or clavate form, rounded at the extremity, generally 4-septate, sometimes 5-septate, and sometimes only 3-septate, pale yellow.

Plate VIII. fig. 35. *a*, Section of thallus and ardella; *b*, sporidia; *c*, ascus with sporidia.

6. *Arthonia ilicina*, Tayl. Thallus thin, membranous, smooth, shining, scaly, cream-colour, limited; ardellæ subimmersed, scattered, irregularly rounded or oblong; disk brownish-black, plane, shining; sporidia in asci, eight, very large, obovato-clavate, 6-septate, upper cell largest.

Arthonia ilicina, Tayl. Fl. Hib. p. 2. 105 (1836).

On holly. Cromeglown, Ireland! *Dr. Taylor in herb. Borrer.* Glengariff, Ireland! *Miss Hutchins in herb. Borrer.* New Forest, Hants! *Mr. Lyell in herb. Borrer.* St. Leonard's Forest, Sussex! *Mr. Borrer.*

Thallus thin, membranous, smooth, somewhat shining, scaly, pale yellow or cream-colour, forming irregular patches 3–4 inches in diameter, limited by an indistinct irregular brown wavy watery border variable in width. *Ardellæ* numerous, scattered, of a large size, but with smaller ones interspersed, irregularly rounded or oblong, their outline entire or slightly wavy, half immersed in the thallus, when dry flat, often cracked, curving up at the margin as it were in loosening themselves from the thallus, when wet convex and prominent. *Disk* plane, of a full brownish-black, slightly shining. *Lamina proligera* pale brown, darker brown on the surface, enclosing asci, each containing eight large sporidia, obovato-clavate, 6-septate, the uppermost cell very remarkably the largest.

Opegrapha atra, var. obscura, Schær. Exsic. 517! is similar in colour and general appearance, but the ardellæ are smaller, closer together and arranged in irregular parallelism, their outline crenato-incised, their surface somewhat wrinkled, the sporidia one half the size, of a different formation and 5-septate. Is not this Acharius's *A. gyrosa* ?

PLATE VIII. fig. 36. *Arthonia ilicina*, Tayl.: *a*, Vertical section of ardella; *b*, sporidia.

PLATE VIII. fig. 37. *Opegrapha atra, var. obscura*, Schær.: *a*, Vertical section of ardella; *b*, sporidium; *c*, ascus with sporidia.

7. *Arthonia lurida*, Ach. Thallus obsolete, smooth, pale dirty brown or lead-colour, indeterminate; ardellæ sessile, irregularly roundish; disk reddish-black, slightly convex, dull; sporidia in asci eight, small, broadly obovate, uniseptate.

Arthonia lurida, Ach. L. Univ. 143 (1810); Syn. 7; Schær. Spicil. 8. 245; Enum. 242. t. 9. f. 6; Exsic. 17!; Borr. E. Bot. Suppl. t. 2692. fig. 2; Hook. Br. Fl. 2. 143; Tayl. Fl. Hib. pt. 2. 104.
Spiloma paradoxum, Ach. L. Univ. 139; Syn. 3.
Coniangium vulgare, Fries, L. Europ. 378 (1831).
Patellaria anomala δ. m. arthonioides, Wallr. Crypt. Germ. 370 (1831).

On fir, holly and oak. Ireland! *Sir T. Gage in herb. Borrer*. Henfield, Black Down and elsewhere, Sussex! *Mr. Borrer*. Orton Wood, Leicestershire! *Rev. A. Bloxam*.

Thallus extremely thin, scarcely distinguishable, pale dirty brown, on firs of a dark lead-gray hue, spreading indeterminately. *Ardellæ* numerous, either distinct or confluent, variable in size, but minute, of an irregular roundish or oblong figure. *Disk* of a dull dark reddish-black, smooth or roughish. *Sporidia* in asci, eight? small, broadly obovate, uniseptate, pale yellow.

PLATE VIII. fig. 38. *a*, Vertical section of thallus and ardellæ; *b*, sporidia.

8. *Arthonia spadicea*, Leight. Thallus obsolete, smooth, shining, pale red-brown, indeterminate; ardellæ sessile, variable in size, larger ones roundish or oblong, smaller round and punctiform; disk dull brownish-black, flat or tumid, smooth; sporidia in asci, eight, small, slenderly clavæform, 3-septate.

Arthonia spadicea, Leight. Lich. Brit. Exsic. 97! (1852).

On the smooth bark of hazel and hawthorn, close to the ground. Shelton Rough near Shrewsbury, Shropshire!

Thallus excessively thin, membranous, of a pale red-brown, smooth, somewhat shining, spreading indeterminately over and scarcely distinguishable from the smooth bark of the base of the trunks which it covers close to the ground. *Ardellæ* numerous, scattered irregularly as if splashed or sprinkled, very variable in size, the larger ones roundish or oblong, or by confluence irregular in form, the smaller ones round and punctiform, of a dull lurid brownish-black; in old and dry states loosening around the circumference and peeling off. *Disk* flat or tumid, especially in the centre, smoothish, dull. *Sporidia* in asci, eight, of a very peculiar form, slenderly clavæform, round at the extremities, 3-septate, pale yellow.

PLATE VIII. fig. 39. *a*, Vertical section of thallus and ardella; *b*, sporidia; *c*, thallus and ardellæ, nat. size.

9. *Coniocarpon*, DC.

Apothecium (ardella) appressed, rotundato-deformed or elongate, sessile, covered with a subcartilaginous membrane which ultimately breaks up into a fine powder, within subgelatinous, containing a series of pyriform asci; perithecium none; disk plane, depressed, not bordered, pruinose. Thallus crustaceous.

Name from *κόνις*, *dust*, and *καρπὸς*, *fruit*.

This genus has in reality precisely the same structure as that of *Arthonia*, but it is retained separate on account of the peculiar property of the upper surface of the ardellæ breaking up into powder, which I have never observed to happen in any of the species of *Arthonia*.

Mr. Borrer (*in litt.* 1852) remarks, "The surface of the apothecium in *Lecanactis lyncea* and in *Arthonia impolita* sometimes becomes powdery. I suspect that both in that state have passed for *Coniocarpon nigrum*, DC., *Spiloma variolosum*, Ach., *S. nigrum*, Lich. Brit." &c.

1. *Coniocarpon cinnabarinum*, DC. Thallus filmy, thin, grayish, determinate; ardellæ sessile, clustered, shapeless, solid; disk plane, depressed, lurid and pruinose, or powdery and of a bright vermilion; sporidia in asci, eight, obovato-clavate, rounded at the extremities, 4-septate, the upper cell largest, pale red.

"*Sphæria gregaria*, Weigel, Obs. Bot. 43. t. 2. f. 10." (1772); Dicks. Crypt. 1. 22; With. Fl. Brit. 4. 391; "Sowerb. Fung. t. 375. f. 5."
Lichen impolitus, Sm. E. Bot. t. 981 (1802).
"*Coniocarpon cinnabarinum*, DC. Fl. Franç, 2nd ed. 323;" Fée, Crypt. tab. 1. f. 10 (1824); Fries! L. Reform. 379; Summa V. Scand. 118.
Spiloma tumidulum, Ach. Meth. 11. t. 1. f. 5 (1803); Sm. E. Bot. t. 2151; Johnst.! Berw. 101; Moug. & Nestl. Stirpes, 651!
—— *tumidulum α.* & *β*, L. Univ. 136 (1810); Syn. 1; Hook. Fl. Scot. 2. 35; Grev. Fl. Edin. 324.
Arthonia tumidula, Ach. in Schrad. N. Journ. Bot. 1. 3. p. 11 (1806).
Spiloma gregarium, Turn. & Borr. Lich. Brit. 42 (1813); Hook. Br. Fl. 2. 167; Tayl. Fl. Hib. pt. 2. 77.
Conioloma coccineum, Mart. Erlang. 284 (1817).
Coniocarpon gregarium, Schær. Spicil. 223 (1823–1836); Enum. 242. t. 9. f. 5; Exsic. 239!
Arthonia cinnabarina, Wallr. Crypt. Germ. 320 (1831).

"*Thallus* forming roundish patches of 1–2 inches in diameter, or sometimes spreading more widely" (limited by an irregular wavy watery brown margin), "in general so very thin as to look little more than a stain on the bark, more rarely a little tartareous, continuous or slightly cracked, externally gray, white, or with a pale bluish tinge, green within, its surface generally smooth and polished, but sometimes a little powdery. *Ardellæ* very numerous, most variable in shape and size, but usually roundish, more or less convex, and scarcely so large, taken singly, as poppy-seed, generally however aggregate and confluent in clusters, which are regularly disposed over the whole thallus: these clusters, again, are of a very uncertain figure, but, like the single ardellæ, for the most part roundish, often so disposed as to appear more or less lobed or stellate, and sometimes too, though much more rarely, oblong, or linear and flexuose, like the lirellæ of many *Opegraphæ*." (Lich. Brit. 43.) *Disk* flattish, depressed or somewhat convex, covered more or less with a bright cinnabar-red powder. The internal structure is precisely similar to that of the genus *Arthonia*. *Sporidia* in asci, eight, of an obovate or clavate form, 4-septate, the upper cell the largest, pale red.

The following varieties are enumerated by the learned authors of the 'Lichenographia Britannica':—

α. cinnabarinum, T. & B. Ardellæ somewhat convex, powdery, vermilion-coloured.

"Thallus thin, nearly white, smooth, or but slightly rugose, generally more or less cracked, but not unfrequently tinged with a pale bluish hue and truly continuous." Lich. Brit. *l. c.*

On the bark of smooth trees: common. Sussex! *Mr. Borrer.* On hazel in the dean at Pease-bridge, Berwickshire! *Dr. G. Johnston.*

β. rosaceum, T. & B.! Ardellæ collected in flat clusters, which have the appearance of being lobed, powdery, vermilion-coloured.

"Thallus smooth, white, very slightly cracked, thicker than in *α*." Lich. Brit. *l. c.*

On an old oak on Poyning's Common, Sussex! *Mr. Borrer.*

γ. marginatum, T. & B.! Ardellæ somewhat convex, particoloured, chiefly powdery on the margins.

The central part of the disk of the ardellæ is either naked and blackish, or pruinose with a whitish powder, the very edges alone being powdery and red.

On the bark of smooth trees: common. Sussex! *Mr. Borrer.*

δ. *concolor*, T. & B.! Ardellæ convex, of the same colour with the thallus, pruinose with a whitish powder.

On ash and oak. Sussex! *Mr. Borrer.*

ε. *dubium*, T. & B.! Ardellæ rather convex, lurid, dark purplish, pruinose.

Thallus subtartareous, slightly cracked and sometimes scaly, of a cinereous or purplish hue.

On ash and oak. Sussex! *Mr. Borrer.*

ζ. *detritum*, T. & B.! Ardellæ depressed, lurid, dark purplish, nearly naked, more or less stellate.

Thallus nearly as in ε, but rather thinner and more polished, and seldom tinged with purple; sometimes a little raised above the ardellæ, so as to form a sort of spurious margin.

On hazel. Sussex! *Mr. Borrer.*

η. *microstigma*, T. & B.! Ardellæ minute, solitary, depressed, covered with whitish pruina.

Thallus a very thin film, with a tinge of purple, sometimes rather thicker and white.

On ash in shady places. Sussex! *Mr. Borrer.*

θ. *astroideum.* Ardellæ rather large, in depressed, naked, radiate or stellate clusters, subimmersed, or very slightly raised above the thallus, dark reddish-black or full brown-black.

Thallus either thin, smooth, and of a dull reddish hue, or thicker, smooth, cracked minutely and copiously, of a pale whitish-gray or cream-colour.

On oak and ash. Ardingley, Michelgrove, and Charlton Forest, Sussex! *Mr. Borrer.*

PLATE VIII. fig. 40. *a*, Vertical section of ardella; *b*, sporidia.

The following is the result of the examination of the authentic specimens *in herb. Borrer* of the genus

Spiloma.

Spiloma sphærale.—Specimens from Schleicher! in herb. Borrer, were composed of masses of roundish granules.

Spiloma dispersum, Turn. & Borr. Lich. Brit. 32!; E. Bot. t. 2398; Hook. Br. Fl. 2. 165.

The pulvinuli of this plant appear under the microscope to be composed externally of oblong brown nearly opake bodies wrinkled or with network on the surface, probably from internal granules, supported on short articulated pedicels, from which the slightest touch easily detaches them, and discovers underneath similar bodies in a younger and less developed state and of a greenish-yellow colour.

Spiloma auratum, Turn. & Borr. Lich. Brit. 33 ! ; E. Bot. t. 2078 ; Hook. Br. Fl. 2. 165.

The pulvinuli consisted of masses of irregular rounded granules heaped together without order or arrangement, darker or brownish on the exterior, of a full yellow internally, and apparently breaking up into very minute granules. I could not detect any pedicels.

Spiloma nigrum and its varieties β. & γ, Turn. & Borr. Lich. Brit. 35 ! ; E. Bot. t. 2076 & 2077 ; Hook. Br. Fl. 2. 166.

The pulvinuli here also were formed of roundish black granules.

Spiloma fuliginosum, Turn. & Borr. Lich. Brit. 37 ! ; E. Bot. t. 2150 ; Hook. Br. Fl. 2. 166.

Similar to the last, but the pulvinuli confluent and scattered.

Spiloma decolorans, Turn. & Borr. Lich. Brit. 39 ! ; E. Bot. t. 2399 ; Hook. Br. Fl. 2. 166.

The sorediate or variolariose state of some thallus.

Spiloma punctatum, Turn. & Borr. Lich. Brit. 40 ! ; E. Bot. t. 2472 ; Hook. Br. Fl. 2. 166.

A section of the apothecia shows them to be composed of a dark brown or blackish perithecium enclosing a pale transparent nucleus, whose upper surface is covered with a dark brown layer. No traces of asci or sporidia. Most probably the young or punctiform state of some *Opegrapha.*

Spiloma tuberculosum, Hook. Br. Fl. 2. 167 ; E. Bot. t. 2556. Something old, imperfect and in decay.

XLI.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, F.Z.S., C.M.E.S. &c.

[Continued from p. 264.]

179. Megalaima caniceps, Frank.

Syn. *Bucco Zeylanicus* ? (Linn.).

Kotoorooal, Cing. *Kotoor,* Mal.

One of our commonest species and universally distributed. It feeds on fruits and berries of all kinds, which it swallows entire; it does not, that I know of, devour small birds when in a state of nature, but one kept in a large aviary in Colombo destroyed all the little *Amadinæ* placed with it. Not content with snapping them up when within his reach, he would lie in wait for them behind a thick bush or the feeding-trough, pounce upon them unawares, and after beating them a little on the ground or perch, swallow them whole. When this cannibal came into my possession, he was confined in a smaller cage than that in which he had at first been secured; this seemed to displease him, and he went to work to find some means of escape; he narrowly examined every side and corner to discover a weak spot, and having detected one, applied himself vigorously to bore a hole through it, as a woodpecker would have done; grasping the bars with his feet, he swung himself round, bringing his whole weight to bear upon his bill, which he used as a pickaxe, till the house resounded with his rapid and well-aimed blows. On being checked from exercising his ingenuity in this manner, he became sulky and refused to eat, or offer his call of recognition when I approached him; in a day or two, however, he apparently thought better of the matter, resumed his labours upon another spot, and fed as voraciously as ever, devouring huge slices of bananas, jungle fruits, the bodies of any small birds I skinned, &c. &c. I hoped he would have lived long with me, but found him dead one morning at the bottom of his cage, and as he was fat and well-favoured, I presume he died a victim to the solitary system.

The species builds in hollow trees, laying three or four pure white, but very shining eggs. Axis 1 in. 1 line, diam. 11 lines. The natives all affirm that the birds hollow out their own nest-hole. One I saw was in an unsound tree, the nest slightly formed of a few bents of dry grass.

180. Megalaima flavifrons, Cuv.

This Barbet is confined to the hilly zone, where it predominates over the other island species. It may be heard at a great distance, and distinguished by its shrill call. Breeds in hollow trees in the month of February: lays three or four roundish, polished white eggs.

181. Megalaima Philippensis, Briss. *Mal-Kotoor,* Cing.; lit. Flower-Kotoor. *Kokoorupan,* Mal.

This is the prevailing species in the northern province, where it has acquired the name of "coppersmith" among the Europeans, from its ceaseless call, which resembles the knocking of an artisan engaged in the manufacture of a caldron. It frequents the tamarind trees, on the fruit of which it feeds. Like the other species, it breeds in holes, and I have seen it in the act of excavating them in decaying portions of living trees.

182. Megalaima rubricapilla, Gmel. *Mal-Kotoor*, Cing.

Very common about Colombo; I have also seen it from Batticaloa, and procured it at Jaffna. It frequents the banian trees in great numbers and feeds upon the ripe fruits, swallowing them entire.

183. Picus gymnopthalmos, Blyth, J. A. S. no. xxxii.

The smallest of our Woodpeckers, and peculiar to the island. I first discovered it near Colombo in the year 1848, and it was described by Mr. Blyth in 1849, *loc. cit.*

It is sparingly, at the same time widely, distributed, and delights in creeping about the jack-trees; it is therefore more plentiful to the south of the island, in the cultivated portions, than towards the northern and jungle districts.

Irides the palest possible yellow; eyelids deep purple.

184. Picus Mahrattensis, Latham.

Confined to the northern province, and found principally about the dead limbs of the *Euphorbia* trees. I have not seen more than half a dozen specimens.

185. Picus Macei, Vieill.

Dr. Kelaart includes this in his Catalogue, *sed non vidi.*

186. Gecinus chlorophanes, Vieill.

Not uncommon in the neighbourhood of Colombo, and in the lower ranges of the hills. Dr. Kelaart says that at Nuwera Elia it "is very frequently seen." Of all our Woodpeckers this seems the only one addicted to walking, and seeking its food on the ground. Here it is often found in pairs, breaking into the dried masses of cow-dung in search of Coleoptera. On being alarmed it takes refuge on the nearest tree or bush, and displays all the arboreal activity of its tribe, climbing round the branches and evading the eye by carefully keeping on the opposite side of the limbs.

187. Brachypternus aurantius, Linn. *Tatchan-cooroovi*, Mal., and *Pastru carpentaru*, Port.; lit. Carpenter-bird. Applied, in fact, indiscriminately to all the Woodpecker tribe, but more especially to this species from its vigorous knocking.

The Yellow-backed Woodpecker is confined exclusively to the

Borassus-growing districts, commencing at Chilaw sparingly, and increasing in numbers till its knocking resounds from almost every palmirah tope in the Jaffna peninsula. In these trees it likewise breeds, excavating large holes in the male trees, they being generally softer than the female.

In the jungle and among the cocoa-nut plantations of the south and central portion of the island it is entirely replaced by

188. Brachypternus Ceylonus, Forster. *Kāāralla*, Cing.; sometimes *Keberella*, Cing.

—which is peculiar to Ceylon, and very common in the low country. Dr. Kelaart also characterizes it as "found in great abundance at Nuwera Elia." In habits it precisely resembles the preceding. Irides red-brown. Its call is a shrill, stridulous scream, often uttered during its flight, which is maintained by short, rapid jerks, repeated at considerable intervals.

189. Brachypternus Stricklandi, Layard.

I procured a solitary specimen of this new Woodpecker at Gillymalle; it proved a female; but Mr. Thwaites having forwarded a large number of both sexes from Kandy, I am enabled now to describe it fully. Length about 11 in., of closed wing $5\frac{1}{4}$ in.; tail $4\frac{1}{4}$ in.; bill $1\frac{3}{4}$ in.; tarsi 1 in.

General colour of back scarlet-maroon, each feather being maroon edged with scarlet; the filamentous feathers on the lower portion of the back near the tail-coverts (which with the tail are brown) are brilliant scarlet. Wing primaries of a lighter brown than the tail-feathers, the outer webs margined maroon, changing into scarlet. Inner webs of the secondaries marked with four large circular white spots; the interior primaries have but three spots, the middle two spots, the outside of all but one. The feathers of the breast and neck chiefly buff with an albescent centre and dark brown edge, giving these portions a scaly appearance, which is lost on the sides and belly, where it merely assumes a mottled irregular form. Chin white, with five distinct very dark brown lines down it. Head of female brown, with numerous good-sized white ocelli (in the male this portion is brilliant scarlet), the feathers over the nostrils light brown; a streak of the same colour forms an eyebrow. Bill light corneous; legs bluish. Irides red-brown.

In habits this species resembles *B. Ceylonus* and *aurantius*. The natives discriminate between it and the former, and tell me that it keeps more to jungle than palm trees.

I dedicate it to the memory of the esteemed naturalist, whose early loss after my acquaintance with him I have never ceased to deplore.

Dr. Kelaart includes *B. rubescens*, Vieill., in his list, on the authority of Mr. Blyth, but in his catalogue of the A. S. Museum Mr. Blyth doubtfully gives it as a synonym of *B. Ceylonus*. Can this be my *B. Stricklandi*?

190. MICROPTERNUS PHAIOCEPS, Blyth.

Decidedly a rare species in the island and almost confined to the south; in fact I have found but one specimen elsewhere, which was in the jungle near Ratnapoora. It is generally seen in pairs.

Of this species Mr. Blyth writes *in epistolâ*, "Your Woodpecker might make a fourth race of *Micropternus*, on the principle that *M. gularis* is separable from *M. phaioceps*." It is singular that out of our small number of *Picidæ*, nearly all should be peculiar or nearly so to the island, and that even in this instance of one of the coast species a difference should occur.

191. CENTROPUS PHILIPPENSIS, Cuvier. *Atti-Cuccula*, Cing. *Chempagam*, Mal.

The common "jungle crow" of European residents is universally distributed. It feeds upon grasshoppers, locusts, leaf-insects, caterpillars, spiders, &c. On the ground it marches about with a pompous air and outspread tail, scanning every blade of grass and making short but rapid darts upon the various insects which fly up at its approach. When of its own free will it resorts to a tree, it flies slowly, sailing along on its rounded wings, frequently progressing sideways; on reaching its destination it jerks up its tail, uttering its monotonous cry of "*whoot, whoot, whoot*," and climbs about the branches, beating the bark for *Phasmiæ* and other insects, which trust in their resemblance to the vegetable world for escape from the bills of their numerous enemies.

On being alarmed it scrambles rapidly to the summit of the tree in perfect silence, and glides away in a contrary direction to that whence the cause of its terror sprung.

I procured a singular albino bird of this species at Pt. Pedro. It was generally smaller, the black and purple portions were changed to a dirty creamy white, the dark red portions to a light brown. The specimen is now in the British Museum.

192. CENTROPUS CHLORORHYNCHOS, Blyth, J. A. S. No. xviii.

This species I discovered in the year 1848, between Colombo and Kandy, on the Avishavelly road. I forwarded the only specimen procured to Mr. Blyth, who described it, *loc. cit.*, and saw no other till the spring of last year, when on my intended trip to Adam's Peak I shot another in some native gardens at Hangwelly, not far from Colombo, intermediate in fact between it and Avishavelly, and three more in the dense jungle near Pallabaddoola, at the foot of the Peak. These are the only specimens hitherto procured of this bird. Dr. Kelaart does not appear to have seen it, and none have been received among Mr. Thwaites's collections. It is then doubtless confined to the particular locality where I obtained it, and is there anything but common. It has the same habits as *C. Philippensis,* and the same call and catlike mewing note. Irides red, as in the former.

193. Oxylophus melanoleucos, Gmel.

Abundant in open plains dotted with low bushes from Hambantotte to Jaffna. It sits upon the tops of the Euphorbia trees and utters a chattering cry.

Shooting one morning in the vicinity of Pt. Pedro, I observed a pair of Mud birds (*Malacocercus Bengalensis*), which hovered about an isolated bush with all the solicitude of parent birds attending upon a nest of young ones; when I drew near they flew before me, feigning lameness, and endeavoured to draw off my attention from some object in the bush; this I soon found was a young *Oxylophus,* which I captured, the Mud birds meanwhile flying about my head, uttering the most unmistakeable cries of distress. I found no other young bird or nest in the bush, which was a small one, and am convinced that these were foster parents to the young cuckoo.

194. Oxylophus Coromandus, Linn.

One of our rarest species, only a few specimens falling under my notice during my residence in the island. One I killed in Jaffna, another near Colombo, and the last near Ratnapoora.

195. Eudynamys orientalis, Linn. *Coosil* and *Coël,* Mal. *Coha* and *Cowde-coha,* Cing.

Wherever crows are found there the "Coël" is found also, depositing a single egg in the unguarded nest of either *Corvus splendens* or *C. culminatus,* indiscriminately.

The egg thus surreptitiously fathered upon the unsuspicious foster parents is of a palish neutral green colour, mottled very thickly with dark blotches. Axis 1 in. 3 lines; diam. 1 inch. It is laid in the month of February and hatched about March. When the young are hatched, they appear (according to native testimony) to eject the young crows in a manner similar to that by which the European cuckoo gets rid of its hapless brethren. Crows seem to have a great antipathy to these birds, and pursue them relentlessly whenever they appear, while the Coël, like a thief taken in the act, seeks safety in ignominious flight.

The natives so much admire the note of this bird, that their poets compare thereto the voices of their mistresses. If we are to believe that a soft voice is a beautiful thing in a woman, we cannot coincide in opinion with them, for the Coël's loud call may be heard a mile away.

196. Cuculus micropterus, Gould.

Dr. Kelaart includes this species among the Ceylon birds, and states that it is a mountain species and found but rarely at Dimboola. I have not met with the species, but perhaps the following young bird, which I cannot identify with anything in the British Muséum, may be the young of this species. I name it provisionally

197. Cuculus Bartlettii, Layard.

Young. Length $10\frac{3}{4}$ in.; of closed wing 6 in.; tail 6 in.; bill 11 lines; tarsi 8 lines.

General colour of back bluish gray with a rufous tinge, which prevails most on the head and on the extreme edge of the outside webs of the tail-feathers; a double row of alternating whitish triangular spots runs down the quills of the last feathers. Wing-feathers banded with white; throat and breast rufous brown barred with white; belly and vent white barred with brown; under tail-coverts barred sparingly in the same manner; over the eye there is a row of white dots commencing at the base of the bill which has a dark brown upper mandible, the lower being yellow with a brown tip; feet yellow. Irides dark brown.

I have obtained many examples of this bird in this state, both at Pt. Pedro and Colombo. It frequents native gardens, delighting in the shade and uttering a piping note.

198. Cuculus canorus, Linn.

A single specimen of this bird, procured in the old Botanical Gardens at Kew, near Colombo, has fallen under my notice. It was shot on an American cork-wood tree (*Bignonia*), the same on which I killed *Motacilla boarula* before mentioned, and three specimens of

199. Cuculus varius, Vahl,

being the only examples I have seen of these birds.

200. Cuculus Sonneratii, Lath.

Dr. Kelaart has procured several specimens of this, one of our rarest birds; he showed me a recent individual the day before my embarkation for England, at the end of March 1853; it was shot in the neighbourhood of Galle, along the course of the Gindurah river, a little inland.

201. Cuculus tenuirostris, Gray.

Very abundant throughout the island; it is migratory, appearing about Jaffna in the month of February. The rufous-bellied variety is never seen with us.

202. Cuculus dicruoides, Hodgs.

The principal habitat of this species seems to be the neighbourhood of Kandy, whence Mr. Thwaites has sent numerous specimens. Dr. Kelaart does not appear to have met with it at Nuwera Elia, as it is not included in his list. I procured it about Cotta, in the low country.

203. Zanclostomus viridirostris, Jerdon. *Mal-coha*, Cing.; lit. Flower Coha. *Handi-koota*, Cing., apud Daniell. *Coosil*, Mal.

Very common in most parts of Ceylon, but abounding in the northern province; it is usually seen in pairs, flitting from tree to tree. It is wary and difficult to shoot, as it creeps through the thickest bushes and trees, and invariably flies out on the contrary side to that on which the shooter stands. It feeds in common with *Eudynamys orientalis*, on the fruit of the banian tree.

My most searching and continuous inquiries into the habits of this and of

204. Phœnicophaus pyrrhocephalus, Forst. *Mal-Kandatta*, Cing.,—

failed in eliciting from the natives any information respecting their nidification.

P. pyrrhocephalus inhabits the densest jungles, never descending to the ground, but living amid the highest branches. It is unknown in the northern districts; in fact, its range seems limited to the mountain zone, and even there it is very local.

Both these latter species are eaten by the natives, who consider them great delicacies; they sell from threepence to sixpence each. Irides white. In life the feathers round the eye resemble the finest crimson velvet.

[To be continued.]

XLII.—*Description of a new* Helix *from Montpellier, and a new* Hydrobia *from Nice, with Observations on some varieties of the Extra-marine Shells of those districts.* By JOHN PAGET, Esq.

Helix micropleuros.

Animal breve, supra nigrescens, subtus albescens, semipellucidum; tentaculis superioribus griseo-nigrescentibus, crassiusculis et obtusis, inferioribus brevioribus et pallidis.

Testa minutissima, subdepressa, supra planiuscula, subtus convexa, costata, aperte umbilicata; apertura rotundato-lunata; peristomate recto, simplice, acuto; anfractibus 3–3½, convexiusculis, paulatim accrescentibus et sutura sat perspicua separatis, ultimo majore. Fusca, sericina.

Diam. 1½–2, long. 1 mill.

Hab. prope Montpellier.

This beautiful little *Helix* is nearly allied both to the *H. rupestris* and *H. pygmæa*. From the *H. rupestris* it is distinguished by its fewer convolutions, flatter shape, thinner shell and smaller size; from the *H. pygmæa* by its less convex whorls and shallower suture, by its last whorl sensibly larger than the rest, its larger mouth and somewhat larger size, and from both more especially by its epidermic ribs, which, although closer, are no less evident than those of the *H. costata* (Müller).

I found this *Helix* after heavy rain on the dead holly leaves on some waste ground, called the Bois de la Moures, about a quarter of a mile south of the high-road between Montpellier and Mauguio, in the south of France.

Hydrobia varica.

Animal elongatulum, fuscum, rostro proboscidiforme, tentaculis elongatulis griseo-cœrulescentibus et pellucentibus, disco obtuso, griseo-cœrulescente.

Testa minutissima, conoideo-ventricosa, vix perforata, tenuissime striata, in ultimo anfractu gibbosa; apertura ovato-pyriformi, obliqua, ad summum obtuse angulata, peristomate subreflexo et acuto; anfractibus 3–4, convexis, sutura sat profunda separatis, ultimo maximo, dimidium testæ efformante.

Tenuissima, corneo-albescens, limo inquinata.

Operculum subpellucidum, in apertura profunde situm, limo vel limi punctulis inquinatum.

Long. 1½–2, diam. 1¼ mill.

Hab. prope Nizza Maritimam.

This *Hydrobia* is nearly allied to the *Hydrobia gibba* (Drap.) which is found in such abundance at the source of the Lesz, near Montpellier, but it is distinguished from it by its less elongated form, by its smaller number of whorls which are less convex and divided by a much shallower suture, by its last whorl more ventricose and never detached, by its mouth less rounded, more oblique and more angular, and by the presence of only one swelling behind the mouth, whereas in the *H. gibba* there are generally several in adult specimens.

I have found this *Hydrobia* in the stream below the mill of Davigo, and in a ditch at the Grenouillères, both of which are supplied from the Var, near Nice. They are attached to the underside of aquatic plants or the underside of stones, and are very plentiful.

The observations I have made on some of the *Pupæ* of the south of France induce me to believe that too much importance has been given to the teeth as a specific character in this genus. The *Pupa cinerea*, which is described as possessing six teeth, viz. two parietal, two columellar, and two palatal, and is considered as presenting no variety except in size, I find on the contrary with five, six, seven, and eight teeth. In the first case, one of the columellar teeth are wanting, and in the two latter there are either one or two additional teeth on the palate. One of the additional teeth, and the one most commonly found, is placed in the columellar angle of the palate, the other near the external angle. This latter, when present, is commonly indicated by a white line externally. These variations in the number of teeth are found both in the small and large varieties of *Pupa cinerea*, and as I have collected at least a dozen of each in this neighbourhood (Nice), they cannot be considered very rare.

The variety of *Pupa quadridens*, in which only three teeth exist, has been formed into a species under various names, as *P. Niso* of Risso, *P. seductilis* of Ziegler, *P. lunatica* of Jan, and yet, in the neighbourhood of Montpellier, I have found every shade of variety, from the four teeth of the type, insensibly passing through the three teeth of this false species to a still more imperfect variety with only two teeth. In like manner the addition of one or two supplemental teeth in the *Pupa secale* has given rise to the *Pupa Boileausiana* of De Charpentier, although I have specimens from Montpellier in which every step of the transition may be found. The same observation may be extended to *Pupa variabilis*, *P. muscorum*, *P. umbilicata*, and probably to many other species, in which the number of the teeth is very uncertain, and in which, therefore, as a specific character, they can only be adopted with great caution.

Another variety of *Pupa cinerea* common here, which I have not seen noticed, is marked by a red band running parallel to the suture along the four last whorls. This band is in general very narrow; but in one specimen found by my son Oliver, in Vaucluse, the band is broad, and resembles that of the *Bulimus acutus*.

The large variety of the *Pupa cinerea* (length 15, diam. 5 mill.) is found here abundantly, and is distinguished not only by its size and form (it is more ventricose and fusiform than the smaller variety), but is also strongly and regularly striated. I have noticed some specimens of this *Pupa* truncated.

The large varieties of the *Pupa quadridens* (length 15, diam. 4 mill.) and *Pupa variabilis* (length 16, diam. 4 mill.) are common here, as in other parts of the Mediterranean coast.

I believe the presence of epidermic spines has not as yet been noticed in any *Pupæ*, yet they certainly do exist in the *Pupa doliolum* of Savoy, and probably of other countries. I found one adult and several young specimens behind the hotel called Grande Maison between Aiguebelle and St. Jean Maurienne. On the four or five upper whorls they are furnished with epidermic ribs terminating just above the suture, in short triangular spines (like those of *Helix ciliata*, though much shorter), forming a projection over the suture, and when fresh, especially if the dew is on them, very evident to the naked eye. I have not yet had an opportunity of comparing these specimens with others in a good condition, but Draparnaud speaks of "a torn appearance of the epidermis," and Rossmässler notices the epidermic ribs, so that I have little doubt the spines will be found too. My specimens are now six months old, but the spines are still very visible, although shrunk, as epidermic spines and ribs always will do on drying.

The *Planorbis cristatus* (Drap.), which is found in the ditches of the Grenouillères near Nice, abundantly, presents all the varieties which are described by authors under the names of *P. nautileus* and *P. imbricatus*. In some specimens the epidermic ribs are distant and well marked, and the spines in which they terminate on the keel very evident; in others the shell is more rounded, the ribs become more numerous, are little more than mere striæ, and the spines disappear altogether. These varieties pass into each other by every possible shade of transition. In adult specimens the peristome is continuous, and the mouth stands out quite separate from the penultimate whorl. In some cases the ribs and spines are not merely epidermic, but are marked on the substance of the shell itself.

All the species of *Planorbis*, and indeed most of the freshwater shells I have found in Nice, are much smaller than those of the South of France or Switzerland.

The *Cyclostoma elegans* of Nice often varies very considerably from that of France, although it is like that found about Genoa, and probably in other parts of Italy. In adult shells the peristome is slightly cup-shaped and thickened, while the mouth stands out quite free from the penultimate whorl, as in the *Cyclos. sulcatum*, which is common at Marseilles, but is not found here. The operculum, although like that of the *elegans*, is placed at some distance within the aperture, as in the *sulcatum*. Notwithstanding these differences, which in some specimens are so strongly marked, that if observed alone they might induce one to form a new species, the transitions are in other cases so insensible from this to the common form that it can only be considered as a variety.

The *Valvata piscinalis*, both here and in Montpellier, has the peristome only subcontinuous.

The *Helix apicina* (Lamk.), which is very common at Nice, has always when young, and frequently when old too, a covering of short, weak, and very deciduous hairs. It is extraordinary that the Abbé Dupuy, who must have had the opportunity of seeing this *Helix* living, should not have observed this character. Rossmässler, whom nothing escapes, had only dead shells to consult, but he *conjectures* the existence of hairs from the marks on the shell, though he does not dare to form a character from them in his description.

The *Helix strigella* (Draparn.) is in like manner commonly described as without hairs, and Rossmässler speaks of it as "*often* with weak hairs which are very short and deciduous." I have never found a single young shell of this species that was not covered with hairs—very short—nor an adult which did not either still retain some, especially on the lower side, or in which the marks where they had been were not quite evident.

Another hairy shell, commonly deprived of its honours because not studied in a perfectly fresh state, is the *Helix rufescens* (Flem.), *montana* (Stud.). I collected it in considerable numbers near the Lac de Joux and the source of the Orbe in Switzerland, where De Charpentier indicates it, and I can still see on many of my specimens very numerous short and often reflexed hairs. When fresh they were still more evident.

The *Helix aperta* (Born), *naticoides* (Drap.), which is exceedingly common in the neighbourhood of Nice, and much esteemed by gourmands as a Lent dish, has not unfrequently its uniform colour interrupted by bands of a lighter tint. I have specimens in which these bands occupy the positions of all the different bands commonly seen in banded shells.

I do not make any observations on the varieties of the *Helix variabilis* and *Helix cespitum* of this neighbourhood, for I confess they are so puzzling that I seek in vain for any character by which to distinguish or recognise them.

The *Helix splendida* of the South of France presents six pretty well-marked varieties. 1st. With broad black bands, called the variety of Provençe. 2nd. With five narrow bands, which is generally considered as the type. 3rd. With the two inferior (4th and 5th) bands only perfect. 4th. With the fourth band only. 5th. With one white band only,—that which usually accompanies the 4th dark band, which in this variety is corneous and translucid. 6th. Without bands, but slightly flammulated. The third of these I found near the Pont du Gard, but all the rest are common in the neighbourhood of Montpellier.

The *H. nemoralis* is no longer found living near Montpellier, nor within fifty miles, but I discovered a considerable number of them imbedded in the alluvium behind the fortress, which, from their perfect condition, had evidently inhabited that place at some former period.

Nice, April 18th, 1854.

XLIII.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq.

[Continued from p. 407.]

730. *Lycoperdon atropurpureum*, Vitt. Mon. p. 42. On exposed pastures. Leigh Down, near Bristol, C. E. Broome.

Peridium perfectly sessile or strongly stipitate, depressed or globose, greyish, when half-grown a little cracked in the centre into polygonal warts, the margin sprinkled with small stellate warts which give it a furfuraceous appearance; when mature dark brown with pale warts, opening irregularly; sometimes there are a few strong warts at the very base. Spores globose, ·00025–·0003 inch in diameter, strongly echinulate, capillitium purplish-brown, but sometimes the whole plant has a yellowish-olive tinge and the capillitium is similarly coloured.

In every stage of growth this is easily distinguished from the common puff-balls which it greatly resembles by its large echinulate spores.

731. *Badhamia nitens*, Berk. in Tr. Linn. Soc. xxi. p. 153. On decayed oak branches. Feb. 21, 1851, East Bergholt, Suffolk, Rev. Dr. Badham; Twycross, Rev. A. Bloxam.

732. *B. pallida*, Berk. *l. c.* On decayed oak branches. March 1, 1851, East Bergholt, Rev. Dr. Badham.

733. *B. fulvella*, Berk. *l. c.* p. 154. On dead wood. East Bergholt, Rev. Dr. Badham.

These three curious species, together with *Physarum hyalinum*, *P. utriculare*, and *Sphærocarpus capsulifer*, constitute a distinct genus characterized by the clustered spores, which are at first enclosed in a common sac. For further particulars we must refer to the volume of the Linnæan Transactions quoted above.

734. *Didymium furfuraceum*, (Schum.) Sœll. ii. p. 204. On oak branches. Wothorpe, Aug. 23, 1853.

735. *Phoma inophila*, Berk. in Hook. Journ. 1853, p. 40. On planks of maple. King's Cliffe, Nov. 1851.

736. *P. mucifera*, Berk. *l. c.* On elm planks. King's Cliffe, Nov. 1851.

737. *P. ulmicola*, Berk. *l. c.* On elm planks exposed to the weather. King's Cliffe, Nov. 1851.

738. *P. epileuca*, Berk. *l. c.* p. 41. On bleached pine planks. Wood Newton, Dec. 1851.

739. *P. fibricola*, Berk. *l. c.* On ash, oak and elm. King's Cliffe, Nov. 1851.

740. *P. bicuspidata*, Berk. *l. c.* On pine wood. Wood Newton, Dec. 1851.

741. *Diplodia fibricola*, Berk. in Hook. Journ. 1853, p. 42. On Lombardy poplar, King's Cliffe, Nov. 1851.

This is the fungus which was found on the elm plank picked up by Capt. Penny, lat. 76° 2′ N., long. 96° W.

742. *D. oöspora*, Berk. *l. c.* On bleached willow. King's Cliffe, Nov. 1851.

743. *Hendersonia fibriseda*, Berk. *l. c.* p. 43. On birch planks. King's Cliffe, Dec. 1851.

744. *Septoria lituus*, n. s. Peritheciis subcutaneis depressis sporis filiformibus apice curvatis sporophoris paullo excedentibus. On smooth twigs. Penzance, J. Ralfs, Esq.

Concealed by the cuticle which is raised into minute pustules; perithecia depressed. Spores filiform, curved at the apex, ·0015 inch long; sporophores filiform, rather shorter.

Plate XV. fig. 5. Spores on thin delicate sporophores which are attached to the walls of the perithecium.

745. *S. Ralfsii*. Subcutanea; epidermide supra perithecia elevata, centro pustularum albo; sporis rectis multinucleatis. On decayed apples, Penzance.

Forming black irregular patches, dotted with minute pustules, the centre of which is white. Spores straight, oblong ·00133 inch long, with about six nuclei.

Plate XV. fig. 6. Spores highly magnified.

746. *S. salicella*, n. s. Subcutanea; epidermide supra peri-

thecia subglobosa elevata; sporis fusiformibus triseptatis cirrhos rubellos efformantibus.

On branches of willows. Penzance, J. Ralfs, Esq.

Concealed by the cuticle which is obscurely pustulate in consequence of the presence of the subglobose perithecia. Spores ejected in the form of pale pink tendrils, fusiform, ·00133 inch long, triseptate.

Plate XV. fig. 7. Spores highly magnified.

747. *S. insularis*, n. s. Maculis brunneis distinctis, epidermide supra perithecia elevata, centro pustularum albo; sporis filiformibus curvulis.

On half-dead ivy leaves. Penzance.

Forming large definite umber-brown spots which are rough from the presence of the concealed perithecia, with a white spot in the centre of each pustule; spores filiform, slightly curved, ·0015 of an inch long.

Plate XV. fig. 8. Spores highly magnified.

748. *S. Badhami*, n. s. Peritheciis subcongregatis fuscis; sporis clavatis elongatis crassiusculis.

On vine leaves, East Bergholt, Oct. 1853.

Forming little brownish specks on either side of the leaf, consisting of a few subconglomerate perithecia. Spores oblong, clavate, ·002 inch long, endochrome sometimes retracted to one end containing a few minute granules: very rarely there are one or two septa.

Septoria Vitis, Lév. is at once known by its dark brown dense patches of perithecia: another species occurs on vine leaves, *S. ampelina*, B. & C., which has filiform curved spores.

Plate XV. fig. 9. *a*. Sporophores and portion of perithecium; *b*. spores. Both highly magnified.

749. *S. Polygonorum*, Desm. no. 1171. Twycross, Rev. A. Bloxam.

750. *Sporidesmium Lepraria*, Berk. in Hook. Journ. 1853, p. 43; *Lepraria nigra*, Eng. Bot.! t. 2409. Abundant everywhere on exposed planks.

751. *Torula Hysterioides*, Corda, Fasc. 1. fig. 139. On poles, Bathampton and Batheaston, C. E. Broome.

Our species is in every respect the plant of Corda, except that he calls the threads "luteoli." In our specimens they have rather a green tinge, though the mass as a whole is black.

752. *Coniothyrium glomeratum*, Corda. In the cracks of elm planks, especially on the medullary rays, King's Cliffe, Nov. 1851.

753. *Phlyctæna vagabunda*, Desm. no. 1624. On dead stems of *Dipsacus sylvestris*, Twycross, Rev. A. Bloxam.

754. *Puccinia truncata*, n. s. Maculis obsoletis; soris oblongis epidermide scariosa cinctis; sporis obovato-oblongis apice truncatis. On leaves of *Iris fœtidissima*, Isle of Wight, Rev. A. Bloxam.

Sori oblong, 1 line or more long, brown, surrounded by the scarious epidermis; spores obovate-oblong, even, attenuated below, upper cell abruptly truncate.

755. *Epitea Baryi*, n. s.; *Epitea*, Bary, Brandpilz, tab. 4. fig. 4. On leaves of *Brachypodium pennatum*, Rev. A. Bloxam, Gopsal.

Dr. De Bary's plant is on the leaves of *Lolium perenne*; the cystidia have in general an abrupt globose head, which seems characteristic of the species, which has not been observed previously in Great Britain.

756. *Institale effusa*, Fr. Summ. p. 447; *Ptychogaster albus*, Corda, Fasc. 2. p. 23. tab. 12. fig. 90. About the roots of Scotch fir, Apethorpe, Norths., autumn.

Excellently figured by Corda, whose plant is exactly ours, and which Fries states to be his *Institale effusa*, a species of which the name only has at present been published. It approaches also very closely to *Institale maxima*, Schwein, which differs only in its redder spores, which are however of the same size and form.

757. *Atractium flammeum*, Berk. and Rav. Breve subcylindricum cinnabarinum deorsum album pruinosum; sporis longis fusiformibus.

On the bark of living willows, Penzance, J. Ralfs, Esq. It has been found in similar situations peeping up from beneath lichens, by H. W. Ravenel, Esq., in South Carolina.

Scarcely ½ a line high, cylindrical, flame-red, pruinose below; head convex. Spores ·003 inch long, curved, fusiform, hyaline, with six or more septa seated on long sporophores.

This has just the habit of *Stilbum aurantiacum*, but is at once distinguished by its peculiar spores. Mr. Ravenel in a late communication suspects it to be a state of some *Nectria*.

758. *Helminthosporium sticticum*, n. s. Maculis gregariis punctiformibus nigris; sporis oblongo-clavatis uniseptatis. On decaying leaves of grasses, Batheaston.

Disposed in minute specks, jet-black, threads fasciculate, nodose or irregular; spores ·0016 of an inch long, oblong, swollen above, uniseptate.

The punctiform spots, black, not olivaceous hue, and uniseptate spores are the characteristics of this species, which is nearly allied to *H. arundinaceum*. The threads of the latter are coarser, and the habit diffuse.

Plate XV. fig. 10. *a*. Threads and spore magnified; *b*. spores more highly magnified.

759. *Monotospora megalospora*, n. s. Floccis rectis simplicibus, sporis obovatis magnis lævibus. On the dead bark of a yew-tree, King's Cliffe.

Jet-black. Flocci erect, straight, nearly equal, simple, articulated. Spores terminal, obovate, even, ·0014–·00133 inch long.

PLATE XV. fig. 11. *a*. A group of threads with their spores; *b*. spores: both magnified.

760. *Botrytis Jonesii*, n. s. Floccis erectis sursum ramosis; ramis ramulisque divergentibus sæpissime oppositis; ultimis fasciculatis, centrali semper sterili acutissimo; sporis subglobosis echinulatis.

Accompanying *Mucor Caninus* and other moulds on the dung of animals, as on that of dogs and rabbits. Near Woolwich, Mrs. Col. Jones. Wothorpe, Norths.

Flocci erect, tinged with fawn colour, simple below, with a few straight main branches above, mostly at right angles and often opposite. These are again divided once or twice in the same way, the central one being always barren, the others bearing about the middle fascicles of fertile branchlets, each tipped with a subglobose echinulate spore, ·0003 inch long.

Drawiugs of this with several other interesting species were communicated by Mrs. Col. Jones. Original specimens accord precisely with our own. The species is one of the most beautiful and interesting of a very handsome group.

PLATE XV. fig. 12. *a*. Fertile thread; *b*. spores: both magnified.

761. *Rhinotrichum Opuntia*, n. s. Floccis furcatis hic illic turgidis; sporis in ramulis ultimis clavatis transversim seriatis. Near Woolwich, Mrs. Col. Jones.

White. Flocci rather thick, simple below, two or three times forked, slight, swollen here and there; ultimate divisions clavate, beset with transverse rows of globose spores.

The characters of this species are so curious, that we are unwilling to omit it, though we have neither specimen nor description. Mrs. Jones's figures however of those species of which we have specimens are so correct, that we have no hesitation in giving it implicit credence.

PLATE XVI. fig. 13. Portion of plant magnified.

761*. *Papulaspora sepedonioides*, Preuss in Sturm's Deutsch. Fl. heft 30. t. 9. On rice paste on which blood-rain had been propagated, King's Cliffe, Aug. 1853.

This very beautiful mould consists of decumbent, articulate, colourless threads, which produce short, erect branches, each surmounted by a large red cellular body about ·0018 inch in diameter. This is all that is figured by Preuss as quoted above, but we have seen the heads studded with oblong erect spores ·0004–·0006 inch long, with their endochrome bipartite or very rarely quadripartite; and if these are truly spores, each individual head presents nearly the structure of an *Epicoccum*. In one instance a spore was observed germinating from the apex.

762. *Oidium Favorum*, n. s. Floccis erectis septatis, sporis flavis brevibus subcylindricis. On honey-comb, near Woolwich, Mrs. Col. Jones.

Flocci erect, white, septate and slightly torulose below, above bearing a few short cylindrical yellow spores. These spores when fallen seem to acquire a septum and then to be gradually attenuated at either end. A new septum is then formed in either division, the whole constituting an irregularly fusiform body.

PLATE XVI. fig. 14. Threads and spores magnified.

763. *O. Balsamii*, Mont. MSS. Candida, articulis doliiformibus utrinque angustatis. On the leaves of *Verbascum nigrum*, Wothorpe, Aug. 23, 1853.

This species was sent from Milan by Balsamo to Dr. Montagne, under the name of *Oidium Tuckeri*, but it is a very different species, distinguished by the very peculiar shape of its spores. Their length is about ·0015. Balsamo's plant grew on *Verbascum montanum*. No *Erysiphe* has at present been observed in connection with this species. The same species occurs on strawberries, to which it is very destructive. See Gard. Chron. April 15, 1854.

764. *Helvella sulcata*, Afz. On the ground in woods, sent from Andover, 1853.

We have seen a single specimen only of this plant, which seems to be certainly the species of Afzelius, and is remarkable for the regular ribs of the stem and the campanulate pileus.

765. *Geoglossum olivaceum*, P. Leigh Down, Bathford Down and other places near Bath, C. E. Broome, Oct. 1853.

This very rare species seems to be undoubtedly distinct from *G. viride*. Sporidia ·0006 inch long.

766. *Peziza sepulta*, Fr. MSS. On the ground, East Bergholt, Nov. 4, 1851.

One to two inches across, globose, clothed with dense woolly fibres, the upper portion often breaking off irregularly and so exposing the disc. Asci cylindrical; sporidia elliptic, with one, two or sometimes several nuclei ·0009 by ·0004 inch long.

This is very closely allied to *Pez. arenaria*, Osbeck, and *P. arenicola*, Lév. It bears also a close resemblance to the genus *Hydrocystis*, Tul.

767. *Peziza* (Geopyxis) *Cornubiensis*, n. s. Media sessilis

villo affixa margine tantum libero subapplanata extus subtiliter villosa; hymenio aurantio; sporidiis oblongis asperulis.

On manured ground, Penzance, Mr. Tracey Millett.

Sessile, $\frac{3}{4}$ of an inch broad, depressed, attached to the soil by villous down; margin free, clothed with delicate obtuse articulate hairs; hymenium orange. Asci subcylindrical; sporidia oblong, ·0009–·0007 inch long.

A very fine species.

768. *P. glumarum*, Desm. no. 1054. On chaff in a farm-yard, Batheaston, Dec. 1852.

The following measurements of the sporidia of *Pezizæ* may be useful:—

P. humosa, ·0009–·001 inch long by ·0004–·0005; the Blackheath plant mentioned in the 'English Flora.'

P. Polytrichi, ·0007–·0008 inch long by ·0007 wide. An analysis of this species is given in Pl. XVI. fig. 14*, in consequence of the highly developed paraphyses and the curious processes which they often bear at their side.

P. scutellata, ·0008 inch long by ·0005 wide.

P. hirta, ·0009 inch long by ·0005 wide, from Wareham; ·0006 inch long by ·0003 wide, from Bowood.

P. leucoloma, ·0008 inch long by ·0004 wide, in the plant so named in 'English Flora.'

P. trechispora, ·0008 inch in diameter.

769. *P.* (Tapezia) *Piggotii*, n. s. Media mycelio lanoso candido, cupulis subhemisphæricis vel cyathiformibus leviter concavis, hymenio pallide lateritio.

On the plaster ceiling of a cottage, Chelmsford, H. Piggot, Esq.

Mycelium white, downy, but not spreading very widely, running up the base of the hemispherical or cyathiform cups which are about 2 lines broad; hymenium pale brick-red; margin generally acute. Asci cylindrical, paraphyses linear; spores elliptic, with a single, very distinct nucleus, in the centre of which is a bright point, ·0005 inch long by ·0003 wide.

Allied to *P. argillacea*, Sow. *P. domestica* is a far smaller species, with spores ·0006 by ·0004 inch.

770. *P.* (Dasyscyphæ) *Berkeleii*, Blox. MSS. Gregaria sessilis, cupulis hemisphæricis furfuraceo-floccosis quandoque pruinosis, hymenio concavo fulvo.

On dead stems of *Umbelliferæ*, Twycross, Rev. A. Bloxam.

Very minute, gregarious, often crowded, hemispherical, with the margin at first strongly inflected, clothed with furfuraceous yellowish flocci. In the younger specimens the orifice is distinctly marked with radiating lines. Hymenium concave, tawny. Asci clavate; sporidia ·0003 to ·0004 inch long, oblong, subfusiform or cymbiform.

Under the lens the coat consists of very short flocci, intermixed with minute hyaline amorphous scales. We cannot point out any very near ally, except possibly *P. humilis*, Desm. It resembles *P. apala* more closely than any other species with which we are acquainted.

771. *P.* (Dasyscyphæ) *aspidiicola*, n. s. Nivea, sicca subalutacea, stipite brevissimo; cupula concava subhemisphærica extus furfuraceo-floccosa. On dead stems of *Aspidium filix mas*. Orton, Leic., Nov. 1851, Rev. A. Bloxam.

Very minute, gregarious, white, rather buff when dry. Stem extremely short, gradually passing into the subhemispherical cup, which is clothed externally with minute pellucid scales, mixed with a few obscure hyaline flocci. Asci very short and slender. Sporidia ·0002 inch long, oblong, subclavate.

Resembling in its investing coat *P. Berkeleii*, but differing in colour, in the distinct stem, more open disc, and in the more minute sporidia. *P. Aspidii*, Libert, is a more minute species, of a purer more persistent white, and with a more tomentose coat.

772. *P.* (Fibrina) *siparia*, n. s. Cupulis subsessilibus extus furfuraceis ochraceis, hymenio fuscescente; sporidiis lineari-oblongis curvis.

On decorticated elm branches, Elmhurst, Oct. 1, 1853.

Accompanied by a floccose stratum, which is however possibly not constant. Cup at first subglobose, then cyathiform, scarcely stipitate, but fixed by a broad base with the margin free, externally ochraceous, furfuraceous; hymenium ochraceous, at length brownish; sporidia linear-oblong, ·00045 inch long, curved, often with a nucleus at either extremity.

This has at first some resemblance to *P. firma*, but the sporidia of that species are subelliptic, pointed at either end, and ·0007 inch long, not to mention other distinctive characters.

773. *P.* (Mollisia) *micrometra*, n. s. Minutissima sessilis subturbinata villo albo affixa brunneola, ore subcontracto subtiliter striato.

On dead stems of *Juncus*, Twycross, Rev. A. Bloxam.

Extremely minute, punctiform, subturbinate, attached by strong villous hairs, smooth above; orifice somewhat contracted, marked with close parallel lines, horn-brown; hymenium plane. Asci clavate; sporidia filiform. A very singular though extremely minute species, to which we can point out no close ally.

774. *Patellaria clavispora*, n. s. Mollis, junior sparsa subglobosa, senior expansa subirregularis picea; sporidiis clavæformibus 4–6-septatis. On twigs of privet, Luckram, Wilts., Nov. 4, 1852.

When young nearly globose, in age expanding, pitch-brown, somewhat irregular, soft; substance beneath the hymenium paler. Asci cylindric; sporidia elongated, clavate, ·001 inch long, 4–6-septate; paraphyses branched, bearing at their tips one or more dark bodies, sometimes arranged like the joints of a necklace.

The fructification of this species is so remarkable that there can be no difficulty in recognizing it, though its external appearance does not differ greatly from that of some other species. In an unpublished species, *T. Ravenelii*, B., there is a similar development of the tips of the paraphyses.

775. *P. livida*, n. s. Gregaria sæpe congesta subhemisphærica sessilis olivaceo-lutea margine albido, extus subtiliter sericea.

Abundant on fallen firs, Gopsal Park, Leicestershire, Dec. 1851.

Minute, gregarious, often crowded, olivaceous yellow, greyish when dry, sessile, hemispherical, fixed by a small point, minutely silky externally, margin dirty white. Hymenium plane. Asci subfusiform, bulging in the centre, often geniculate; sporidia oblong or elliptic, perhaps immature.

This species has a Lichenoid aspect, but has no crust whatever and is certainly undescribed. It resembles in general appearance *Patellaria carpinea*, with which it agrees closely in fruit. *P. rhabarbarina* also is closely allied.

**Triblidium caliciiforme*, Fr. Summa, p. 369; *Cenangium caliciiforme*, Syst. Myc. On oak bark, Shrewsbury, Rev. W. A. Leighton; Essex, H. Piggot, Esq.

Asci containing four sporidia, varying greatly in length, but sometimes as much as ·002 inch.

776. *Abrothallus Welwitschii*, Mont. Ann. d. Sc. Nat. Ser. 3. vol. xvi. p. 79. On *Sticta fuliginosa*, Essex, H. Piggot, Esq.

This curious production is considered by Montagne a Discomycete near *Agyrium*, and by Tulasne a Lichen. We are not in a position to decide so knotty a point, but we have great pleasure in recording the discovery of so curious an object by Mr. Piggot.

777. *Sphæria* (Platystomæ) *fibritecta*, Berk. in Hook. Journ. 1853, p. 43. On bleached larch planks, King's Cliffe, Dec. 1851.

778. *S.* (Caulicolæ) *tritorulosa*, n. s. Subcuticularis semiimmersa subglobosa ostiolo papillæformi ascis elongatis, sporidiis tritorulosis.

On dead stems of *Epilobium hirsutum*, Twycross, Rev. A. Bloxam.

At first covered by the cuticle, then exposed, half immersed; perithecia subglobose with a papillæform ostiolum; asci cylindrical; sporidia oblong, ·0006–·0007 inch long, containing three nuclei, and with two constrictions.

Plate XVI. fig. 15. Asci and sporidia magnified.

779. *S.* (Caulicolæ) *Vectis*, n. s. Subcuticularis ostiolo demum nudo; ascis brevibus cylindricis sporidiis oblongis 5-septatis, articulo quarto tumido.

On dead leaves of *Iris fœtidissima*, Isle of Wight, Rev. A. Bloxam.

Covered by the cuticle, which is at length pierced by the black ostiolum, sometimes regularly diffused, sometimes forming little pale patches; asci short, curved, cylindrical; sporidia oblong, ·0001 inch in length, 5-septate, the fourth joint being much swollen.

PLATE XVI. fig. 16. Asci and sporidia magnified.

**Nectria ochraceo-pallida*, (B. and B.), var. *corallina*. On elder, Gopsal, Rev. A. Bloxam. On elm, King's Cliffe.

Rather smaller than the paler plant and less depressed, but there is so little difference in the fruit that we think it better not to distinguish them.

780. *Nectria Ralfsii*, n. s. Cæspitosa; peritheciis crassis aurantiacis furfure albido dense inspersis, siccis fortiter collapsis; ore obscuro papillæformi; sporidiis elongatis uniseptatis.

On dead branches, apparently of beech. Penzance. Also on furze, of a delicate salmon colour.

Cæspitose. Perithecia orange, globose, but strongly collapsed, when dry covered with whitish furfuraceous scales; mouth generally obscure, sometimes minutely papillæform. Asci clavate, sporidia oblong, elongated, uniseptate, with one or two nuclei in each division, varying greatly in size from ·0006 to ·001 inch in length. The hymenium is sometimes exposed, apparently from the circumcision of the upper portion of the perithecium.

Allied to *N. cinnabarina*, but presenting many points of distinction, especially in its generally elongated sporidia.

781. *N. Bloxami*, B. and B. Sparsa cinnabarina peritheciis fortiter collapsis subglabris, sporidiis elongatis subfusiformibus quadrinucleatis.

On dead stems of herbaceous plants, Twycross, Rev. A. Bloxam.

Scattered, dark cinnabar red. Perithecia nearly smooth, strongly collapsed. Sporidia elongated, subfusiform, quadrinucleate, ·00065 inch long.

This species differs from *N. ochraceo-pallida* and its coralline variety, not only in its dark cinnabar hue and collapsed perithecia, but in the far more delicate and shorter sporidia. There is sometimes a single very obscure septum.

781*. *N. inaurata*, n. s. Cæspitosa, peritheciis globoso-depressis quandoque rubro-tinctis fuscis, flavo-pruinosis, ostiolo papillæformi demum impresso nudo atro-fusco; ascis sporidiisque biformibus, aliis clavatis sporidiis minimis innumeris curvulis, aliis cylindricis sporidiis octonis ellipticis utrinque appendiculatis.

On dead twigs of holly. Shooter's Hill, F. Currie, Esq. Near Bath.

A figure of the asci and sporidia of this curious species will be shortly given in the 'Gardeners' Chronicle.' Similar fruit occurs in *Nectria Cucurbitula.*

782. *Aylographum amplum*, n. s. Peritheciis congregatis congestisve subdepressis furcatis ramosisque. On decaying stems of *Rubi*, Twycross, Rev. A. Bloxam.

Distinguished by the perithecia being crowded together in the most perfect specimens and by their comparatively large size. Those before us are not so perfect as could be wished, but the species is unrecorded, and the genus new to this country.

Bloxamia, n. g.

Peridium deorsum persistens, sursum delicatissimum hyalinum evanescens demum excipuliforme; sporidia quadrata tubulis arcte congestis enata. Genus curiosissimum anomalum, *Dichosporio* proximum, asci enim ni fallimur non typici, *Myxormiam* quodammodo in memoriam revocans.

783. *Bloxamia truncata*, n. s. On dead Wych elm, Batheaston, Feb. 1852.

Perithecia punctiform, often slightly elongated, depressed, with vertical sides, firmer below and persistent, extremely delicate, white and evanescent above. Hymenium consisting of closely packed tubes which produce a row of subquadrate spores, ·0001 wide, ·000125 long.

This very curious plant in many respects agrees with Nees von Esenbeck's *Dichosporium*, but Dittmar could not have overlooked the tubes in which the spores are generated. We do not regard these tubes as typical asci, but of the same nature as those in *Sporoschisma*, and, if so, it will on the one side be connected with *Conoplea* of Fries, and on the other with *Myrothecium* through *Myxormia*. The spores closely resemble those of *Scopinella barbata* when the light is indistinct, but under a very superior microscope no division is apparent.

Plate XVI. fig. 17. *a*. Plant, natural size; *b*. magnified; *c*. mass of tubes; *d*. two of the tubes separate; *e*. spores. All but the first more or less magnified.

784. *Antennaria semiovata*, n. s. Floccis fertilibus erectis brevibus ramosis; articulis torulosis lævibus; pycnidiis semiovatis; peritheciis curvis acuminatis. On the leaves of *Filix mas*, near Bath, Sept. 1853.

Clothing the leaves with dense matted felt. Barren threads creeping, often united into an irregular membrane; fertile erect, generally slightly branched, but sometimes subdichotomous; pycnidia semi-ovate; perithecia curved, acuminate.

It is difficult to say what is a species in this genus, which will ultimately coalesce with *Capnodium*, of which it appears to present one form of fruit. A few curved acuminate perithecia without fruit were scattered amongst the threads.

Plate XVI. fig. 18. *a*. Threads in various states; *b*. pycnidia; *c*. perithecia. All magnified.

XLIV.—*A Reply to* Prof. Sedgwick's *Article published in the Annals and Magazine of Natural History, 2nd Series, No.* 76, *April* 1854. By Prof. Milne-Edwards.

To the Editors of the Annals of Natural History.

Gentlemen,

Professor Sedgwick having inserted in the Number of your Journal that I have just received (April 1854), an extensive article on certain passages in the 'Monograph of the British Fossil Corals' published two years ago by M. J. Haime and myself, I hope you will allow me to lay my reply before your readers.

Two points are discussed in Prof. Sedgwick's article: the first is relative to the refusal of the loan of fossil corals belonging to the Cambridge Museum; the second to what we considered as being our scientific property, and had seen presented to the public in Prof. M'Coy's last work, without any reference to its origin.

§ 1. When some of the Members of the Council of the Palæontographical Society proposed to me the laborious task of describing the Fossil Corals of England, Mr. Bowerbank, Sir H. de la Beche, Mr. Davidson, and some more of my friends, kindly undertook to obtain for me the loan of the necessary specimens. The efforts of those gentlemen were so successful, that I soon received in Paris ample materials for most parts of the intended work: the Corals belonging to the Geological Society, the Museum of Bristol, the collections of Mr. Bowerbank, Mr. Stokes, Sir H. De la Beche, Mr. Searles Wood, Mr. Fred. Edwards, Mr. Wetherell, Mr. Pratt, Mr. D. Sharpe, Mr. Walton, Dr. Wright, Dr. Battersby, Mr. Pengelly, Mr. Fletcher, Mr. J. Gray, Prof. Phillips, and several other geologists, were in the most liberal manner placed at my disposal for publication, and I eagerly seize this opportunity to renew my thanks for the aid so afforded to my researches. In order to complete some parts of our Monograph, M. Haime and myself were desirous of obtaining a similar favour from the Cambridge Museum, and consequently an application for the loan of specimens was made, in the first instance by us to Prof. M'Coy, and subsequently to Prof. Sedgwick by the Honorary Secretary of the Palæontographical Society, my most esteemed friend Mr. Bowerbank. But I was informed that Prof. Sedgwick considered the loan of such specimens not compatible with the regulations of the Cambridge Museum.

M. Haime and I were fully aware that we had no right to throw any censure on that decision; but as it occasioned some omissions in our Monograph, we deemed it necessary to state the circumstance that had rendered our work more incomplete than we had at first hoped it would have been; and consequently we did so in the part of our publication where those omissions began to have some importance.

This simple statement appears to have displeased Prof. Sedgwick, and in a letter addressed to me, on the 8th of December last, he denied the veracity of it; saying that no application for the loan of the Cambridge fossil corals had ever been made; that had such a request reached him, he would have laid it before the Trustees and Auditors of the Museum, and should probably have obtained their consent. I immediately answered Prof. Sedgwick, reminding him of the circumstances above alluded to, and adding, that if I had been misinformed, M. Haime and I would, with pleasure, rectify our statement in the next Fasciculus of our Monograph. But I heard nothing more on the subject, till I received from my bookseller the Number of your 'Annals' containing Prof. Sedgwick's article.

That article shows clearly, that when writing to me in December last, Prof. Sedgwick had forgotten the real state of the case; that an application for the loan of specimens *had been made* on my behalf by Mr. Bowerbank as well as by myself, and *had been rejected* by the justly celebrated geologist of Cambridge. Professor Sedgwick now supposes that the unfortunate negotiation was relative to certain Oolitic fossils only, and not to the Palæozoic corals as well as the former. This distinction is not, in our opinion, well founded, nor is it concordant with the recollections of Mr. Bowerbank, who had written to Cambridge on the subject; but even were it so, I should not consider it now as being of much importance, since the tenour of the article just published by Prof. Sedgwick clearly shows that at all events the result of the application would have been the same; that is to say, *negative*.

It is also necessary to remark here, that the corals, which we were most desirous to obtain, were those from the Oolite and

Mountain Limestone previously described by Prof. M'Coy in your 'Annals' (1848 and 1849). We wished to lay before the public, in our 'Monograph of the British Fossil Corals,' figures of those species executed under our direction, and showing the characters which we deemed necessary to point out. Through the kindness of Mr. Davidson and Mr. Walton, we were enabled to do so for the Oolitic corals, and, as stated in the passage criticised by Professor Sedgwick, the omissions occasioned by what we considered as a refusal of the loan of the Mountain Limestone specimens belonging to the Cambridge Museum, have turned out to be less prejudicial than we at first feared, in consequence of Prof. M'Coy having since then published good figures of them. We had no thought of blaming Prof. M'Coy for so doing, and, as we shall now proceed to show, that circumstance had nothing to do with what we complained of in our book.

I do not therefore see any reason to induce M. Haime and myself to modify the passage of our Monograph relative to the refusal of the loan of the Cambridge corals, or to apologise for it.

§ 2. Professor Sedgwick considers as being equally ill-founded, and also injurious to his friend Prof. M'Coy, an opinion expressed by M. Haime and myself in a note, page 151, of our Monograph. This is of more consequence than the discussion about the extent of the refusal above alluded to, and must therefore be seriously examined here.

In that note we said—"In the beginning of his book (page 17) Prof. M'Coy expresses his regret at not having been acquainted with the latter publication (viz. *the first Fasciculus of our Monograph of the British Fossil Corals*) early enough to be able to refer to it; and we feel much gratified in seeing that the results which Prof. M'Coy appears therefore to have obtained solely from his own observations, are often very similar to those published by ourselves a year before; even by a singular coincidence he often makes use of the same names for the divisions previously established in the first part of this Monograph."

The signification of these words must have been very clear to every one conversant with the contents of the two books alluded to; but in consequence of Prof. Sedgwick's article I deem it necessary to be more explicit.

Prof. M'Coy's work, the title of which is '*A detailed Systematic Description of the British Palæozoic Fossils*,' does not contain the description of one single new species of coral, nor does the author establish in it any new genera. It consists mostly in the reprint of the articles published some years before by Prof. M'Coy in the 'Annals,' and duly quoted by us in our 'Monograph of the British Fossil Corals.' What Prof. M'Coy added to this reprint in his *Systematic* work, consists essentially in the plates and in the general classification of the Palæozoic corals; the manner in which the previously established genera are united to form natural divisions of superior value; the characters assigned to these divisions and the names given to them; in short, the whole *systematic* arrangement.

The First Fasciculus of our 'Monograph of the British Fossil Corals' was principally devoted to the exposition of our general classification of the class of Corals, and did not contain the description of any Palæozoic fossils.

It is therefore evident that the above-quoted note, relative to the similarity of the results presented in both publications, could not be applicable to anything else than the systematic part of Prof. M'Coy's work, and what we added about the names given to his divisions is not susceptible of any other interpretation. Consequently we must examine whether the blame so implied in that note be founded or not.

Our classification was published in England in 1850*, and was known to Prof. M'Coy previously to the printing of most part of his work, since he mentioned the existence of it in the very beginning of his book (p. 17).

Now the classification presented by Prof. M'Coy bears the greatest resemblance to ours; some parts are new and belong to that palæontologist, but most of his divisions are exactly the same as ours, and even bear the same names.

Nowhere, however, does he intimate, even in the most distant way, that the classification thus developed in his book is essentially or in part ours. He intermingles the divisions founded on the results of his own observations with those previously established by us, and in examining his book, every unbiased reader would be led to suppose that the various families and subfamilies there described, and even the system of classification altogether, was the scientific property of the author. Prof. M'Coy even goes so far as to say that he has not profited materially by any new portion of our Monograph not previously published in the 'Comptes Rendus de l'Acad. des Sciences;' whereas there are some important parts of his classification that we claim, and that had never been mentioned in the 'Comptes Rendus.' The di-

* I do not clearly understand what Prof. M'Coy means, in his argumentation about the date of this work; and I must add, that what he says about the date of the publication of our French work (the Monographie des Polypiers Palæozoiques) is not only completely irrelevant to the point in discussion, but also erroneous. It was the First Fasciculus of that work which we mentioned in our note as having appeared previously to Prof. M'Coy's book, and the date assigned to it by that gentleman (the 26th of June 1851) is not that of its publication, but in reality that of the publication of the Third and last Fasciculus of the same book. This attempt to make our statement appear contrary to truth is therefore unsuccessful.

stinction here alluded to is however of no importance, for in no instance does Prof. M'Coy mention having borrowed either from our papers in the 'Comptes Rendus,' or in any other publication, what we claim as being our scientific property in his system of classification.

Prof. M'Coy does not attempt to refute our claims, but in order to account for not having informed his readers to whom the classification presented in his work essentially belongs, he now says that in his opinion there is no need for referring to the authors of zoological groups that are larger or less definite than the small divisions to which the name of a genus is now given. In a descriptive catalogue of species, that might be admitted; but in a work that professes to be a *systematic* arrangement, and that contains the characters as well as the designation of the various zoological divisions, I should think it incumbent on the author to mention the principal source from which he has derived the knowledge of those divisions.

The explanation given by Prof. M'Coy does not therefore change the opinion which I had formed on the subject now under discussion, and does not in the slightest degree invalidate the statement criticised by Prof. Sedgwick.

§ 3. In a letter from Prof. M'Coy, published by Prof. Sedgwick, the former gentleman says, "I may add that MM. Edwards and Haime have figured and described, as new, in their 'Monographie,' several corals previously published by myself in the 'Annals of Natural History,' and that the first idle time I have, I shall write a paper on this and other scientific unfairnesses in their works, with which at present we have nothing to do."

The first part of this paragraph is correct. When the descriptive part of the above work was printed*, we had not yet seen the Number of the 'Annals and Magazine' published in December 1850, and containing the description of some new Palæozoic fossils by Prof. M'Coy; but before receiving the above lines we had done him full justice in that respect, for in the Fifth Fasciculus of our work on British Fossil Corals, the manuscript of which is in the hands of the Palæontographical Society,

* Almost all the text of our 'Monographie des Polypiers Palæoz.' was printed in 1850, or in January 1851, previously to my departure for Italy, where, on account of the bad state of my health, I passed several months in the beginning of 1851 (April to July). Some copies for private distribution had even been given to a few friends; but in consequence of the circumstance here alluded to, and the time taken up by the preparation and printing of the tables during my absence, the last Fasciculus containing the description of the above-mentioned species did not appear till June following. This explains how it happened that Prof. M'Coy's paper, published in December 1850, was not known to us early enough to be quoted in that work.

we have dropped our names and adopted his. As to the *scientific unfairnesses* in our other works which Prof. M'Coy promises to point out, I should be very glad by his making known what he considers as *unfairnesses*; for if I have wronged either that author or any other, it must have been unconsciously, and I am always desirous of repairing the errors that I may have committed. I trust, however, that Prof. M'Coy's efforts in that direction will not prove more successful than the arguments by which he and Prof. Sedgwick have endeavoured to invalidate the statement made by M. Haime and myself in our work on the British Corals, and that I shall not be obliged to waste more time on the subject.

I have the honour to be, Gentlemen,
Your most obedient servant,
MILNE-EDWARDS.

Paris, April 28th, 1854.

XLV.—*A Synopsis of the Fissirostral family* Bucconidæ. By PHILIP LUTLEY SCLATER, M.A., F.Z.S.

[Concluded from p. 365.]

Genus II. MALACOPTILA.

A. *Malacoptila*, G. R. Gray.

1. MALACOPTILA FUSCA (Gm.).

White-breasted Barbet, Lath. Syn. ii. 505.
Bucco fuscus, Gm. S. N. i. p. 408; Lath. Ind. Orn. i. p. 206.
Lypornix torquata, juv., Wagl. S. A. sp. 4.
Monasa unitorques, Du Bus, Bull. Ac. Brux. xiv. pt. 2. p. 107; Rev. Zool. 1848, p. 249.
Monasa fusca, Strickl. Cont. to Orn. 1852, p. 43.
Le Tamatia brun, Le Vail. Ois. de Par. v. 2. pl. 43.
Bucco fuscus, Vieill. N. D. d'H. N. iii. 239; Vieill. Enc. Meth. 1419.
Tamatia fusca, Less. Tr. d'Orn. p. 168.
Monasa fusca, Gray's Gen. i. p. 74 (pars); Bp. Consp. Av. p. 147 (pars).
Malacoptila fusca, Gray, List of Gen. (1841) p. 13.

M. brunnea clare fulvo striata: macula utrinque frontali et magna triangulari superpectorali albis: ventre obscure fulvescente: pedibus albidis: rostro nigro basi aurantio.

Long. tota 6·5; alæ 3·6; caudæ 2·7.

Hab. in Cayenna (Le Vail.); Rio Nigro (A. W.).

This species has been much confounded with *M. torquata*. M. de Lafresnaye in the 'Revue Zoologique,' and Mr. Strickland in the 'Contributions to Ornithology,' have clearly pointed out the differences between them, which will be sufficiently obvious on a comparison of the two descriptions, and may be seen at a glance on looking at the birds themselves. Latham's original specimens of his "*White-breasted Barbet,*" under which name he gave the first published description of this species, are still extant in the Derby Museum at Liverpool. This bird extends from Cayenne to the upper branches of the Rio Negro, where examples were collected by Mr. Wallace.

2. Malacoptila rufa (Spix).

Bucco rufus, Spix, Av. Bras. i. t. 40. fig. 1. p. 52.
Lypornix rufa, Wagl. S. A. sp.; Tsch. F. P. p. 257; Tsch. Av. Consp.
Monasa rufa, Gray's Gen. i. p. 74; Gray, List of B. M. p. 50; Bp. Consp. p. 147.

M. brunnea; capite cinereo albo striato: loris et colli lateribus rufescentibus: plaga super-pectorali alba, infra tenuiter nigro marginata; ventre medio albescente: rostro nigro, mandibula inferiore basi flava.

Long. tota 7·0; alæ 3·5; caudæ 2·7.

Hab. in sylvis fl. Amazonum (Spix); Para (Wallace); Peruvia Bor. Or. (Tsch.).

My thanks are due to Mr. Alfred Wallace for allowing me to examine this and many other birds collected by him on the Amazons and Rio Negro. As Dr. von Tschudi mentions the present species as an inhabitant of north-east Peru, and Mr. Wallace's specimens were from Para, we must conclude that it inhabits the whole region of the upper and lower Amazon.

3. Malacoptila torquata (Hahn).

Bucco torquatus, Hahn, Ausl. Vög. pl. 13. p. 5.
Bucco fuscus, Licht. Verz. d. Doubl. p. 8.
Bucco striatus, Spix. Av. Bras. i. t. 40. fig. 2. p. 53.
Capito fuscus, Max. Beit. iv. 364.
Lypornix torquata, adult, Wagl, S. Av. sp. 4.
Lypornix striata, Sw. Orn. Draw. pl. 34.
Monasa fusca, Bp.; Gray's Gen. p. 74 (pars); Bp. Consp. p. 147 (pars).

M. nigrescenti-brunnea rufescente fulvo striata: dorso imo remigibus et rectricibus immaculatis et pallidioribus: plaga pectorali alba infra vitta nigra marginata: loris et ventre summo rufescentibus: ventre laterali virescentiore brunneo, medio cum crisso albescentiore: pedibus nigrescentibus: rostro nigro.

Long. tota 8·0; alæ 3·7; caudæ 3·7.

Hab. in Brasilia Mer. Or. (Max.); Bahia (Licht.).

The present bird is one of the best known of its genus, and perhaps the commonest in collections. Prince Maximilian of Neuwied gives the following account of it:—

"This Puff-bird is one of the commonest wood-birds in South

Brazil. Near Rio de Janeiro, about S. Cristovao, I found it in all the thick woods, even in the neighbourhood of dwellings. They sit still and melancholy upon a low bough, or upon the ground, or hop about on the watch for insects, the remains of which are found in their stomachs. In the south provinces near Rio, Cabo Frio, on the Parahyba, and still farther north, they are common; in the more northerly provinces that I travelled through, I did not meet with them so often. They are by no means timid, and are easy to be shot."

4. Malacoptila fulvogularis, Sclater.

Malacoptila fulvogularis, Sclater, Pr. Z. S. 1853, Dec. 13th.

M. capite toto et dorso summo nigris, scapis plumarum leviter fulvis: dorso alis caudaque fuliginoso-brunneis; dorso medio punctis paucis triangularibus fulvis; uropygii plumis anguste fulvo marginatis; cauda immaculata: mento et gutture toto clare fulvis: pectore nigro, scapis plumarum late albis: ventre leviter fulvescente.

Long. tota 8·5; alæ 3·7.

Hab. in Bolivia (Mus. Derb.).

The only specimen of this species I have yet seen is in the Derby Museum at Liverpool. The bill is black, the head brownish black passing into brown on the back and rump; the top and sides of the head and upper neck have the shafts of the feathers and the adjoining barb of a clear wood-brown; on the middle of the back are a few triangular spots of clear brown; the rump-feathers are narrowly edged with lighter brown. The wing- and tail-feathers are clear brown, the wing-feathers lighter on the outside edge. The chin and whole throat are clear fulvous; the breast-feathers are medially whitish and bordered with blackish brown. The belly and crissum are fulvous whitish.

In the colouring of the head and upper neck this species resembles the preceding.

5. Malacoptila substriata, Sclater.

Malacoptila substriata, Sclater, Pr. Zool. Soc. Dec. 13th, 1853.

M. supra umbrino-brunnea capite nigrescentiore: capite et dorso summo longitrorsum fulvo striolatis: dorsi uropygiique plumis rufescente ochraceo anguste marginatis: alis caudaque immaculate cinerascenti-brunneis: loris et mystacibus elongatis albis: lateribus capitis et corpore infra nigrescentibus, ochraceo et albo late striatis: gula media et pectore toto rufescente ochraceo: ventre brunneo et ochraceo-albido confuse mixto: cauda subtus cinerascentiore: rostro pedibusque nigris.

Long. tota 7·8; alæ 3·8; caudæ 3·8.

Hab. in Nova Grenada.

In the curiously produced feathers descending from each extremity of the lower mandible, this species agrees with the three following, and they are also all four closely allied in plumage.

6. Malacoptila aspersa, Sclater.

Malacoptila aspersa, Sclater, Pr. Zool. Soc. Dec. 13th, 1853.

M. supra fuliginoso-brunnea, dorso rufescentiore: alis caudaque immaculate brunneis: nucha dorso toto et alarum tectricibus maculis triangularibus clare fulvis aspersis: loris albescentibus: regionis auricularis plumarum scapis pallide fulvis: mystacibus et plumis mentalibus rigidis: gula alba: pectore in ferrugineum transeunte: ventre toto crissoque obscure albis ferrugineo tinctis: pectore et ventris lateribus obsolete fuliginoso striatis: rostro nigro, mandibula inferiore ad basin flava: pedibus obscure brunneis.

Long. tota 7·25; alæ 3·2; caudæ 3·2.

Hab. Caraccas in Venezuela.

I found this new species among the birds of this family in the British Museum, which I have had full opportunity of examining through the kindness of Mr. G. R. Gray. In the upper plumage it closely resembles *M. mystacalis*, but the spots are rather smaller and more generally distributed than in that species. The front is fuliginous, the lores whitish. The under surface comes nearer to *M. substriata*, but the throat and mental bristles are here quite white and not ferruginous, and the spots are not so dark. The bill resembles in colour that of *M. mystacalis*, but is more slender in form.

7. Malacoptila mystacalis (Lafr.).

Monasa mysticalis, Lafr. Rev. de Zool. 1850, p. 215. pl. 3.

M. fuliginoso-brunnea; dorsi medii et tectricum alarium plumis macula triangulari pallide fulva ad apicem notatis: fronte loris et plumis mystacalibus albis: gula media et pectore toto ferrugineo-rubro; ventre medio albicante; lateribus obsolete fulvo striatis: rostro nigro, mandibula inferiore basi flavo; pedibus pallidis.

Long. tota 7·4; alæ 4·0; caudæ 3·5.

Hab. in Nova Grenada.

This and the two preceding and next following species are remarkable for the great development of the rictal bristles and the *quasi* moustachios descending from each side of the chin, whence M. de Lafresnaye formed his name for this bird. The present species may be distinguished from the two preceding by the deep red-brown throat and breast. Two examples in my possession came, as M. de Lafresnaye's, from Santa Fé di Bogota.

8. Malacoptila panamensis, Lafr.

Malacoptila panamensis, Lafr. Rev. Zool. 1847, p. 79.
Capito panamensis, Bp. Consp. Av. p. 146.

M. supra tota rufo-fusco-brunnea uropygio caudaque intensioribus et unicoloribus: dorsi plumis alæque tectricibus totis macula parva pallide fulva fere triangulari terminatis: oculorum ambitu auriumque tectricibus vivide rufis, earum scapis gracilibus pallidioribus: vitta frontali aliaque mystaciforma utrinque a mandibula infera descendente niveis, hujus vittæ sicut menti et colli laterum plumis strictis, elongatis, acuminatis et rigidiusculis: subtus rufescenti-albescens; mento hujusdem coloris; collo antico et pectore supremo ferrugineis: pectoris imi ventrisque plumis sordide albis, nigro-fusco marginatis quasi large reticulatis; hypochondriis rufescentibus: rostro elongato, nigro, basi vibrissis pilisque elongatis rigidissimis obtecto: pedibus pallidis, digito medio ut rite in hoc genere longissimo.

Long. tota 18 cent.; alæ 9 cent.; caudæ 7 cent.
Hab. in prov. Panama.

I have given M. de Lafresnaye's description of this species, with which I am not well acquainted, having seen but one specimen that I imagine belongs to it. This is in the Derby Museum at Liverpool, and was obtained by De Lattre at Coban in June 1843. The example from which M. de Lafresnaye took his specific characters was brought by the same active collector from Panama, and is now in the Philadelphian Museum.

9. Malacoptila inornata (Du Bus).

Monasa inornata, Du Bus, Bull. Ac. Brux. xiv. pt. 2. p. 107; Rev. Zool. 1848, p. 249; Bp. Consp. Av. p. 147.

M. supra sordide fusca: dorsi et tectricum alarum minorum et mediarum plumis singulis apice rufescente maculatis: uropygio et cauda fuscescenti-rufis: capitis lateribus fuscis, plumis singulis in medio longitrorsum rufescente striolatis: collo antico pectore epigastrio et hypochondriis rufescente et fusco variis; ventre albido; remigibus obscure fuscis: rostro obscure fusco, apiculo et subtus flavicante: pedibus fuscescentibus, unguibus fuscis.

Long. 17 cent.
Hab. in Guatimala.

M. Du Bus says that this species is nearly allied to his *M. unitorques*, i. e. *M. fusca*, but without any collar or longitudinal *striæ* above. It does not seem to agree with any bird of the genus with which I am acquainted.

B. *Nonnula.*

10. Malacoptila rubecula (Spix).

Bucco rubecula, Spix, Av. Bras. i. p. 51. t. 39. fig. 1.
Monasa phaioleucos, Temm. Pl. Col. 323. fig. 2.
'*Cuculus rufalbinus*, Temm.,' Cuv. Règn. An. i. 455.
Lypornix rubecula, Sw. Orn. Dr. pl. 35.
Monasa rubecula, Gray's Gen. p. 74; Gray, List of B. M. p. 50; Bp. Consp. p. 147.

M. cinerascenti-brunnea: gula et pectore brunneo-rufescentibus: loris et ventre medio albis: rostro nigro.
Long. tota 6·0; alæ 2·5.
Hab. prope pagum *Malhada* flumini S. Francisci proximum (Spix); in sylvis fl. Amazonum (Wallace).

The preceding characters are drawn up from a specimen belonging to Mr. Wallace. Others are in the British and Munich Museums; but I do not consider this a common bird in collections, and though I possess examples of twenty-one out of the thirty-three species described in this Synopsis, the present is one of those that I have never been fortunate enough to meet with except as before mentioned.

It is difficult to ascertain the true date of the publication of the different *feuilletons* of Temminck's 'Planches Coloriées,' but I believe Spix's name for this species was the first published, as is generally allowed to have been the case.

The name *Nonnula*—proposed for the subdivision of the present genus which contains this and the next two succeeding species, in a communication upon new *Bucconidæ* made to the Zoological Society last December—I coined as a diminutive of *Nonna*, i. e. *Monaca*, the word, I suppose, intended by Vieillot when he established the genus *Monasa*.

11. Malacoptila frontalis, Sclater.

M. cinerascenti-brunnea: pectore brunneo-rufescente, quasi fere ferrugineo; ventre albescente: capite summo antice castaneo: rostro nigro, mandibula inferiore basi flavescente.
Long. tota 5·5; alæ 2·5; caudæ 2·3.
Hab. in Nova Grenada.

The British Museum contains two specimens of this apparently new *Malacoptila*, selected amongst other interesting novelties from a collection lately received by Mr. S. Stevens from Santa Fé di Bogota. I have to thank Mr. G. R. Gray for allowing me to examine them.

The species is most closely allied to the preceding, and intermediate between that and the succeeding *M. ruficapilla*. It may be distinguished from the former by its chestnut head, brighter red breast, broader and longer bill, and absence of all indications of white upon the front or lores. The two external rectrices are light brown, the others blackish edged with light brown.

In younger birds the chestnut head is wanting, which renders them easy to be confounded with *M. rubecula*.

Mr. Eyton's collection also contains an example of this bird.

12. Malacoptila ruficapilla (Tsch.).

Lypornix ruficapilla, Tsch. Av. Consp. p. 300; Tsch. F. P. p. 258. pl. 24. fig. 1.
Monasa ruficapilla, Gray's Gen. p. 74; Bp. Consp. p. 147.

M. brunnea: pileo castaneo: collo postico cinereo: subtus cinerea medialiter rufa.
Long. tota 6·0; alæ 2·4.
Hab. in Peruv. Bor. Or. (Tsch.).

This pretty little species was discovered by Von Tschudi in North-east Peru. I have seen specimens in the French National Collection and in the Derby Museum at Liverpool. It seems closely allied to *M. rubecula* in form, and is of about the same size.

Genus III. Monasa.

1. Monasa atra (Bodd.).

Coucou noir de Cayenne, Buff. Pl. Enl. 512.
Cuculus ater, Bodd. Tabl. d. Pl. Enl. p. 30.
—— *tranquillus*, Gm. S. N. i. 417.
Bucco cinereus, Gm. S. N. i. 409.
Corvus australis, Gm. S. N. i. 377.
Bucco calcaratus, Lath. Ind. Orn. i. 206.
Corvus affinis, Shaw's Zool. vii. 381.
Bucco cinereus, Licht. Verz. d. Doubl. p. 8.
Lypornix tranquilla, Wagl. Syst. sp. 1.
Monasa tranquilla, Bp. Consp. p. 147; Schomb. Reisen, iii. 719; Vieill. N. D. d'H. N. xxi. 321; Vieill. Enc. Méth. 1338.
Monasa atra, Gray's Gen. i. p. 74; Gray, List of B. M. p. 49.
Le Barbacou à bec rouge, Le Vail. Ois. de Par. ii. t. 44, 45.

M. nigra: alarum tectricibus albo limbatis: rostro rubro: pedibus nigris.
Long. tota 11·0; alæ 5·3; caudæ 5·2.
Hab. in Guiana (Schomb.); Cayenna (Buff.); Trinit. ins.?

This bird, which has been honoured with no less than six different specific names by the older authors, is common in collections from Cayenne, and I have seen examples said to be from Trinidad. Schomburgk says that it is always found in pairs, and prefers the more open woods and the trees on the banks of the rivers. He never found it in the bush.

2. Monasa flavirostris, Strickl.

Monasa flavirostris, Strickl. Cont. Orn. 1850, p. 47. pl. 48.
—— *axillaris*, Lafr. Rev. Zool. 1850, p. 216.

M. nigra: tectricibus alarum minoribus superioribus et inferioribus niveis: rostro flavo: pedibus plumbeis.
Long. tota 8·2; alæ 4·3; caudæ 3·75.
Hab. in Peruv. Or. Rio Negro (Lafr.); Nova Grenada (?).

Mr. Strickland and the Baron de Lafresnaye published their respective discoveries of this bird about the same time, but I think Mr. Strickland's name has slightly the priority. Mr. Strickland's specimen was, I believe, from the upper branches of the Amazon, M. de Lafresnaye's from the Rio Negro; the bird therefore in all probability ranges along the head-waters of both streams. The locality of 'New Grenada' I give on the authority of specimens in my own collection, which have the usually unmistakeable appearance of '*Bogota*' skins.

This species may be easily distinguished from the preceding by its smaller size, yellow bill and snowy-white under and upper lesser wing-coverts, and the greater wing-coverts not being edged with white.

3. Monasa nigrifrons (Spix).

Bucco nigrifrons, Spix, Av. Bras. i. p. 53. t. 43. fig. 2.
Lypornix unicolor, Wagl. S. A. sp. 2.
Monasa nigrifrons, Gray's Gen. i. p. 74; Gray, List. of B. M. p. 49; Bp. Consp. p. 147.

M. nigro-plumbea unicolor: rostro rubro: pedibus nigris.
Long. tota 9·8; alæ 5·0; caudæ 4·7.
Hab. in vicinitate Paræ (Wallace); in sylvis fluminis Amazonum (Spix); Bolivia (?).

The *M. atra* appears to be replaced upon the Amazons by the present species, which was first discovered by Spix. It has no appearance of white upon the wings, the whole plumage being nearly uniform plumbeous black.

A skin of Mr. Eyton's is labelled '*Bolivia*,' so it possibly ranges as far as the extreme streams of those tributaries of the Amazon which flow from that country.

4. Monasa personata, Vieill.

Monasa personata, Vieill. Gal. des Ois. pl. 36 (1820); Enc. Méth. p. 1339.
Bucco leucops, Licht. Verz. d. Doubl. p. 8 (1823).
—— *albifrons*, Spix, Av. Bras. vol. i. pl. 41 (1824).
—— *albifrons* sive *leucops*, Spix, *l. c.* p. 53.
Lypornix leucops, Wagl. S. Av. sp. 3.
Capito leucops, Max. Beit. iv. 368.

Tamatia leucops, Sw. Orn. Draw. pl. 12.
Monasa leucops, Gray's Gen. p. 74; Gray, List of B. M. p. 49; Bp. Consp. p. 147.

M. plumbescenti-nigra: facie alba: rostro rubro: pedibus nigris.
Long. tota 11·2; alæ 5·2; caudæ 5·2.
Hab. in vicinitate Paræ (Wallace); in campis provinciæ Piauhy (Spix); Brasilia Mer. Orient. (Max.).

The three names for this species also were published about the same time, but I believe Vieillot has the priority. It is a very common bird in collections from the Brazils. The Prince Maximilian of Neuwied met with it frequently during his travels in South-east Brazil, and gives us the following account of it:—

"This fine *Tamatia* I did not meet with so often as the former (*Malacoptila torquata*). It does not live so near human habitations, but is found in the vast thickly-wooded districts, where we obtained many of them. In the summer they live in pairs, in the cold season singly or in flocks. At times pouring forth close to us from among the leafy branches their loud peculiar cry, they astonished the hunters not a little. They are somewhat less stupid and lonely than the former species. I have often seen them in motion, especially when several of them were uttering their loud cries in concert. In their stomachs I found remains of insects. About their nidification I can give no information."

Genus IV. Chelidoptera.

1. Chelidoptera tenebrosa (Pall.).

Cuculus tenebrosus, Pallas, Neue Nord. Beitr. iii. p. 3 (1783); Gm. S. N. i. p. 417; Lath. Ind. Orn. i. p. 221.
Monasa tenebrosa, Vieill. N. D. d'H. N. xxi. 321; Vieill. Enc. Méth. p. 1339; Steph. Zool. xiv. 156.
Bucco tenebrosus, Licht. Verz. p. 8.
Capito tenebrosus, Max. Beit. iv. 372.
Monasa tenebrio, Temm. Pl. Col. 323. fig. 1 (fig. acc.).
Brachypetes tenebrosa, Sw. Class. Birds, ii. 334.
Chelidoptera tenebrosa, Gould, Pr. Z. S. 1836, p. 81; Gray's Gen. i. p. 75; Gray, List of B. M. p. 50; Schomb. Reisen, iii. 720; Bp. Consp. p. 148.
Lypornix tenebrosa, Sw. Orn. Dr. pl. 36; Wagler, S. A. sp. 7.
White-rumped Black Cuckoo, Lath. Syn. ii. 544.
Petit Coucou noir de Cayenne, Buff. Pl. Enl. 505 (fig. pess.).
Le Barbacou à croupion blanc, Le Vail. Ois. de Par. ii. t. 46.

Ch. nigra, ventre castaneo; dorso postico et tectricibus alarum inferioribus cum crisso albis: rostro pedibusque nigris.
Long. tota 7·5; alæ 4·5; caudæ 2·5 (sp. ex Brasil).
" 6·0 " 4·1 " 2·0 (sp. ex Guiana).
" 6·0 " 3·8 " 2·0 (sp. ex ins. Trinit.).
Hab. in Brasilia (Max.); fl. Amazon (Wallace); Cayenne; Guiana (Schomb.); Trinitate ins.

"This bird," says Prince Maximilian of Neuwied, "is not rare in most provinces of South Brazil, and very common in many of them. It is found in certain spots sitting still and immoveable upon the high isolated branches of the forest trees. From time to time it flies after an insect into the air, and falls back again to its place like a true *Muscicapa*. It is a stupid, still, melancholy bird, but likes to sit high and not low, and near the ground, like the other *Tamatiæ*. As in form and colour it rather resembles a swallow, the Brazilians call it *Andurinha do mato*—wood-swallow. The resemblance is greatest when the bird sits upon the ground, for its feet are little adapted for walking, and it consequently shuffles along like a swallow does. Its flight is light and undulating. Sitting upon a high point where it can overlook the neighbourhood, it often emits a short call-note. It is anything but timid, and very easy to shoot. It is usually found where the woods are varied with open country, on the edges of the woods, but likewise in the interior of them. The food of these birds consists of insects, of which I have found the remains in their stomachs. On the Rio Grande del Belmonte I observed how these birds nest. In the month of August I saw them enter a round hole in a perpendicular sand-bank on the river, like a kingfisher's. After digging about two feet in a horizontal direction, we found two milk-white eggs upon a bad lining of a few feathers."

This bird, which was first described by Pallas as long ago as 1783, was rightly separated by Mr. Gould from the rest of the family on account of its very lengthened form of wing. M. Natterer's observations on its habits as given by Mr. Gould coincide with those of the Prince Maximilian just quoted, and I may add, that Mr. Wallace's account of its mode of nesting is likewise the same as that previously given—not that any confirmation was necessary to the evidence of so accurate an observer.

A Trinidad skin of this bird in my own collection is much smaller than the Brazilian examples, and the colours are generally more intense. The Guiana specimens in the British Museum collected by Schomburgk are also rather smaller, and agree nearly with mine from Trinidad.

The same variation occurs in many other birds, amounting, or being considered to amount in some cases to a specific difference.

2. Chelidoptera albipennis, Bp.

Chelidoptera albipennis, Bp. Journ. f. Orn. 1853, p. 47.

Ch. præcedenti similis, sed minor et magis nigra: abdomine intense castaneo: tectricibus alarum inferioribus candidis: remigibus primariis basi, secondariis apice latissime albis. (Bp. *l. c.*)

Hab. in Venezuela; Cumana.

I have seen the single specimen in the Museum of the Jardin des Plantes at Paris, upon which the Prince Charles Bonaparte established this new species. I must confess I should like to see more examples of it; as it appears to me to be very possibly nothing more than the small variety of the preceding type-species with an accidental white bar on the wing. But I did not make a very accurate examination of it, and the Prince Charles Bonaparte has had a much better opportunity of deciding whether it is a good species than I have. To his authority I defer.

XLVI.—*On the Anatomy of the Giraffe* (Camelopardalis giraffa, *Linn.*). By T. Spencer Cobbold, M.D., Conservator of the Anatomical Museum, University of Edinburgh*.

I have already communicated to the Physiological Society of this city a few of the results obtained by a careful dissection and evisceration of the carcase of a Giraffe. Subsequent examination of the parts then removed has furnished me with additional details, to which, in connection with the above, I now beg to direct your attention.

The animal recently formed an attractive feature in the collection well known as Wombwell's Travelling Menagerie. From one of the keepers I ascertained that it had been in this country only seven months; in height it was about 14 feet, and was believed to be rather more than two years old. Until a very short while before death no symptoms of disease had been detected, and the creature was regarded as an exceedingly healthy specimen. I understood that no fewer than six individuals of this interesting genus (which comprises but this one species) had been purchased at different times for the collection, but each of them, as in the present instance, expired before it had been eight months in Wombwell's possession. This cannot surprise us, as we well know that in spite of all the painstaking and expense incurred in endeavouring to keep them alive, no such effort can prove successful, unless a roomy apartment and numerous other desiderata be supplied, such as are so advantageously afforded in the case of those kept in the London Zoological Society's Gardens, Regent's Park.

In the Giraffe under consideration, the first unfavourable indications appeared in the fore-limbs; these symptoms were attributed to the severity of the cold which prevailed here in the winter season. The usual remedies were applied, but the extremities gradually gave way until complete paralysis supervened, and the animal sank about eight days after the first traces of internal disturbance.

* Read to the Royal Physical Society of Edinburgh, April 5th, 1854.

The carcase was purchased for the Museum of Natural History by Prof. Traill, to whom our thanks are due for handing over to the Anatomical Museum of the University, the viscera and soft parts which remained after the skin and extremities had been removed. In prosecuting the dissection, Mr. John Lowe kindly rendered assistance, when the following facts were noted.

The rumen, reticulum, psalterium, and stomach occupied the anterior two-thirds of the abdominal cavity, the intestines being situated further back and suspended, as it were, from the lumbo-sacral region of the spine. The paunch was very greatly distended with food, to which the general enlargement of the abdomen, observable before the body was opened, seemed principally due. I allude to this circumstance in particular, because little or no fluid had accumulated in the peritoneal cavity, and the omenta (which in all the three previously recorded dissections of the Giraffe made in this country were found loaded with fat) in the present instance exhibited scarcely the slightest trace of fatty deposit. In the colon, cæcum and rectum, the fæces had assumed their characteristic pellet-like form, and the alimentary mucous surface appeared healthy throughout.

The spleen, though of the normal size, was very soft and readily tore up on being handled, the pulp of an almost absolutely black colour separating and running out like thin fluid, leaving the matrix (consisting of the trabeculæ, arterial and venous trunks) quite bare in places. This rapid disintegration was not considered sufficiently explained by the circumstance of the animal having been dead four days.

The pancreas was healthy and in its usual situation.

The liver, placed far forward in contact with the diaphragm and in front of the stomach on the right side of the body, is an exceedingly simple organ. In form, it is elongated, compressed and slightly fissured, so as to indicate a bilobular tendency: on the under surface there is an elevation corresponding to the lobus Spigelii, the outer border of which is particularly prominent. The entire gland weighed 5 pounds and 6 ounces, and measured in the longitudinal diameter 16 inches, 9 inches transversely, and but $2\frac{1}{2}$ in thickness. To the naked eye and to the touch, it appeared healthy, but here and there were detected small hard points, which on further examination were found to be cysts containing in their interior *cysticerci*, or entozoa in the larva state. It was not until nine days had elapsed since the death of the Giraffe, that I detected also in the bile-ducts of the liver, several individuals of the genus *Fasciola**, and by means of a

* *Fasciola*, Linnæus, Blanchard, &c. *Distoma*, Rudolphi, Bremser, &c. The term *Distoma* is unfortunate, as leading to the idea of two mouths; the genera *Fasciola* and *Distoma* have only one true oral aperture, as in

syringe, I subsequently washed out of the ducts nearly forty specimens of this entozoon, many of which were thus fortunately preserved entire, and having placed them in strong spirit, I have succeeded in injecting their so-called vascular and digestive systems.

No gall-bladder could be discovered.

On removing the abdominal viscera *en masse*, the connecting fibro-cellular tissue surrounding the left kidney was found infiltrated, soft and yielding; the renal organ in a semi-putrid condition, with its substance broken up, pultaceous and intensely fœtid; the capsule enclosing the right kidney was more firm, but on being opened the contained gland presented the same far advanced state of decomposition. The bladder was small, contracted and empty.

The contents of the thorax were next examined. We found the lungs collapsed, the one on the left side more completely so; both were very soft, of a dark brown colour externally, and appeared small in proportion to the calibre of the thoracic cavity. The left lung was much congested and gangrenous in places; softening and partial disintegration of some of the larger bronchi had also commenced. The right lung was less congested and more healthy throughout.

In reference to the heart, no particular observations were made at the time of its removal. I have compared it with that of the Camel, in which ruminant the relative size of the auricles and ventricles is less disproportionate; the organ is also very much larger than that of the Giraffe. The present example weighed 4 pounds, measured 8 inches from base to apex, and 6 inches in breadth through its greatest transverse diameter.

We have thus far considered the general characters and morbid appearances presented by those viscera in which the vital functions are principally performed. It is singular that so great an amount of internal disease should have been going on while the animal appeared in a healthy state. When the keepers were informed of these results, much surprise was expressed by one of them, more especially at the statement made respecting the almost entire absence of fat. In dissections of the Giraffe, the prevalence of this element has hitherto attracted particular attention, so that in this instance its non-occurrence affords strong presumptive evidence, that the functions of nutrition and secretion had for some time been impaired.

Monostoma; they are distinguished from the latter genus by the presence of two ventral suckers (which were originally considered *stomata*), and from each other by the digestive organs, which in *Fasciola* are ramified or dendritic. See Blanchard's papers, Ann. des Sciences Nat. 1847, Zool. p. 278 *et seq.*

Other lesions than those already enumerated were detected. The paralysis finds its explanation in ramollissement of the spinal cord, softening of that portion of it corresponding to the last cervical and first dorsal vertebræ having taken place; elsewhere it was firm in texture and closely enveloped by the dura mater. The brain was healthy, but a desire to preserve the cranium entire prevented our examining it very minutely. Its removal piecemeal has enabled me, however, to retain a tolerably accurate cast of its size and form, and illustrates the small bulk of the cerebellum as compared with the cerebrum. The following are its dimensions:—extreme length 6 inches; breadth 4 inches; longitudinal diameter of the hemispheres $4\frac{1}{2}$ inches. The cranial cavity when emptied of its contents was found capable of holding 21 ounces of water. The cerebrum and cerebellum weighed 19 ounces.

Differences in the development of the cranium are said to be found in giraffes inhabiting respectively the more northern or southern regions of Africa. These distinctive peculiarities have more especial relation to the position and approximation of the horns. In the variety under consideration, which was imported from the coast of Abyssinia (whence they are usually obtained), I have noted the following particulars in reference to the bones of the head:—

Length of cranium; incisive symphysis to horn tips	20	inches.
Do. do. incisive angle to occipital crest ...	19	,,
Incisive angle to tip of central eminence	$11\frac{1}{2}$	,,
Extreme cranial breadth	$8\frac{3}{4}$	,,
Length of horns	$5\frac{1}{2}$	,,
Distance between horn tips	4	,,
Depth of orbit	3	,,
Greatest diameter of orbital ring	$2\frac{1}{2}$	,,
Breadth of occipital condyles	$3\frac{7}{8}$	,,
Depth of each condyle	$2\frac{1}{4}$	,,
Distance between articular surfaces of condyles, only ...	4	lines.
Length of hard palate	$10\frac{1}{2}$	inches.
Extreme width of ditto	3	,,
Length of lower jaw	$15\frac{1}{4}$	,,
Depth of rami of ditto	6	,,
Breadth between condyles of ditto	$2\frac{1}{2}$	,,
Do. between rami	$4\frac{1}{4}$	,,
Do. opposite fourth molares	$1\frac{1}{4}$	,,

Several of the grinding teeth are much decayed, and illustrate further the impoverished state of the nutritive functions. The dental formula stands thus:—

$$\text{Incisors } \frac{0-0}{4-4}; \text{ molars } \frac{6-6}{6-6}; =32.$$

The four posterior grinders had not penetrated the gum. The two outer incisors have divided crowns.

I have but little to say concerning the *tongue*, which has been most carefully anatomised by Professor Owen. We have injected and dissected this organ, and, as Prof. Owen has shown, no vascular reservoirs, or any trace of erectile tissue is to be found, whereby (as Sir Everard Home supposed) the prehensile movements of the organ might be regulated; on the contrary, its exalted functions are due to muscular action, the motor nerves supplying it being very large and tortuous when the tongue is not stretched out. Imbedded in the cellular aponeurosis surrounding the styloglossi and lingualis muscles, were found three small semitransparent cysts, containing entozoa, and resembling somewhat those *cysticerci* which we spoke of when describing the liver. A microscopic examination of their contents throws much doubt upon their identity, but upon these differences we shall not now enter. The tongue measures in length 16 inches; in breadth (3 in. from tip) $2\frac{1}{4}$, and at the molar region 3 inches; the anterior darker portion (or that continually exposed to the air) measures rather more than 7 inches.

In conclusion it may be noted, that at the anterior part of the mouth, beneath the tongue and immediately behind the incisors, there are two small membranous folds, at the base of each of which the orifices of two salivary ducts are visible. The palatal ridges and buccal papillæ are largely developed. The passages to the tonsils readily admit the tip of the little finger. The rudimentary uvula consists of three small and closely approximated papillæ. The trachea measures 4 feet in length, and if slightly stretched will be increased 7 inches. The elastic ligamentum nuchæ, which in the living state extended about 5 feet 6 inches, after its removal measured only 3 feet 7 inches. Examined microscopically Professor Quekett tells us that the fibres of this latter structure exhibit a transversely striated appearance, which is due to the presence of certain (scalariform) openings, which do not extend across the entire diameter of the fibres. Several gentlemen have availed themselves of the opportunity here afforded; we have searched for these characteristic markings according to indications given by Prof. Quekett, but it does not appear that any of us have succeeded in detecting the openings in question.

XLVII.—*On the Growth of Sea-Weeds.*
By P. H. Gosse, A.L.S.

The Rhodosperms, or Red Sea-weeds, must be the test of success in any attempts to cultivate the marine *Algæ*, and this for several reasons; such as their superior beauty; the great number of their species; their delicacy of habit; and their organic rank in the class. The Chlorosperms, or Green Sea-weeds, have been mastered; and the central tanks in the Zoological Society's Aquarium afford interesting and easily accessible examples of the successful treatment of these. Here the visitor sees a profuse growth of *Ulva*, *Enteromorpha*, and *Conferva*, covering the slate ends of the tanks with their abundant vegetation, all of which has grown since last summer; and an object of exquisite beauty is presented by a large stone completely concealed by a crop of the lovely *Bryopsis plumosa*, which has overspread its surface with luxuriant fronds growing so densely as to remind us of a bank of moss, though greatly excelling it in elegance, and affording shelter to myriads of tiny *Entomostraca*, that play in its foliage like clouds of moving dust. Hitherto, however, the Rhodosperms have resisted domestic culture, refusing, like the eagle *, to propagate in captivity.

It was therefore with great satisfaction that I thought I perceived indications of new growth in some Red Algæ which I am keeping in a small tank at my residence at Islington. Some of these were received from the coast at the end of February last, and others had survived the winter in confinement, having been brought up from Weymouth on the 1st of December 1853.

The first suspicion which I had that any of these were sprouting, was produced by my observing, early in April, minute points projecting from various parts of the frond of a *Gracilaria confervoides*. They were of a paler red than the rest of the frond, and from their appearance I conjectured that they might be new shoots sprouting forth. I observed the same appearance on other fronds of the same species, of which several tufty plants were in the tank; but it was not until the 14th of April that I instituted a careful examination of these and other Rhodosperms. On that day I selected fronds of different species, noting with precision the size, form, and number of their projecting tubercles, and making accurate sketches of them, both of the natural size, and as they appeared under a lens. Thus I obtained fixed data from which to determine the question of their growth.

The flattened wire-like fronds of *Gracilaria*, which I selected, had a considerable number of these tiny points, none of which exceeded half a line in length; they generally projected in pairs from opposite sides of the frond, but showed a tendency to cluster about the terminations of the fronds, which had been broken off and were therefore truncate. On the 21st the points had increased to twice, and in some instances to thrice their former length; they had acquired a fusiform figure, and were indubitably growing shoots.

* "The prison'd eagle will not pair."—Byron.

On the 14th the lens had detected, springing parasitically from a frond of *Gracilaria*, a very minute filament of a *Ceramium*, just discernible. Its tip was simply pointed; but on the 17th this had divided into two incurvated hooks, which on the 21st had increased so as to be visible with the naked eye.

A plant of *Chondrus crispus*, the firm fleshy variety, showed the extremities of its old fronds plump, somewhat swollen, and of a tender cherry-red hue; while from the base new minute fronds were springing. The latter on the 21st had doubled their length. This plant has been in my possession all the winter.

So also has a fine specimen of *Rhodymenia jubata*, dredged in Weymouth Harbour last November. It consists of numerous ribbon-like fronds, much fringed at the margins. Their original red hue had become much discoloured in the course of the winter, partly by decay, partly by the growth of minute fungoid Algæ, and partly by the deposition of the spores from *Ulvæ*, &c., which adhered, like a green dust, to them. The fronds had curled upon themselves a good deal, and I was often on the point of throwing away the plant, as a worthless incumbrance. I was much pleased therefore to see signs of vigour here, and those more unequivocal than in any other species I had examined. On the surface of the fronds and along their edges new ciliary filaments were sprouting, but most numerously at the tips of the branchlets, and of the fronds themselves. From some of these extremities, which were attenuated to a slender point, the "*cilia*" were shooting in close-set array, half a dozen or more springing from the same point, radiating and crossing each other in all directions, a perfect maze of tiny spines. At first the individual *cilia* in these groups were less than a line in length; but they speedily increased both in length and numbers, and were found studding the ends and branchlets of all the fronds, imparting to them a singular appearance.

On the 28th (after the lapse of another week) there was no longer any possibility of doubt as to the plants being in a growing condition. The budding points on the *Gracilaria* had greatly increased in length, and some of them were already bifurcating; several of the shoots were now one-sixth of an inch in length, or at least four times as large as they had been when first measured a fortnight before.

The furcate points of the *Ceramium*, the basal shoots of the *Chondrus*, and the cilia of the *Rhodymenia*, had all likewise manifested similar increase.

On the same day (the 28th of April) I marked some minute scales of the *Corallina officinalis*, in its incrusting stage; which from the freshness and plumpness of their edges, especially of the more prominent papillæ, seemed to be in a growing state.

I made a careful sketch of the outline of one, to serve as a standard of comparison. For a fortnight I could detect no certain increase, but being then absent from home for a week, I found on my return a decided growth, the scale having pushed out an irregular sinuous projection.

At the time of my closing this note for the press, the state of things is as follows. The shoots of the *Gracilaria* have attained a length of one-third to one-half of an inch: those of the *Rhodymenia jubata* are from one-half to two-thirds of an inch in length; they are very numerous, especially about the roots of the plant, where they form a dense thicket of a rich crimson colour. The shoots of the *Chondrus* are steadily increasing, but more slowly. The tiny *Ceramium* has come to an untimely end, having been eaten off, probably by some vagrant *Rissoa*. The *Corallina* I have just described. Besides these, patches of the fine dense filaments of a *Callithamnion* (perhaps *Rothii*) are appearing on some of the shells; and the tips of a specimen of *Phyllophora rubens* have the brightness of new growth; but as I have not subjected these to strict comparisons, I will not insist on them. The facts above recorded are sufficient to show that there is nothing in the nature of the *Rhodosperms* to prevent their being cultivated in confinement, with a facility far superior to that which attends the culture of multitudes of terrestrial plants that reward the skill and perseverance of the horticulturist.

P. H. Gosse.

May 19th, 1854.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 25, 1852.—J. Gould, Esq., F.R.S., Vice-President, in the Chair.

Descriptions of eighteen new species of Land Shells, from the Collection of H. Cuming, Esq. By Dr. L. Pfeiffer.

1. Helix avus, Pfr. *H. testâ umbilicatâ, depressâ, solidâ, obliquè striatulâ, nitidulâ, pallide fulvâ; spirâ convexâ, brevi; suturâ levi; anfractibus 4 vix convexiusculis, sensim accrescentibus, ultimo carinato, utrinque convexiore, fascia fusca ad suturam, pallidaque ad carinam ornato, basi pallido, circa umbilicum mediocrem, pervium subcompresso; aperturâ vix obliquâ, subtriangulari-lunari; peristomate crasso, albo, expanso et reflexo, marginibus remotis, callo crasso junctis.*

Diam. maj. 37, min. 31, alt. 18 mill.

Hab. in insulis Philippinis.

2. Helix Emiliana, Pfr. *H. testâ perforatâ, conoideo-lenti-*

culari, solidulâ, supernè confertim costulatâ, lineis impressis spiralibus subregulariter granulatâ, opacâ, lutescenti-fuscâ; spirâ conoideâ, vertice elevato, obtusiusculo; anfractibus 6 *convexiusculis, lente accrescentibus, ultimo non descendente, compressè carinato, basi convexo, radiatim striatulo, nitidulo; aperturâ obliquâ, angulato-lunari; peristomate simplice, recto, margine columellari ad perforationem reflexiusculo.*

Diam. maj. 16, min. 15, alt. 8 mill.

Hab. in insula Ceylon.

3. Helix Redfieldi, Pfr. *H. testâ umbilicatâ, conoideo-globosâ, tenui, irregulariter striatâ et obsoletissimè decussatâ, diaphanâ, nitidâ, fulvo-corneâ; spirâ conoideâ, obtusulâ; anfractibus* $5\frac{1}{2}$ *convexis, regulariter accrescentibus, ultimo inflato, non descendente; aperturâ parum obliquâ, lunato-rotundatâ, altiore quam latâ, intus margaritaceâ; peristomate simplice, recto, acuto, marginibus remotis, columellari subverticali, sursum dilatato, umbilicum angustum semitegente.*

Diam. maj. 17, min. 15, alt. 14 mill.

Hab. Shang Hai, Chinæ (*Mr. Fortune*).

4. Helix nuda, Pfr. *H. testâ vix perforatâ, conoideo-depressâ, tenui, radiatim striatulâ, pellucidâ, pallide fulvo-corneâ; spirâ conoideâ, acutiusculâ; suturâ impressâ, albo-submarginatâ; anfractibus* 6 *convexiusculis, ultimo majore, inflato, non descendente; aperturâ ferè diagonali, rotundato lunari, latiore quam altâ; peristomate simplice, recto, marginibus subconniventibus, dextro arcuatim antrorsum dilatato, columellari subrecedente, arcuato, supernè dilatato, reflexo.*

Diam. maj. 11, min. $9\frac{2}{3}$, alt. 7 mill.

Hab. in Himalayah (*Mr. Fortune*).

5. Helix Minerva, Pfr. *H. testâ umbilicatâ, sublenticulari, solidâ, subtiliter et confertim striatâ, carinatâ, nitidulâ, luteâ, fasciis* 2 *nigro-castaneis supra et infra carinam ornatâ; spirâ brevi, convexâ, obtusâ; suturâ lineari; anfractibus* 4 *sensim accrescentibus, vix convexiusculis, ultimo non descendente, basi, præsertim antice, convexo, circa umbilicum angustum, conicum, subcompresso; aperturâ diagonali, rotundato-lunari, intus submargaritaceâ; peristomate simplice, recto, marginibus remotis, supero antrorsum subarcuato, columellari subverticali, sursum dilatato, patente.*

Diam. maj. 25, min. $22\frac{1}{2}$, alt. 12 mill.

Hab. in insulâ Celebes?

6. Helix Rehbeini, Pfr. *H. testâ imperforatâ, globosâ, solidâ, minutissimè striatulâ, sub epidermide non nitente, virenti-luteâ albâ, plerumque fasciis saturatè castaneis pluribus latis cinctâ; spirâ conoideo-semiglobosâ, obtusulâ; anfractibus* $4\frac{1}{2}$ *modicè convexis, rapidè crescentibus, ultimo rotundato, anticè breviter descendente, circa columellam vix declivem, latam, albam, subexcavatam nigricante; aperturâ diagonali, lunato-rotundatâ,*

intus albidâ; peristomate albo, expanso-reflexiusculo, intus subincrassato.

Diam. maj. 27, min. 23, alt. 20 mill.

Hab. in insulis Philippinis.

7. Helix Eva, Pfr. *H. testâ imperforatâ, trochiformi, solidâ, subtiliter et confertim striatâ, vix nitidulâ, carneâ, sursum fasciâ fusco-violaceâ ornatâ vel omnino fusculâ; spirâ conicâ, acutiusculâ; suturâ impressâ; anfractibus 5 vix convexis, ultimo non descendente, acutè carinato, basi convexiusculo, medio impresso; aperturâ perobliquâ, lunato-rhombeâ; peristomate fusco-limbato, marginibus subparallelis, supero expansiusculo, basali arcuato, medio angulum obsoletum formante, incrassato, breviter reflexo.*

Diam. maj. 14, min. 12, alt. 9 mill.

Hab. in insulis Novis Hebridibus.

8. Helix isodon, Pfr. *H. testâ angustè umbilicatâ, conoideo-lenticulari, solidâ, undique minutè granulatâ, castaneo-fuscâ; spirâ latè conoideâ, obtusulâ; anfractibus 5 vix convexiusculis, lentè accrescentibus, ultimo carinato, anticè perdeflexo, strangulato et scrobiculato, basi convexo; aperturâ ferè horizontali, auriformi; peristomate fusculo, subincrassato, reflexo, marginibus callo alte elevato flexuoso, medio laminam linguæformem emittente junctis, dextro valdè curvato, bidentato, basali declivi, unidentato, dentibus subæqualibus, validis.*

Diam. maj. 19, min. $17\frac{1}{2}$, alt. $10\frac{2}{3}$ mill.

Hab. in Columbiâ occidentali.

9. Bulimus Janus, Pfr. *B. testâ imperforatâ, dextrorsâ vel sinistrorsâ, subfusiformi-oblongâ, solidâ, vix nitidulâ, luteâ-fasciis 3 extus opace viridibus, intus nitide atro-castaneis, peristoma non attingentibus, basali latissimâ, varicibusque castaneis sparsis ornatâ; spirâ conicâ, acutiusculâ; anfractibus 6–7 convexiusculis, ultimo $\frac{2}{5}$ longitudinis subæquante, basi attenuato; columellâ verticali, strictâ; aperturâ obliquâ, semiovali, basi subangulatâ; peristomate subincrassato, breviter reflexo, albo, marginibus callo nigro-castaneo junctis.*

Long. 47, diam. 20 mill.

Hab. in Novis Hebridibus.

10. Bulimus fuligineus, Pfr. *B. testâ imperforatâ, oblongâ, solidâ, longitudinaliter striatâ et concentricè irregulariter subsulcatâ, fuligineâ; spirâ convexo-conicâ, obtusulâ; suturâ profundâ, pallidâ; anfractibus 5 modicè convexis, rapidè accrescentibus, ultimo $\frac{3}{5}$ longitudinis æquante, basi attenuato; columellâ carneâ, subtortâ, basi subtruncatâ; aperturâ vix obliquâ, elongato-auriformi, intus lividâ; peristomate undique expansiusculo, margine dextro medio impresso, intus subdentato.*

Long. 38, diam. 16 mill.

Hab. in Novis Hebridibus.

11. Bulimus Blandi, Pfr. *B. testâ perviè et angustè umbilicatâ, turritâ, tenuiusculâ, obliquè confertim filoso-striatâ, opacâ,*

calcareâ; spirâ elongatâ, infra apicem latum, obtusum attenuatâ; suturâ vix impressâ; anfractibus 17 *planis, ultimo subangulato,* $\frac{1}{7}$ *longitudinis subæquante; aperturâ vix obliquâ, subtetragonâ; peristomate simplice, recto, margine columellari supernè reflexiusculo.*

Long. 22, diam. 7 mill.

Hab. Baranguilla in Andibus Columbianis (*Bland*).

12. Partula glutinosa, Pfr. *P. testâ subumbilicatâ, subpyramidatâ, solidâ, lævigatâ (sub lente vix decussatulâ), epidermide fulvâ, nitidâ, quasi glutinosâ obductâ; spirâ elevato-conicâ, apice acutâ; suturâ lævi; anfractibus* 5, *superis planis, ultimo spiram subæquante, convexiore, basi quasi saccato; columellâ leviter arcuatâ, supernè vix plicatâ; aperturâ ferè verticali, oblongâ, obliquè protractâ; peristomate lato, intus calloso, violaceo-fusco limbato, marginibus subparallelis.*

Long. 19, diam. 10 mill.

Hab. ——?

13. Partula dentifera, Pfr. *P. testâ subumbilicatâ, ovato-conicâ, solidâ, sublævigatâ, parum nitidâ, pallide stramineâ; spirâ conicâ, apice acutiusculâ; suturâ marginatâ; anfractibus* $5\frac{1}{2}$, *summis planis, penultimo convexiore, ultimo spirâ vix breviore, convexo, anticè medio impresso; columellâ subverticali, vix plicatâ; aperturâ vix obliquâ, angustâ, obversè auriformi; peristomate valdè incrassato, albo, patente, marginibus subparallelis, dextro supernè valdè curvato, medio tuberculum acutum, dentiforme gerente.*

Long. $21\frac{1}{2}$, diam. 10 mill.

Hab. ——?

14. Achatina iostoma, Pfr. *A. testâ fusiformi-ovatâ, tenui, undique æqualiter granulatâ, parum nitidâ, fulvâ, strigis obscuris, latis, subangulatis, castaneis ornatâ; spirâ conicâ, supernè attenuatâ, pallidâ, apice obtusâ; suturâ subcrenatâ; anfractibus* $7\frac{1}{2}$ *vix convexiusculis, ultimo spiram paulò superante, basi subattenuato; columellâ leviter tortâ, basi obliquè et breviter truncatâ; aperturâ verticali, angustè semiovali, intus pallide lilacinâ, nitidâ; peristomate simplice, margine dextro regulariter arcuato.*

Long. 128, diam. 56 mill.

Hab. Fernando Po (*Fraser*).

15. Achatina glutinosa, Pfr. *A. testâ ovato-conicâ, tenuiusculâ, longitudinaliter striatâ, subunicolore fulvâ; spirâ conicâ, sursum attenuatâ, apice obtusiusculâ; anfractibus* $7\frac{1}{2}$, *mediis lineis spiralibus subdecussatis, ad suturam submarginatam profundè striatis, ultimo spiram paulò superante, sublævigato, glutinoso-nitente; columellâ plicato-tortâ, basi abruptè truncatâ; aperturâ obliquâ, ferè ovali, intus lilaceâ, margaritaceâ; peristomate simplice, fusco-limbato, margine basali arcuato.*

Long. 98, diam. 45 mill.

Hab. in Africâ occidentali (*Fraser*).

16. Achatina Deshayesi, Pfr. *A. testâ turrito-ovatâ, tenuiusculâ, sublævigatâ, nitidâ, corneo-fuscâ; spirâ elongatâ, convexâ, apice obtusulâ; suturâ simplice, subprofundâ; anfractibus 7 convexis, ultimo $\frac{2}{5}$ longitudinis subæquante, basi rotundato; columellâ subtortâ, latè et obliquè truncatâ; aperturâ vix obliquâ, rhombeo-semiovali; peristomate simplice, obtuso, margine dextro subrepando.*

Long. 11, diam. 5 mill.

Hab. in insulâ Ceylon.

17. Achatina cerea, Pfr. *A. testâ oblongo-turritâ, tenui, subtiliter et regulariter striatâ, nitidâ, pellucidâ, pallide cereâ; spirâ rectilineari, apice obtusâ; suturâ mediocri, minutè crenulatâ; anfractibus 8 vix convexis, ultimo $\frac{1}{4}$ longitudinis vix superante, infra medium subangulato; columellâ curvatâ, abruptè truncatâ; aperturâ obliquâ, oblongâ; peristomate simplice, recto, margine dextro leviter arcuato.*

Long. 14, diam. $4\frac{2}{3}$ mill.

Hab. Fernando Po (*Fraser*).

18. Helicina sublævigata, Pfr. *H. testâ conoideo-depressâ, solidulâ, sublævigatâ, nitidulâ, unicolore rubellâ vel albidâ, subtus violaceo zonatâ; spirâ breviter conoideâ, vertice obtusulo; anfractibus 5 vix convexiusculis, ultimo latiore, peripheriâ obsoletè angulato; aperturâ diagonali, subsemiovali; columellâ brevi, simplice, callum crassiusculum, circumscriptum retrorsum emittente; peristomate simplice, breviter expanso, margine basali ferè rectilineari, ad columellam subdentato. Operculum tenue, corneum.*

Diam. maj. 8, min. $6\frac{1}{2}$ alt. 5 mill.

Hab. in Novis Hebridibus.

Notes on the Didunculus, a species of Pigeon supposed to be peculiar to the Navigator's Islands. By Lieut. the Hon. F. Walpole, R.N. Communicated by J. H. Gurney, Esq., F.Z.S.

May 25.

Lieut. Walpole always saw this bird (when in its natural state) either perching on trees or flying about them,—feeding by day and roosting by night among the branches. He never saw them on the ground, though he has seen places where they appeared to have been scratching, either for roots or for other food. The crops of the specimens which he examined were, however, generally filled with green berries, which grew in clusters on a species of ash. The number of specimens so examined was considerable, as the birds formed Lieut. Walpole's principal food while on these islands. He found the flesh most excellent, though in colour darker even that of the English wood-pigeon. The flight of the *Didunculus* is mostly limited to a transit from wood to wood, as they rarely attempt to pass from one island to another,—the distance between the islands varying from ten to eighty nautical miles.

Though their flight appears to be inferior to that of most pigeons, it is of the same swooping and continuous character.

They retire late to roost, but are not nocturnal.

They are generally seen either in pairs or in small flocks. The largest flock seen by Lieut. Walpole consisted of nine.

In the breeding season they pair and retire to the interior of the islands, where they nest amongst the rocks.

Lieut. Walpole does not know the colour or number of the eggs, but states that the young are naked and helpless.

The male bird is superior to the female in size, colour, and carriage, but does not attain his full plumage until the second year.

The natives of the Samoon Islands are fond of keeping the *Didunculi* tame as pets, either taking them from the nest, or, when older, with bird-lime.

They attach the bird by a long string fastened round one leg to a stick about two feet in length, with a fork at the end, which is stuck generally in the wall inside the hut, but sometimes in the ground outside.

The natives, when they walk, often carry with them these sticks with the birds attached, and train the birds to leave the stick occasionally and hover above it till it is again presented for the bird to perch on,—the line by which it is attached being long enough to admit of this operation.

July 27, 1852.—G. R. Waterhouse, Esq., in the Chair.

Note on the Indian Weaver-bird (Ploceus Philippensis). By Lieut. Burgess.

The dimensions of the male are as follows:—Length $6\frac{1}{2}$ inches; from the carpal joint to the end of the longest quill-feather, $2\frac{6}{8}$ inches. Irides dark brown; beak bluish black; base of the lower mandible dull yellow on the underside; legs, feet and claws pale flesh-coloured brown.

Length $6\frac{1}{4}$ inches; from the carpal joint to the end of the longest quill-feather, $2\frac{6}{8}$ inches. Beak yellowish horn colour; base of both mandibles, especially that of the lower, dull brownish orange; legs, feet and claws as in the male.

These pretty little birds are sociable in their habits, building several nests on the same tree. The nests are of beautiful construction, shaped like a ball, with a long pendent tube. They are generally formed of a species of strong wiry grass, but in places where the date-palm grows, they are made with fine fibres, split by these little architects out of the small spiked side-leaflets of the branches. Both male and female work, though the male appears to prefer looking on and squabbling with his neighbours to building. When a blade of grass or fibre has been brought to the nest, considerable time is required to work it into the growing fabric, the builder weaving both on the outside and inside. The entrance tube is a most beautiful piece of workmanship, and in many nests is nearly a foot long. When these birds commence building, they almost invariably fix upon a thorny tree, or one growing over a stream or old well. In places where date trees are growing on the banks of a stream they appear to prefer them, but I do not recollect having seen nests away from water. Having selected their situation, they begin by weaving a stem of grass or fibre of date leaf, attaching to it a ring of the same materials; on one side of this ring is worked the body of the nest, on the other the entrance tube. A very slender drooping bough is generally selected; the upper portion of the ball of the nest, as it is being worked, is strengthened with lumps of mud.

In one or two instances I have seen an upper room over the nest, between it and the bough. This appears to be the abode of the male. On one occasion, when watching a colony of these birds building, I observed a nest with an upper story, in which the male was lazily sitting whilst the female was working at the room below; and the natives who assisted me in getting some of the nests assured me that the upper is the male's abode. The upper room is made by widening the stem of the nest, and adding a penthouse to it. When the nest is finished, which takes place about the middle of August (the heighth of the monsoon), the eggs, six or eight in number and of a pure white, are laid. During the breeding season the male employs himself alternately in helping his mate and fighting with all others of his kind that approach his nest. His song, often repeated, is simple and very sweet.

It is a very curious fact, that out of some fifty nests not more than one or two have the upper room attached. If this penthouse is put up to keep off the monsoon rains, why should so few males have them?

The claws of these birds are remarkably long, enabling them to hang securely to their nests when building them. Their food consists of seeds. In the month of April I shot two or three in the hedge round a stackyard. They were males, in the same plumage as the adult female. The adult male loses, I believe, his bright golden plumage after the breeding season.

Descriptions of New Shells, from the Cumingian Collection. By Arthur Adams, F.L.S. etc.

1. Myochama Stutchburyi, A. Adams. *M. testa inæquivalvi, subæquilaterali, rosea; valva dextra affixa, sinistra convexiuscula, apice acuto, antice recurvo, longitudinaliter costata, transverse oblique plicata; costis squamulato-nodosis; latere antico rotundato, postico oblique truncato.*

Hab. Australia.

This species, named in honour of the founder of the genus, differs from the type *M. anomioïdes* in being longitudinally ribbed radiately from the apex, and in the apex of the umbones being sharp, produced, and flattened.

2. Myochama Keppelliana, A. Adams. *M. testa inæquivalvi, æquilaterali, carnea; valva dextra affixa, sinistra convexa, apice producto, acuto, inflexo, longitudinaliter radiatim*

costata; costis nonnullis dichotomis, squamulis rotundatis, arcuatis, confertis, ornatis; latere postico oblique truncato, antico rotundato.

Hab. Bass's Straits, deep water.

This species, found by the Hon. Captain Keppell, differs from the type in the ribs radiating regularly from the apex and not being nodosely wrinkled, but furnished with regular rounded arcuated scaly tubercles.

3. Crassatella obesa, A. Adams. *C. testa æquivalvi, inæquilaterali, crassa, gibbosa, epidermide rufo-fusca sericea obtecta, transverse valde plicata, plicis prominentibus, ad marginem ventralem evanidis; lunula impressa lanceolata; latere postico subproducto, angulato, margine truncato; latere antico gibboso, margine rotundato.*

Hab. New Zealand, deep water (*Mr. Strange*).

This species somewhat resembles *C. lapidea*, Reeve, but it is not rayed, nor beaked so strongly posteriorly, and the valves are much more gibbous and very strongly transversely plicate.

4. Crassatella Cumingii, A. Adams. *C. testa æquivalvi, inæquilaterali, subtrigonali, epidermide fusca radiatim striata obtecta, transverse concentrice valde plicata, plicis crassis, elevatis, ad marginem ventralem evanidis; latere antico rotundato, postico subrostrato, margine oblique truncato.*

Hab. Moreton Bay, East Australia, deep water (*Mr. Strange*).

This large species is near *C. pulchra*, Reeve, but differs in being more gibbose, less beaked posteriorly, in the plicæ being stronger, and in wanting the coloured rays.

5. Aspergillum Strangei, A. Adams. *A. testa æquivalvi, subæquilaterali, alba, transversim sulcosa, umbonibus prominulis; tubo inferne clauso, disco terminali basi adhærente, ad latera expansiusculo, margine tubulis minimis ornato, postice subcarinato, producto, tubulis curtis instructo; superne elongato, tortuoso, carinis obtusis quatuor longitudinalibus, ornato, margine simplice recto.*

Hab. Seas of Australia (*Mr. Strange*).

Two specimens of this curious form were collected, one attached to a stone, and the other to the valve of a *Mytilus*. They were found at Sydney, in shoal water. The fact of the tube being nothing more than the valves greatly expanded and modified, is well shown in one of the specimens.

6. Trigonia Strangei, A. Adams. *T. testa æquivalvi, inæquilaterali, subtrigona, fusca, longitudinaliter valde costata; costis antice confertis, postice magis distantibus, squamis nodiformibus, transversis, imbricatis, confertis, ornatis; interstitiis transverse crebre striatis; latere antico rotundato, postico oblique subtruncato.*

Hab. Sydney, deep water (*Mr. Strange*).

This species is larger than *T. margaritacea*, and somewhat resembles in the style of sculpture *T. uniophora*, Gray. The form of the scales on the ribs at once distinguishes it, however; the shape of the shell, especially the outline of the hind slope, is also very different.

7. Chiton insculptus, A. Adams. *C. testa oblonga, valde elevata, valvis terminalibus cæterarumque areis lateralibus radiatim costatis, costis granatis, granis transversis, subconfertis, ad marginem obsoletis; umbonibus carinatis; valva terminali antice umbonata; areis centralibus longitudinaliter valde liratis; liris obsolete rugoso-granulatis. Coccineus, areis centralibus lineis nigro-fuscis duabus ornatis; ligamento luteo-fusco fuscoque articulato squamulato, squamulis lævis, nitidis, convexis.*

Hab. New Zealand, on dead shells, deep water (*Mr. Strange*).

A beautifully sculptured species of a red colour, with two dark parallel lines down the centre of the valves.

8. Chiton muricatus, A. Adams. *C. testa oblonga, in medio valde elevata, nigro-fusco alboque variegata, valvis terminalibus cæterarumque areis lateralibus radiatim costatis; costis granis elevatis acutis ornatis; valva terminali in medio umbonata; areis centralibus longitudinaliter valde liratis, umbonibus lævibus, elevatis, subproductis; ligamento squamulato; squamulis mucronatis, imbricatis, apicibus suberectis.*

Hab. Sydney, under stones, low water (*Mr. Strange*).

This species is remarkable for the somewhat triangular imbricate scales of the ligament ending in sharp pointed mucrones; the ligament is tessellated with pale fuscous and dark brown; the ribs on the lateral areas are four, muricated with sharp granules.

9. Chiton versicolor, A. Adams. *C. testa oblongo-ovali, elevatiuscula, rufo, albo, fuscoque varie picta; valvis obtusis, in medio longitudinaliter sulcosis, umbonibus acutis subrostratis, apicibus deflexis; valva terminali in medio umbonata; ligamento tenuiter granoso-coriaceo rufo-fusco, maculis albis quinque ornato.*

Hab. Sydney, under stones, low water (*Mr. Strange*).

A prettily variegated species, with the scales on the ligament minute, imbedded and not imbricate, and the entire upper surface of the valves delicately shagreened.

ROYAL SOCIETY.

March 2, 1854.—Professor Graham, V.P., in the Chair.

1. "On the Growth of Land Shells." By E. J. Lowe, Esq., F.G.S., F.R.A.S. &c.

Perhaps the following observations on the growth of land shells may contain sufficient information to prove interesting to the Royal Society. Before describing them, however, a few introductory remarks will be necessary. Every individual experimented upon has been kept in confinement since the day it was hatched. Each species has been placed in a separate box (filled with soil to the depth of three inches), and care has been taken to feed the Mollusca every other day, the food chiefly consisting of the leaves of the lettuce and cabbage. In very dry weather the soil has been moistened with rain-water about once a week; in the box containing *Helix pomatia* small lumps of chalk have been mixed with the soil.

The species experimented upon were:—

Helix aspersa	Zonites cellarius
— caperata	— lucidus
— hispida	— nitidulus
— nemoralis	— radiatulus
— pomatia	Bulimus obscurus
— rotundata	Clausilia nigricans
— virgata	Pupa umbilicata

The facts arrived at are,—

1st. The shells of Helicidæ increase but little for a considerable period, never arriving at maturity before the animal has *once* become dormant.

2nd. Shells do not grow whilst the animal itself remains dormant.

3rd. The growth of shells is very rapid when it does take place.

4th. Most species bury themselves in the ground to increase the dimensions of their shells.

First Experiment with Helix pomatia.

A specimen of this species having deposited thirteen eggs which were hatched during the first week of August 1852, six of the young ones were deposited in a box (having a lace cover) placed in the shade. The young Helices were regularly fed every other day until the beginning of December, when they buried themselves in the soil for winter; up to this period they had gradually increased in dimensions to the size of *Helix hispida*. From December until April the soil was kept dry, the box being placed in the cellar. On the 1st of April they were replaced in the garden, the soil having previously been copiously watered. On the 3rd of April the young ones appeared on the surface, being *no larger* in size than they were in December, and although regularly fed up to the 20th of June they scarcely increased, not being perceptibly larger in size than they were in December. However, on the 20th of June five of them disappeared, having buried themselves (with the mouth of the shell *downwards*) in the soil; on the 30th of June they reappeared, having in ten days grown so rapidly as at this time to become equal in size to *Helix pisana*. They again buried themselves on the 15th of July and reappeared on the 1st of August, having again increased in size. From this date they did not apparently become any larger, and on the 2nd of November food was withheld for the winter, and at the present time (February 14th) they are in a dormant state. Probably they will arrive at maturity by July or August next. The sixth specimen did not bury itself until the 15th of August.

Second Experiment with Helix aspersa.

A pair of *Helix aspersa* having been procured in the act of copulation on the 19th of May 1852, they were placed in confinement. Each individual deposited about 70 eggs, which began to hatch on the 20th of June: these young ones grew but little during the summer. They buried themselves in the soil on the 10th of October, coming again to the surface on the 5th of April, *not having grown during the winter*. In May they buried themselves (with their *heads downwards* as with *Helix pomatia*,—in winter they and other species buried themselves with the *head upwards*), appearing again in a week *double the size*; this process was carried on at about fortnightly intervals until July the 18th, when they were almost fully grown. It is worthy of remark that this species, as well as *Helix pomatia* and *Helix nemoralis*, and probably other of the Helicæ, form an operculum at the aperture, after which they retire considerably within the shell, and form a second (much thinner), behind which they rest during the winter.

It would be swelling this paper too much to describe all the observations in full; it will perhaps therefore be considered sufficient to remark that the process of growth *within the ground* takes place with *Helix nemoralis*, *Helix virgata*, *Helix caperata*, and *Helix hispida*. *Helix rotundata* burrows into decayed wood to increase the size of its shell. *Zonites radiatulus* appears to remain on decaying blades of grass; whilst *Pupa umbilicata*, *Clausilia nigricans* and *Bulimus obscurus* bury *their heads only* to increase their shells. With respect to *Zonites cellarius*, *Zonites lucidus*, and *Zonites nitidulus*, it was not satisfactorily ascertained whether their heads were buried during the process of growth.

Observatory, Beeston, E. J. Lowe.
1854, February 14th.

BOTANICAL SOCIETY OF EDINBURGH.

April 13, 1854.—Professor Balfour, President, in the Chair.

Professor Balfour stated that Mr. Croall of Montrose, in an account of a trip to Clova, published in Hooker's Kew Miscellany, had remarked—"*Polypodium alpestre* at the head of the glen grows side by side with *Lastrea dilatata*, but I nowhere observed *Athyrium filix-fœmina* associated with, or at the same elevation as, *Polypodium alpestre*." This statement was not in accordance with what was observed by Dr. Balfour and his party during their trip to Clova at the beginning of August last. They found *Athyrium filix-fœmina* and *Polypodium alpestre* growing together both in Glen Fiadh and in Glen Dole. In many instances, it was necessary to look at the fructification in order to avoid picking the one for the other. At the head of Glen Dole, and above the path called Jock's Road, both ferns grew luxuriantly. *Polypodium alpestre* descends much lower than has been supposed. It was found at little more than 50 feet above the Dole, on the bank below the *Astragalus alpinus* cliff.

Mr. G. Lawson remarked that a statement similar to that of Mr. Croall had been made to him last summer, and he was thus led to pay particular attention to the point when he visited Clova as one of Professor Balfour's party. The statement is not correct, the *Athyrium* being a frequent associate of *Polypodium alpestre*. This circumstance, together with the variability of both plants (whose respective varieties are in some cases very similar to each other), rendered it often difficult to distinguish the one from the other, without inspecting the sori.

Mr. G. Lawson exhibited under the microscope preparations of the colouring-matters of the flower of *Strelitzia Reginæ*, and drawings of the same. This plant is interesting as presenting examples of both the xanthic and cyanic series in the same flower, but still more remarkable in the microscopical peculiarities of its colouring-matters, which are referred to by Mohl in the "Vegetable Cell" (p. 44). Mr. Lawson stated that in the blue (or purplish-blue) part of the flower, the colouring-matter entirely consists of spherical granules of an intense blue or bluish-purple colour, with occasionally cells containing similar shaped granules of bright crimson. All the granules of any one cell appear to be constantly of the same colour. In the yellow part of the flower, the colouring-matter appears in a very different form. Instead of spherical granules, we have slender filaments, which are more or less spirally twisted and rolled up in various ways in the cell, resembling in their twisting the more delicate spiral fibres in the external cells of the roots of Epiphytal orchids; but they are in many cases short, and form small round coils, giving the outline of globular bodies, which likewise, however, occasionally occur. While red and blue colouring-matters usually occur in the vegetable kingdom diffused in the cell-sap, we find them both in *Strelitzia* in a globular form. Although deceptive appearances often presented themselves, Mr. Lawson felt inclined to believe, from the examination of numerous specimens, that diffused colour did not at all occur in the flowers of *Strelitzia*. When the flower has attained its maturity, the cells are often so completely filled with the deep blue granules, that they appear as a dense mass of blue, apparently homogeneous, matter in the interior of the cell. The flower should therefore be examined in the young state, not only before it has expanded, but long before the spathe has opened to expose it to the action of the light; even then the colouring of the flower will be found to have far advanced, but the cells are not then so completely filled with the blue globular granules as to disguise their character, and are distinctly seen. The cells containing the yellow filaments are generally of larger size and more elongated in form than those containing blue or red globules.

The following papers were read:—

1. "Experiments on the Dyeing properties of the Lichens," by W. Lauder Lindsay, M.D., Assistant Physician Royal Crichton Institution, Dumfries.

The author presented to the Society the tabulated results of between 500 and 600 experiments made two or three years ago, the chief object of which was to endeavour to call attention to the fact, that we possess in our own island Lichens capable of furnishing dyes nearly, if not quite, equal in beauty to Orchil, Cudbear, and Litmus.

2. "On a species of *Potamogeton* from Lough Corrib," by Mr. J. Kirk, of Coventry. Mr. Kirk considered the Potamogeton as allied to the *P. longifolius* of 'English Botany Supplement,' and remarked:—

"My specimens differ from the plate in Eng. Bot. Sup. in having most of the leaves on long stalks, and in the absence of the apiculus. The specimen there figured was picked up floating [growing from the bottom, not loose—Ed. *Ann. Nat. Hist.*] in Lough Corrib in July 1835, by Mr. J. Ball, 'whilst sailing between Ma'am and Cong,' and given by him to Mr. Babington, and is the only specimen known to have been found in the British Islands up to September 1853. The most striking character in my specimen is the singular and prominent midrib, the central portion of which consists of three longitudinal veins or ribs running closely parallel with each other, whilst on either side are three to six ribs running closely parallel to them, but rather more distant from each other; the whole connected by transverse veins, and in the fresh state often more than one-fourth of an inch in width, appearing, until closely inspected, a compact solid midrib, on either side of which are two to five fine veins, the whole connected by numerous secondary veinlets. Some of the submerged leaves were 18 inches in length, and most beautifully pellucid, in this respect far surpassing the other British members of the genus. The floating leaves were scarcely coriaceous, linear-lanceolate or lanceolate, and occurred only in small quantities. The original specimen, in Mr. Babington's possession, exhibits traces of this peculiar midrib, which, I think, is almost sufficient to identify it with my specimen. The differences alluded to in the outset are not more than may be found between specimens of well-known species gathered in their prime, and others gathered, as in the present specimens, where decay has actually commenced—witness *P. rufescens* and *P. zosteræfolius*. In the last-named species, the early leaves are invariably apiculate, but no trace of an apiculus is to be found in those produced during or after flowering-time. Whether the plant is identical with *P. longifolius* (Gay), is a question I am not prepared to answer, but feel much disposed to doubt the latter being anything more than a name; at any rate no individual with fresh specimens of my Lough Corrib plant before him could overlook the prominent midrib (although in the dried state it is not nearly so conspicuous). Mr. Babington, from inspection of some of my dried specimens, considers it different from his original specimen on the grounds already stated, and is disposed to look upon it as perhaps the *Potamogeton sparganifolius* of Fries.

Mr. Borrer, to whom I sent recent fragments as well as dried specimens, considers it identical with the Eng. Bot. Sup. plant."

3. "On the Flowering of Plants in the Royal Botanic Garden," by Mr. M'Nab.

4. Illustrations of the application of "Nature Printing" to the copying of Botanical Specimens, by W. Lauder Lindsay, M.D.

MISCELLANEOUS.

BELLIA ARENARIA.

To the Editors of the Annals of Natural History.

8 Mulgrave Place, Plymouth, May 17, 1854.

GENTLEMEN,—In the April Number of this Journal for 1851, p. 318, there is figured and described by me an Amphipod Crustacean under the name of *Bellia arenaria.*

Finding that the same generic name has been applied to one of the *Anomoura,* it would be better perhaps, for the convenience of science, that the same name should not be repeated in one class of animals.

It is therefore proposed to call this animal for the future "*Sulcator arenarius,*" or "the Sand-ploughing Screw," the name being derived from the furrow which it makes in the wet sand when crawling; the only one of the tribe, as far as I am aware, that so progresses.

I am, Sirs, very obediently yours,
C. SPENCE BATE.

MR. BOWERBANK AND PROF. SEDGWICK.

To the Editors of the Annals of Natural History.

Queen's College, Belfast, 22nd May, 1854.

GENTLEMEN,—Mr. Bowerbank's letter, in your last Number, in reply to Professor Sedgwick's remarks on a statement printed by M. Milne-Edwards in the Palæontographical Society's volume for 1852, may be briefly answered (and I hope to his satisfaction) by my statement that *I have seen the list he enclosed* of the fossils he asked for, and *it only contained the names of the new British Oolitic corals* mentioned in my paper on Mesozoic Radiata in a former volume of the 'Annals,' *and no Palæozoic corals.* Prof. Sedgwick's statements are therefore strictly correct, and Mr. Bowerbank's surmises that he had written for both kinds, as well as any defence of Prof. Milne-Edwards founded thereon, are clearly negatived. The list is still at Cambridge.

I have the honour to remain, Gentlemen,
Your most obliged and obedient servant,
FREDERICK M'COY.

On the Habits of the Mungoos (Herpestes griseus). By Lieut. Pegus.

In this communication the author gives an account of a combat which he witnessed at Pondicherry, between a Mungoos and a Cobra (*Naia tripudians*). The snake was brought in a trap to the Travellers' Bungalow, which is enclosed by stone walls, and on being liberated and seeing the Mungoos it endeavoured to make its escape. The latter, however, attacked it immediately with much fury, and a battle ensued, which lasted about five minutes, when the snake was observed to dart upon its assailant and wound it with its fangs.

The Mungoos on this rolled over and lay for some little time as if dead, with a black foam at its mouth; it then suddenly started up and darted off into the bush. In about twenty minutes it returned, when the mouth was observed to be marked with green from some herb it had been eating. It appeared quite recovered, and immediately attacked the snake with even more fury than before. This combat lasted about six minutes, when the Mungoos got the snake by the neck, killed it, and severed its head from its body. The snake was upwards of five feet long.—*Proc. Zool. Soc.* July 27, 1852.

Viola lactea.—[*Edinb. Cat.*]

The following may be added to the list of unrecorded localities for the *Viola lactea*: Mayals Green, Gower, Glamorganshire.

Mayals, May 24th. Caroline Catherine Lucas.

On some Varieties of Land Shells from the South of France. By J. Paget.

Since my former communication* I have discovered another hairy *Helix*, which in every other respect resembles the *H. Carthusiana* of Draparnaud, or the *H. Cantiana* of English authors. I met with several specimens of this shell dead, last autumn, on some wet meadows near the Pont du Var, Nice, but did not remark any peculiarity about them. On observing however the other day a young *Helix* which I had found in some irrigated gardens near the town, and which I had taken for a young *Carthusiana*, to be thickly covered with very short hairs, I examined the adult specimens with more care, and found on each of the six I possess, portions of the hairs still remaining. I leave others to decide the value of this character in the determination of the species, but I would call the attention of English conchologists to a careful examination of their specimens of *H. Cantiana* from Cambridgeshire, in which I think it is not impossible that the same peculiarity may be observed.

Herr Adolph Schmidt inquires, in the 'Zeitschrift für Malacozoologie,' if the *H. depilata* is not hairy when young. I have *always* found it so when young, and generally more or less so when adult and *living*, but, like many other Helices, it easily loses both hairs and epidermis after the death of the animal.

Nice, May 22.

* See p. 454.

SCHÆRER'S COLLECTION OF LICHENS.

We are informed by M. Guthnick, Director of the Botanic Garden at Berne, that the private collection of Lichens belonging to the late Pastor Schærer has been sold to M. Edmund Boissier of Geneva.

He states that there still remain for sale the collections which served as the basis of Schærer's 'Lichenes Helvetici Exsiccati,' amounting to 650 species or varieties, of each one of which, with a few exceptions, there are from 10 to 50 specimens. This rich collection has been valued by Mr. Shuttleworth and himself at 1500 French francs, which he considers "*beaucoup au-dessous* de leur valeur,"—and from which sum a small abatement would be made to a purchaser. He is desirous that a number of British botanists should join together to purchase, and is open to offers.

M. Guthnick also states, that he can supply Schærer's 'Lich. Helv. Exsic.,' thirteen volumes, at 12 French francs per volume.

METEOROLOGICAL OBSERVATIONS FOR APRIL 1854.

Chiswick.—April 1, 2. Very fine. 3. Fine: clear: frosty. 4. Slight haze: cloudless: very clear. 5. Very fine. 6. Foggy: very fine. 7—9. Very fine. 10. Foggy: cold haze. 11. Hazy: fine: clear. 12. Cold haze: very dry air: partially overcast. 13. Dry haze: fine: clear. 14, 15. Very fine. 16. Quite clear: very fine: overcast. 17. Light clouds: fine: clear. 18. Slight haze: fine: very clear. 19. Slight haze: cloudless. 20. Very fine. 21. Cloudy. 22. Uniformly overcast: drizzling rain. 23. Cloudy and cold, with dry air: boisterous: very clear. 24. Cloudless: masses of white clouds formed in the forenoon: excessively dry air: very clear: severe and destructive black frost at night. 25. Light clouds: very dry air: clear. 26. Overcast. 27. Showery. 28. Cloudy and cold: very clear. 29. Rain: cloudy: clear. 30. Rain: cloudy: overcast.—The frost on the 24th was more severe than in any April for at least thirty previous years.

Mean temperature of the month	47°·53
Mean temperature of April 1853	45 ·44
Mean temperature of April for the last twenty-eight years	47 ·16
Average amount of rain in April	1·64 inch.

Boston.—April 1—7. Fine. 8. Cloudy. 9—14. Fine. 15. Cloudy. 16—20. Fine. 21. Rain A.M. 22. Rain A.M. and P.M. 23—26. Cloudy. 27. Rain A.M. and P.M., with thunder and lightning. 28. Rain A.M. 29. Cloudy: rain A.M. 30. Cloudy: rain P.M.

Sandwick Manse, Orkney.—April 1. Rain A.M.: rain, clear P.M. 2. Clear A.M.: showers P.M. 3. Showers A.M.: rain P.M. 4. Bright A.M.: cloudy P.M. 5. Showers A.M.: cloudy P.M. 6. Drizzle A.M.: clear P.M. 7. Bright A.M.: cloudy P.M. 8. Bright A.M.: showers P.M. 9. Bright A.M.: cloudy P.M. 10. Bright A.M.: showers P.M. 11. Bright A.M.: clear, aurora P.M. 12. Clear A.M. and P.M. 13. Fine A.M.: clear P.M. 14. Fine, clear A.M.: clear, aurora P.M. 15. Fog A.M.: damp P.M. 16. Cloudy A.M.: clear P.M. 17. Clear, fine A.M. and P.M. 18, 19. Clear A.M.: clear, aurora P.M. 20. Clear, fine A.M.: clear, fine, aurora P.M. 21. Clear, fine A.M.: cloudy P.M. 22. Cloudy A.M. and P.M. 23. Snow-showers A.M.: cloudy P.M. 24. Cloudy A.M.: cloudy, solar halo P.M. 25. Bright A.M.: clear P.M. 26. Damp A.M.: rain P.M. 27. Showers A.M. and P.M. 28. Snow-showers A.M. and P.M. 29. Clear A.M.: rain P.M. 30. Showers A.M.: showers, clear P.M.

Mean temperature of April for twenty-seven previous years	43°·43
Mean temperature of April 1853	44 ·49
Mean temperature of this month	44 ·68
Average quantity of rain in April for thirteen previous years	1·86 inch.

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.
1854. April.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·290	30·139	29·87	29·82	29·81	71	30	45	49	44½	sw.	wsw.	wsw.	....	....	·07
2.	30·409	30·250	30·05	30·12	30·13	62	32	46	46	38½	e.	ese.	w.	....	....	·12
3.	30·496	30·457	30·09	30·23	30·15	58	26	46·5	42½	45	n.	n.	w.	....	....	·04
4.	30·527	30·384	30·12	30·04	29·88	61	28	45·5	47½	47	w.	wnw.	sw.	....	....	·07
☽ 5.	30·371	30·342	29·95	29·98	30·14	65	27	46	44	44	sw.	w.	wsw.	....	....	·13
6.	30·441	30·308	29·99	29·78	29·98	67	28	47	48	42	w.	w.	wnw.	....	....	·06
7.	30·392	30·344	29·98	30·11	30·09	69	33	52	44	45½	w.	nw.	ssw.	....	....	·02
8.	30·229	30·058	29·85	29·86	29·72	69	29	50	48	46	s.	sw.	w.	....	....	·05
9.	30·184	30·125	29·77	30·00	30·13	65	31	49	47	46½	ne.	nnw.	wsw.	....	....	·01
10.	30·214	30·130	29·88	30·11	30·19	54	30	47	48½	46	e.	e.	w.	....	....	....
11.	30·201	30·110	29·83	30·30	30·46	64	37	46	47	38	ne.	ene.	ese.	....	....	·05
12.	30·356	30·320	30·05	30·48	30·40	60	44	47	45½	42	e.	ne.	se.	·01	....	....
○ 13.	30·346	30·250	30·07	30·40	30·34	61	26	48	50	42½	e.	e.	ese.	....	....	....
14.	30·171	30·053	29·85	30·23	30·14	66	29	49	49½	42½	e.	e.	se.	....	....	....
15.	30·027	29·990	29·70	30·09	30·17	67	26	48	49	46	ne.	n.	n.	·01	....	....
16.	30·195	30·103	29·82	30·26	30·24	64	40	47	46½	42	ne.	n.	se.	....	....	....
17.	30·234	30·206	29·94	30·22	30·21	59	32	48	51	45	e.	ene.	sse.	....	....	....
18.	30·130	30·024	29·87	30·18	30·12	67	41	47	50	45	e.	e.	se.	....	....	....
19.	29·968	29·868	29·67	30·07	30·00	77	44	52	47	44	se.	e.	se.	....	....	....
☾ 20.	29·750	29·566	29·47	29·89	29·82	75	51	55	53	46	e.	e.	calm	....	....	....
21.	29·486	29·367	29·20	29·63	29·76	70	41	51	49½	47½	s.	ene.	nne.	·01	....	....
22.	29·639	29·341	29·14	29·86	30·03	49	39	45	42½	38	n.	ne.	n.	·06	·13	....
23.	30·111	29·864	29·65	30·21	30·37	47	31	44	37½	37	ne.	ne.	n.	....	·05	·04
24.	30·416	30·299	30·00	30·39	30·39	51	18	43	43	43½	ne.	nne.	w.	....	....	....
25.	30·427	30·374	30·10	30·38	30·42	51	39	39·5	48	44½	n.	n.	w.	....	....	....
26.	30·391	30·302	30·06	30·23	29·89	56	35	50	49	46	ne.	n.	w.	....	....	....
● 27.	30·002	29·802	29·53	29·76	29·95	54	36	51·5	44	41	nw.	nw.	nnw.	·13	·02	·36
28.	29·913	29·840	29·55	29·96	29·74	53	37	42·5	39	37½	n.	n.	n.	....	·32	·03
29.	29·699	29·637	29·36	29·71	29·32	53	29	43·5	41½	37	n.	n.	s.	·04	·16	·07
30.	29·528	29·295	29·04	28·89	28·83	52	46	46	44	40½	sw.	w.	ssw.	·04	·07	·30
Mean.	30·151	30·038	29·78	30·039	30·027	61·23	33·83	47·2	46·36	43·01				0·30	0·75	1·42

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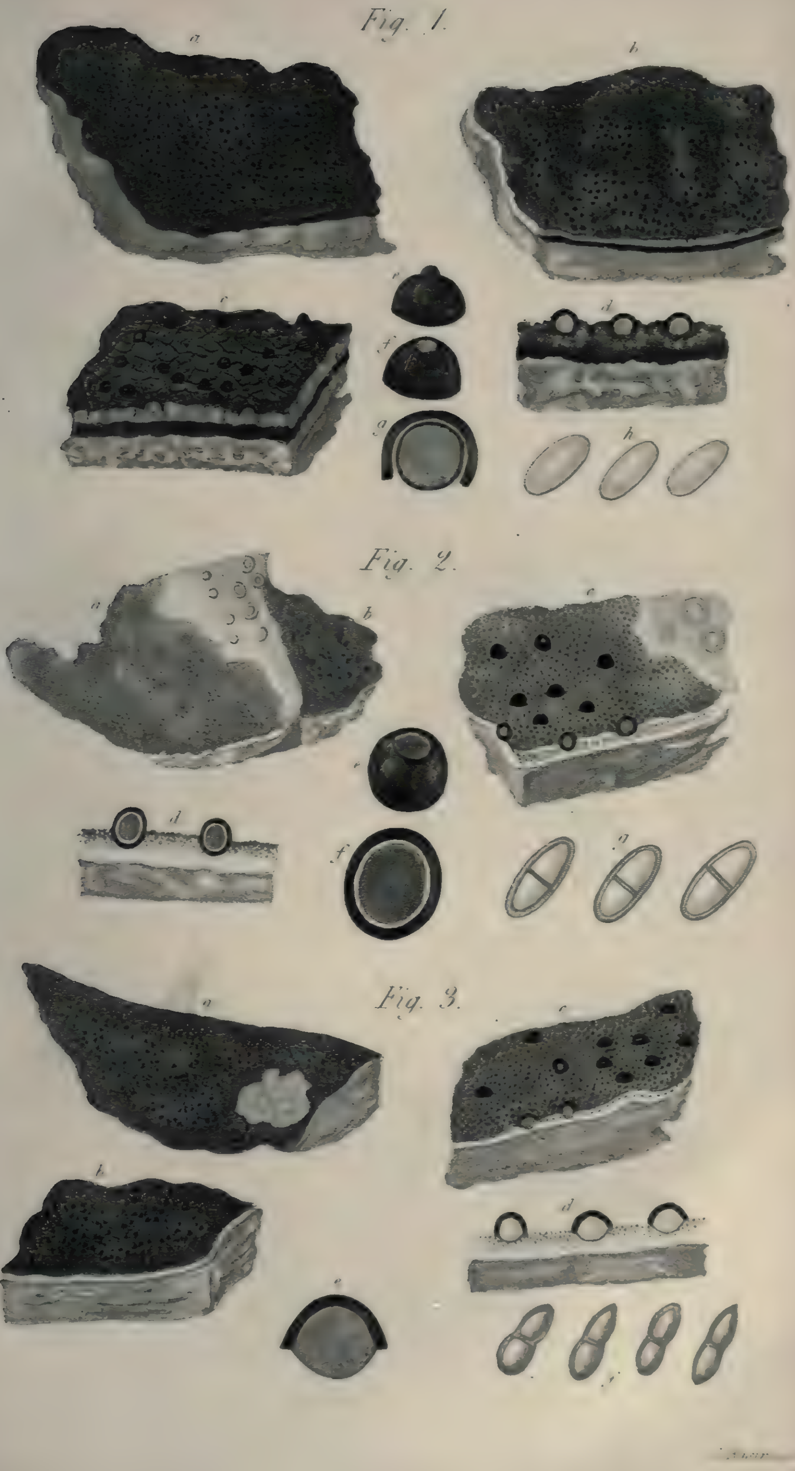
END OF THE THIRTEENTH VOLUME.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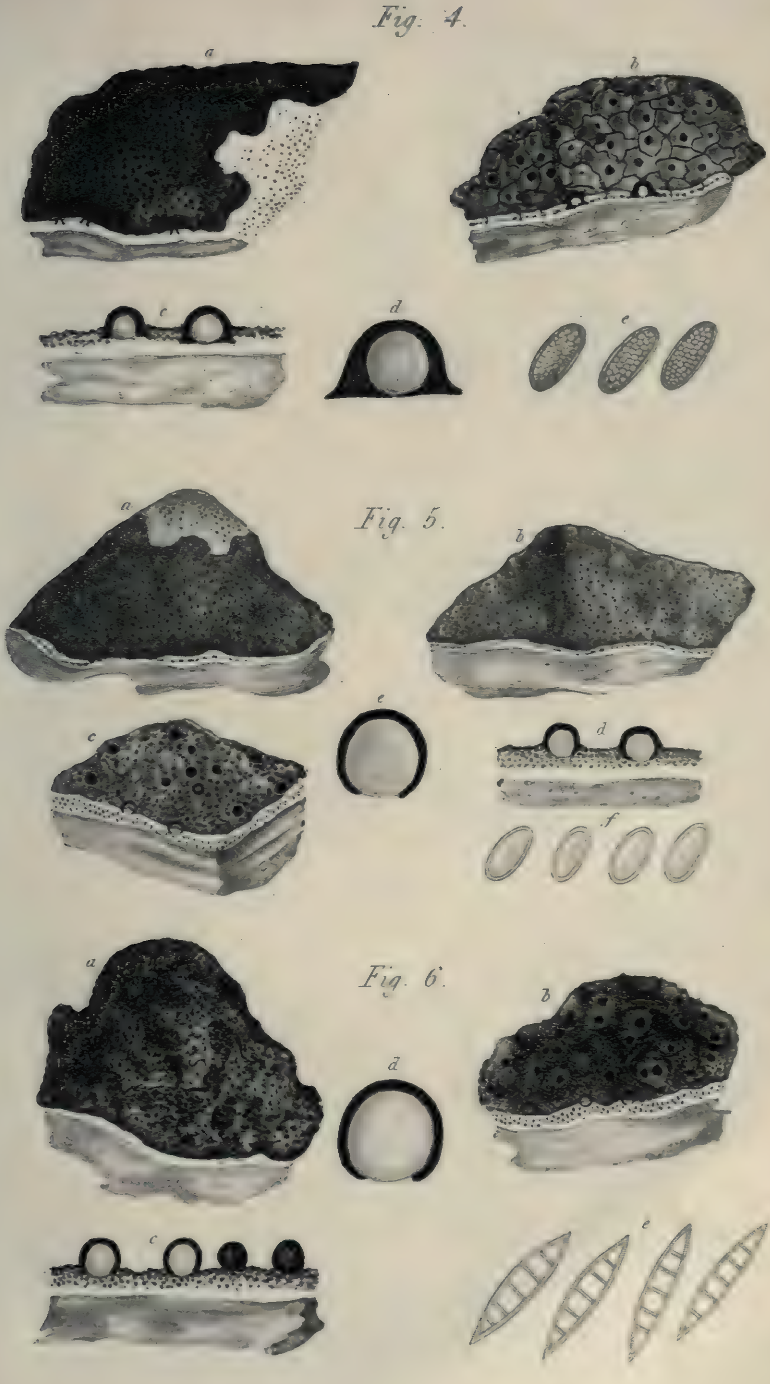
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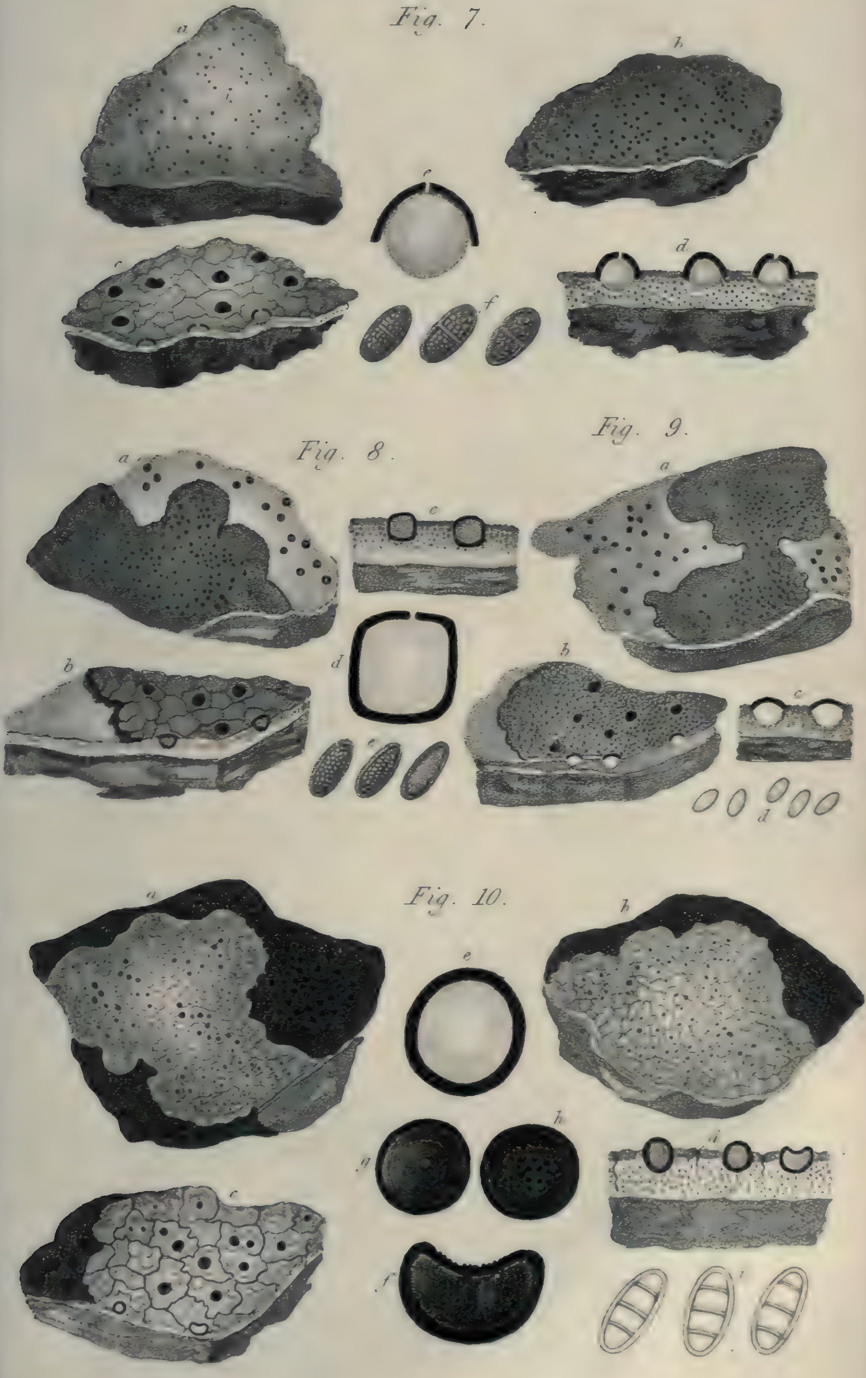
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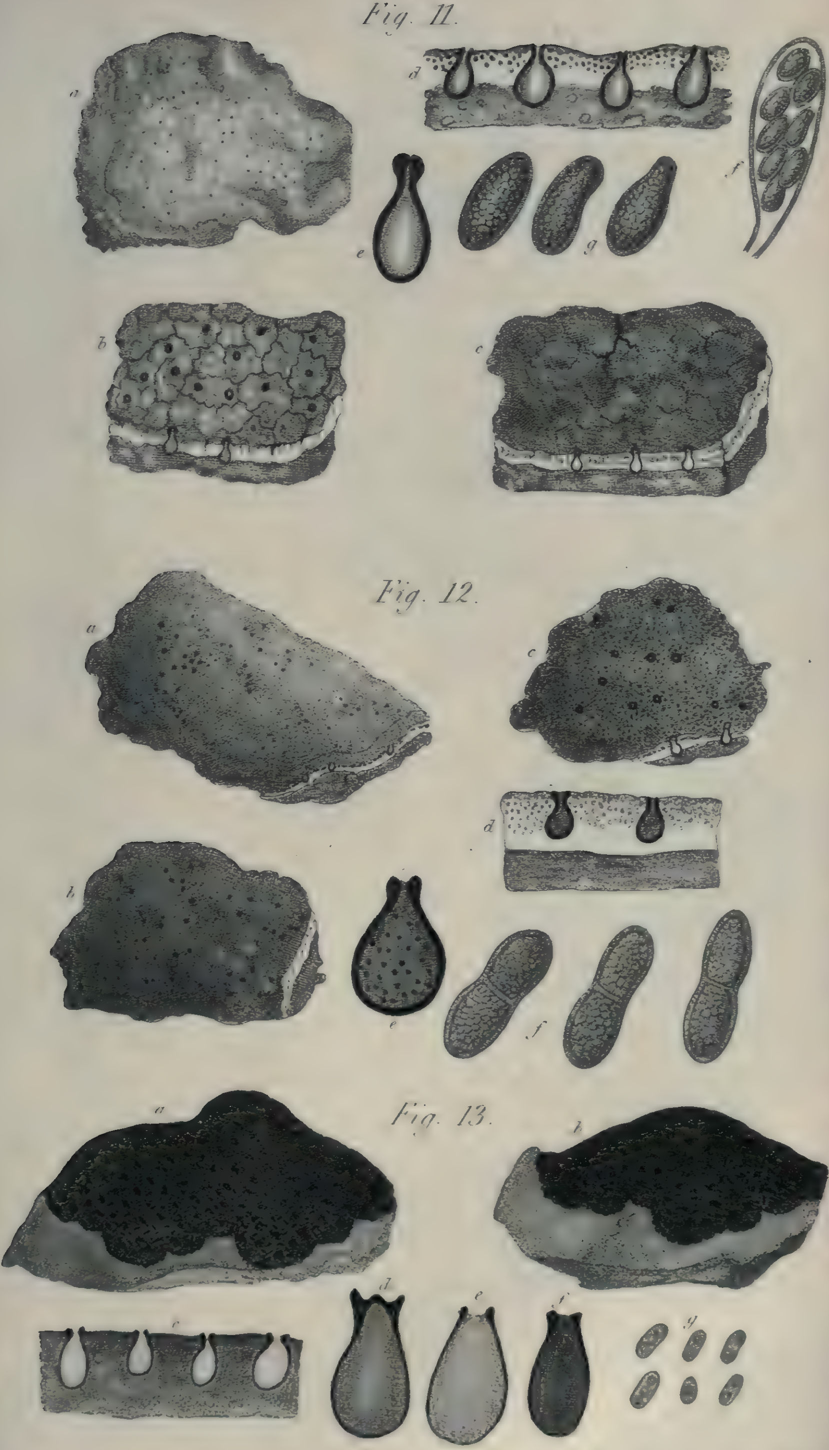
Fig. 11.
Fig. 12.
Fig. 13.

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J. Basire, Lith.

W. A. Leighton, del.

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W. A. Leighton, del.

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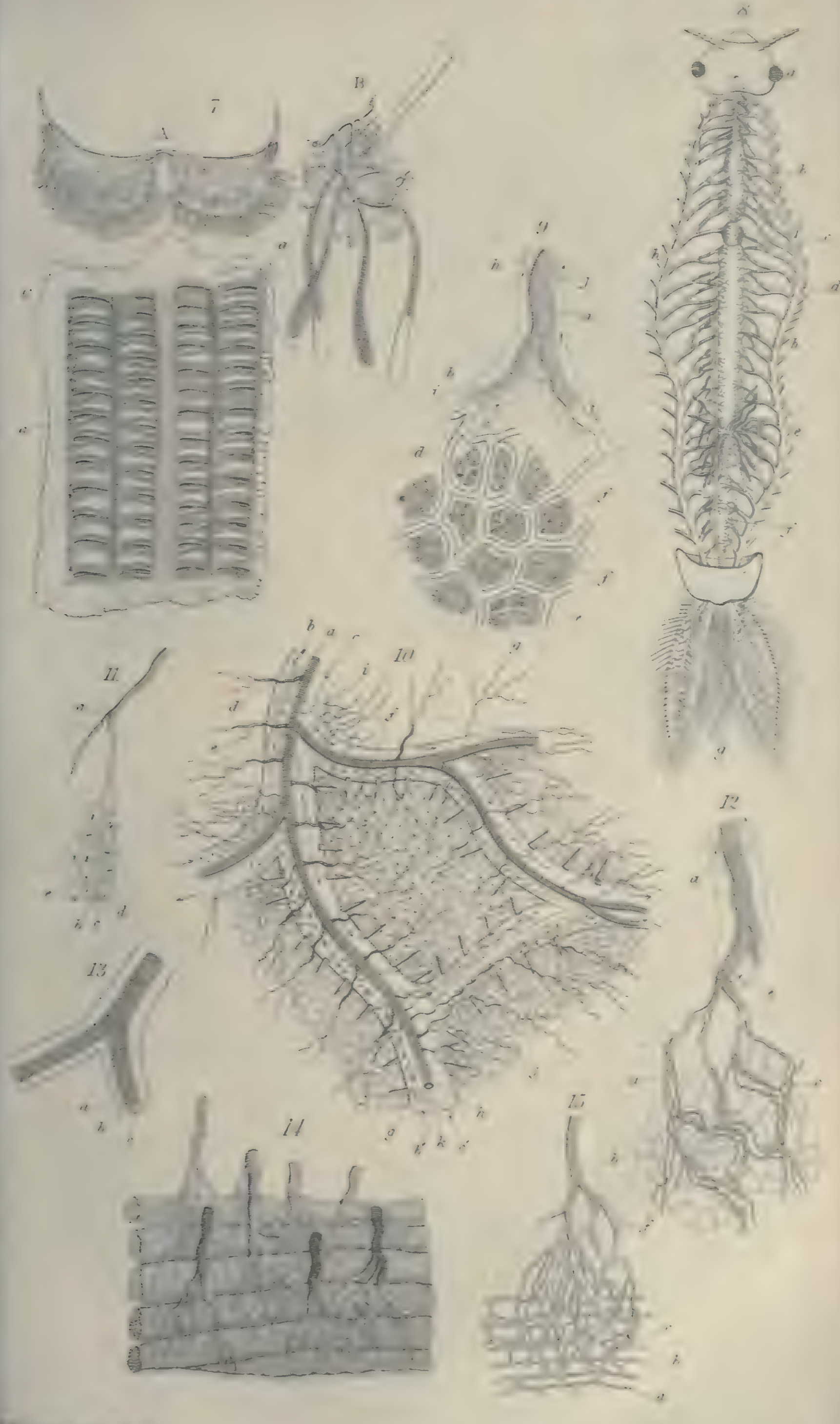
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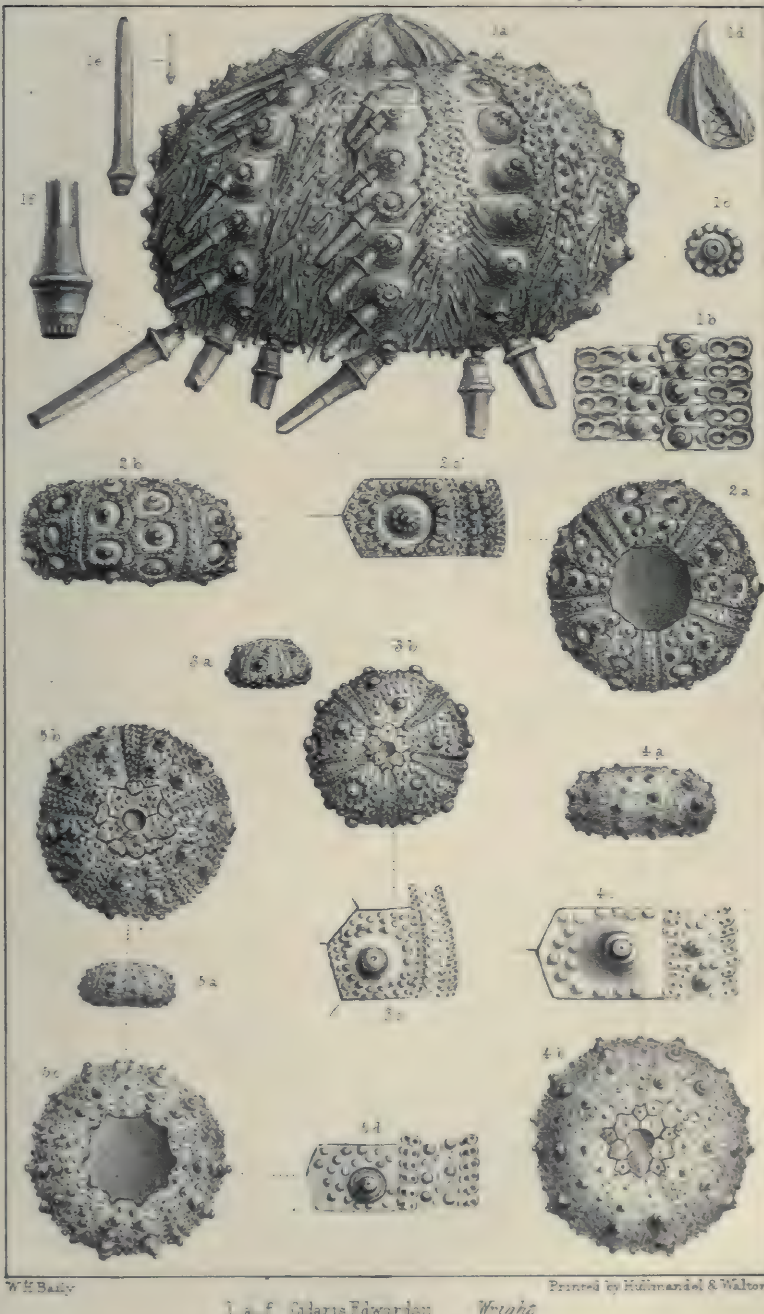

W. H. Baily

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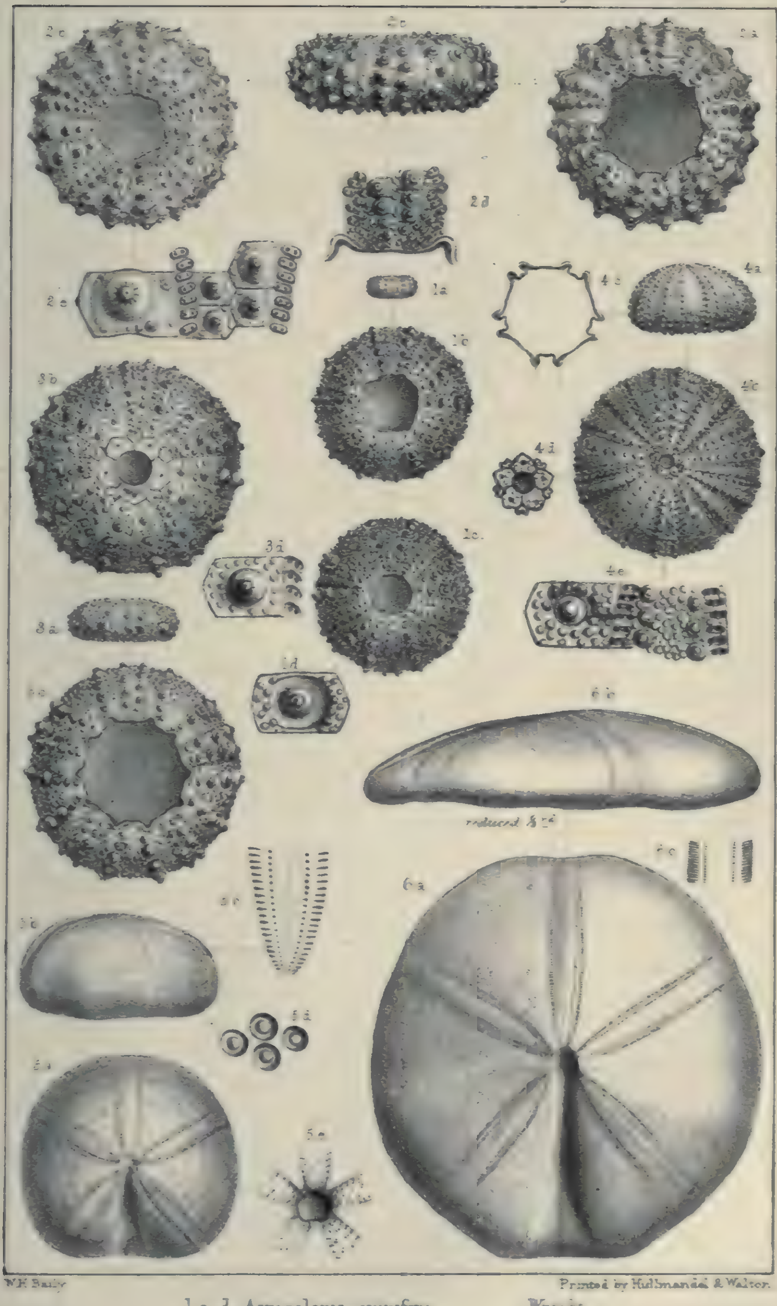
1 a–f Cidaris Edwardsii Wright
2 a–c " Bouchardii "
3 a–c Hemicidaris minor Agassiz
4 a–d Pedina Bakeri Wright
5 a–d " Etheridgii "



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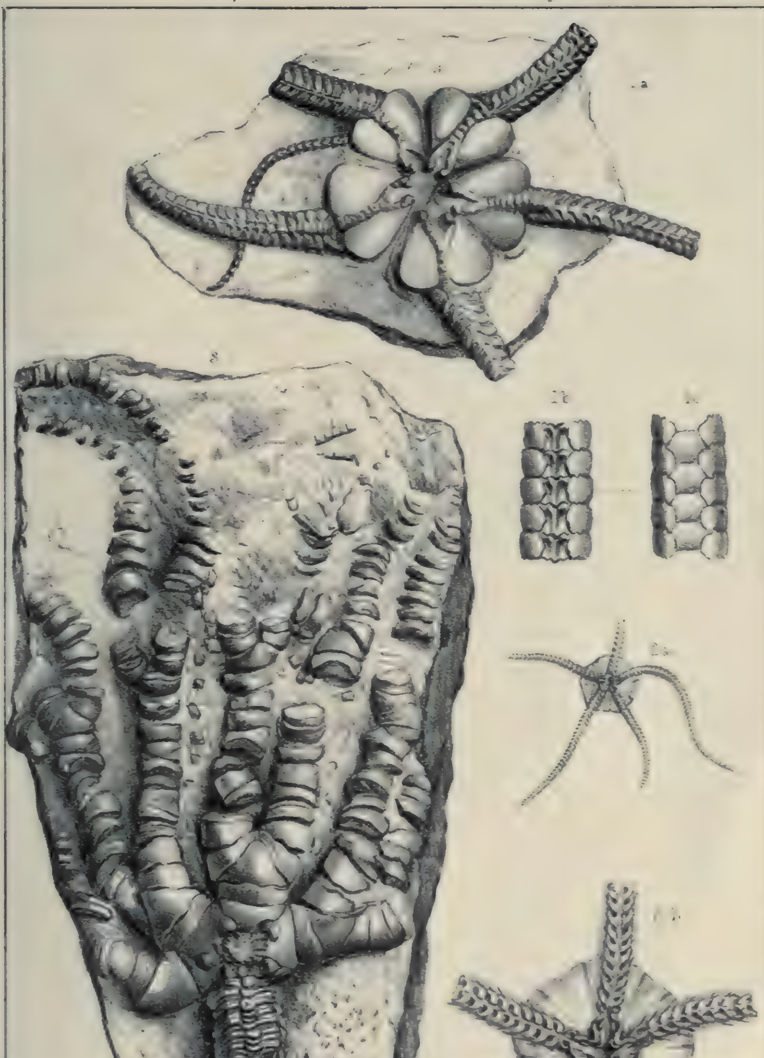
1 a–d. Acrosalenia crinifera. Wright.
2 a–e. Diadema Davidsoni. "
3 a–i. " Moorei. "
4 a–e. Polycyphus Deslongchampsii. "
5 a–e. Nucleolites Woodwardii. "
6 a–c. " Michelini. "



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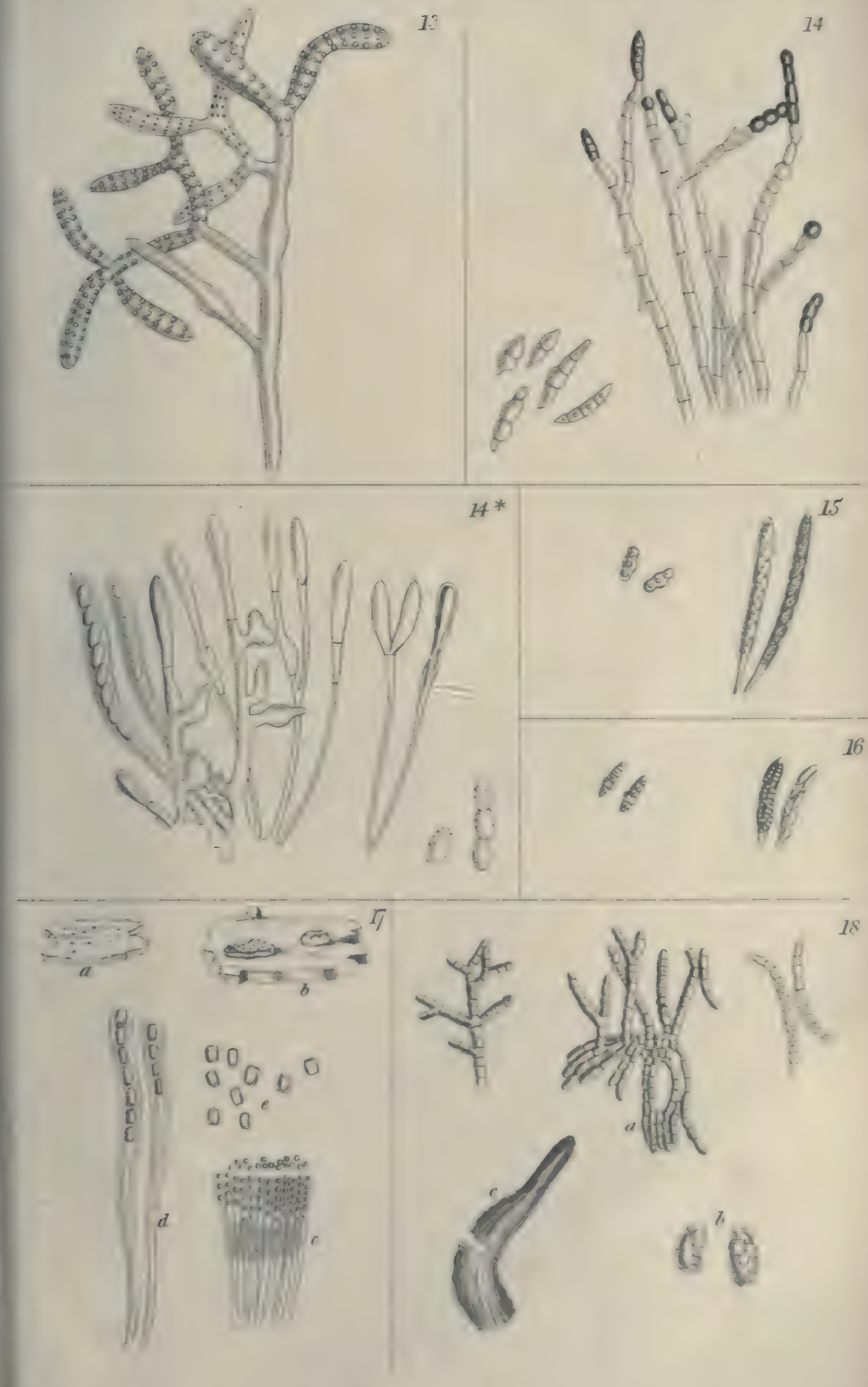
1 a–c. Ophioderma Gaveyi Wright
2. a. b. „ Griesbachii „
3. Pentacrinus Goldfussi „

J. De C. Sowerby sc.

MJB del.

J De C Sowerby sc.

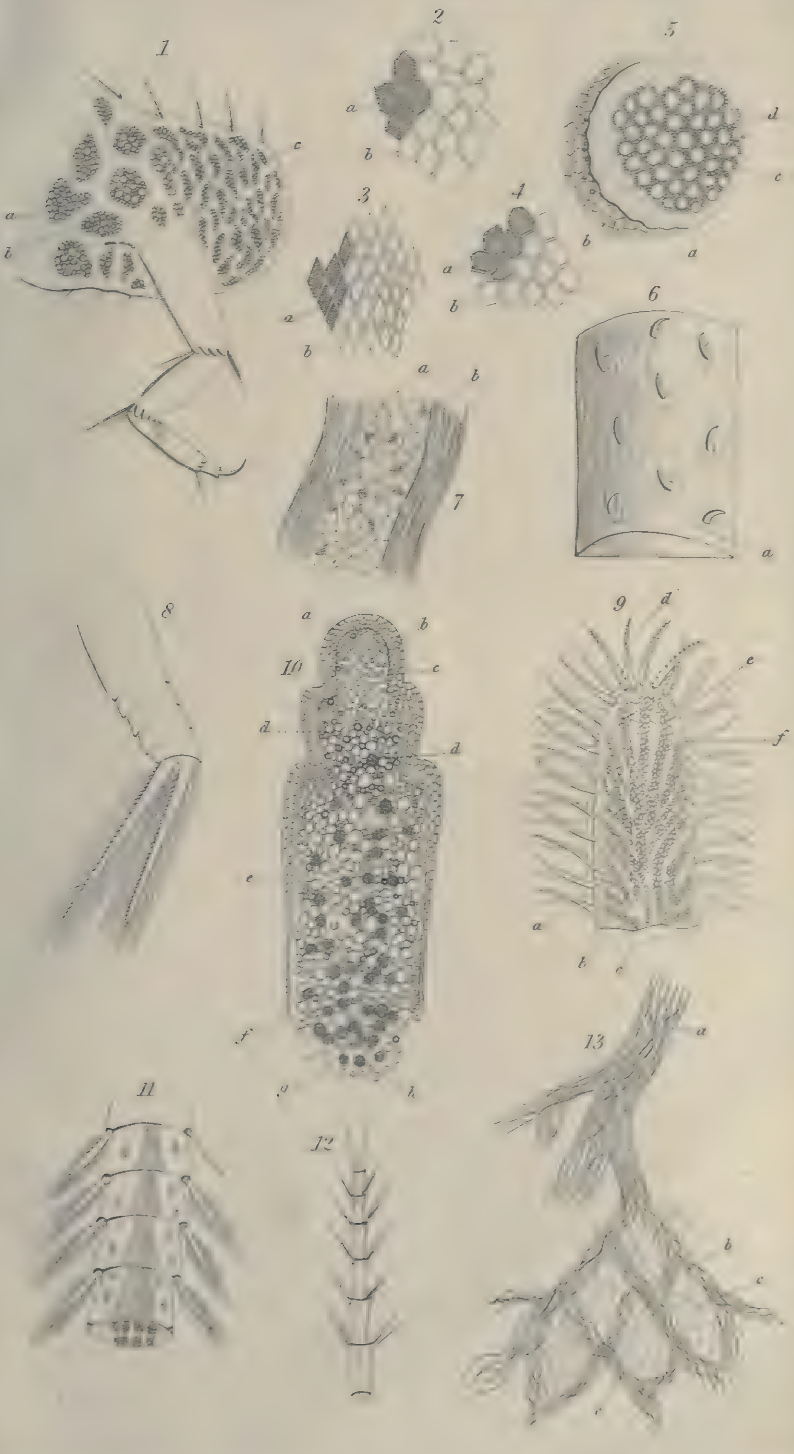


C.J.B. delt

J. De C. Sowerby sc.

T. Williams, del. ad nat.

J. Basire sc.



T. Williams jr. ad nat.

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