THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

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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. 91. JULY 1855.

I.—*Observations on the Development of Gonidia* (?) *from the Cell-contents of the* Characeæ, *and on the Circulation of the Mucus-substance of the Cell; with a Postscript.* By H. J. CARTER, Esq., Assistant Surgeon H.C.S., Bombay.

THE following is a short summary of observations on the cell-contents of the Characeæ made in the island of Bombay during the last eight months, and which want of time only now prevents me from communicating in a more extended and complete form. All physiologists are acquainted with the development of the spiral filaments in the *globule* and a new plant from the *nucule*, but the passage of the cell-contents into gonidia in this family of the Algæ does not seem to have met with description; nor has, I think, the circulatory movement been satisfactorily explained.

Before, however, proceeding to the detail of these phænomena, it is desirable to refresh the memory of the reader with a description of the recent cell of the Characeæ in which the circulation is going on, and for this purpose I shall take an internode of *Nitella*, as at once furnishing the simplest and largest type of the cell throughout the family*.

* The species of *Nitella* which I have used for my observations is a delicate, slender plant with long internodes and umbelliferous verticils, the

The internode of *Nitella* consists of—1st, the *cell-wall*; 2nd, the *green layer*; 3rd, the *mucus-layer*; and 4th, the *axial fluid*, to each of which parts separately let us now direct our attention.

Cell-wall.—This, in the internode, is cylindrical, more or less convex at each end, transparent, and resistent like all other cellulose membranes of the same kind.

Green layer.—In contact with the inner surface of the cell-wall is a layer of green bodies, which, being more or less discoidal, we shall call "green disks." These disks, which are slightly separated from each other, are arranged up and down the internode in parallel lines, and the layer which they thus form is divided into two equal parts by two transparent linear intervals, which, for reasons that will appear hereafter, have been aptly termed by Slack the "lines of repose." Neither these lines, nor the lines of green disks which are parallel to them, are exactly parallel with the longitudinal axis of the internode, but twisted round it in a semispiral form, so that by transmitted light the two white intervals, which are on opposite sides of the internode, present the appearance of a cross with acute angles, which angles vary in their degree with the length of the internode.

The green disk, which is more or less elliptical and compressed, is composed of a vesicle of chlorophyll in which are three or more granules of compressed, circular or elliptical form, each of which is also, apparently, in a distinct vesicle of chlorophyll, and the whole thus grouped together form a green body which is attached to, or imbedded in, the cell-wall of a third vesicle. At least, this appears to be the typical form of the "green disk," though its component parts are not always distinctly individualized; and a vesicle with a nucleus, such as I have described, may frequently be seen among the cell-contents of the internode when the latter has been evacuated, whilst the divisions of the green disk with a granule in each, as well as faint lines between them, indicative of each being surrounded by a transparent vesicle, may often be seen while the disk is *in situ*. Thus, the green layer is composed of a number of vesicles set together in linear arrangement, to each of which is appended the green disk mentioned. The average size of the green disk

latter consisting of sixteen to twenty branches, alternately long and short. The long branches are thrice divided, and the last division in all terminated by a spine. The organs of fructification, which are cast together in the axils of the verticil or separately in the centres of the umbels of the branches, are, with the terminal divisions of the latter, too small to be seen distinctly by the unassisted eye. It grows here and there in the muddy tanks of the island of Bombay all the year round, and from the slime and foreign matter which collects about it, looks not unlike toad's spawn. Its chief character, when cleansed of this, is its delicate, slender, umbelliferous aspect.

in the species of *Nitella* on which I have been making observations, is 1–4300th of an inch in diameter. Iodine with and without sulphuric acid gives it a dark brown-red colour, but does not turn it or its contents blue.

Mucus-layer.—Immediately within the green layer is a granular, colourless mucus, which is unequally and unevenly spread over the surface, so that it presents a wavy line towards the axial fluid. The unevenness of the inner surface of this mucus arises from partial aggregations of its substance, which are most prominent and accumulated midway between the lines of repose. One of these aggregations is generally larger than the rest, and this in the spiniform cells which terminate the branchlets and in the early state of the internode itself contains the cytoblast, which with its accompanying mucus also at this early period lines the inside of the cell; so that the whole of the granular mucus-layer and its contents, which afterwards form such a large portion of the internode, is developed from this cytoblast, and should be regarded as merely an increase in quantity of the original protoplasm or primordial utricle of Mohl.

We have now to direct our attention to the contents of the granular mucus, which, when one extremity of the internode is truncated by a sharp cutting instrument, under water, rushes out partly in a loose amorphous form, and partly enclosed in vesicles of variable dimensions, the largest of which are sometimes nearly as wide as the internode. Both the amorphous masses and vesicles are again charged with vesicles of different sizes, circular disks containing a finely granulated substance, subreniform or round starch-globules, and a number of irregularly-shaped bodies of different sizes, but of which none exceed the 1500th part of an inch in diameter.

The most striking of these contents are the circular disks, which, from their defined outline and uniform size and appearance, are easily distinguished from any of the other bodies. They average about the 2150th part of an inch in diameter, and appear to be filled with a minutely granular mucus of a very faint yellow colour, which, a certain time after the disk has been exposed to the water, contracts into an elliptical form, and thus shows that it is enclosed within a capsule, from which it is also distinct. These disks may be seen in considerable numbers loose or imbedded in the amorphous masses of mucus, or in that filling the large vesicles, or in variable plurality in transparent globular vesicles otherwise empty; lastly, they may be seen fixed singly to, or in the wall of a vesicle, which appears to be their normal appendage, and though this vesicle is sometimes hardly distinguishable, it is at others five or six times the diameter of the disk. Iodine colours the nucleus of a deep brown amber colour, but leaves the capsule and globular cell unaffected.

Many globular vesicles of different sizes, which appear to be entirely empty, are also to be observed, and here and there a solitary starch-globule.

But the composition of the irregular bodies, which appear to vary in size from a minute granule to the largest starch-globule, is not so evident. These bodies, which have a faint yellow opake colour, and apparently granular structure, are like the circular disks loosely scattered through the mucus, or enclosed in plurality within transparent globular vesicles otherwise empty, or attached to or imbedded singly, in the wall of one of these cells, which also seems to be *their* normal appendage. In *Chara verticillata* (Roxb.) these bodies in the early part of their growth are club-shaped, after which the large end appears to expand into an irregular, globular or agariciform head, to which the small end then forms a kind of pedicel, and thus they are also found within vesicles. At first these irregular bodies look very much like starch-granules, and particularly the agariciform ones, from the eccentric lines on their surface; but iodine, even when assisted by sulphuric acid, only turns them of a deep brown amber colour like that which it produces in the nucleus of the disk; sometimes it seems to have little or no effect upon them. They differ from the circular disk in the extreme irregularity of their form, their apparent want of capsule, greater thickness, deeper yellow colour, greater opacity, and in their apparent origin from granules infinitely smaller than the circular disks.

Axial fluid.—This, as before stated, fills the centre of the internode; it is of an aqueous consistence, colourless, and frequently contains bunches of acicular raphides (oxalate of lime ?), starch-globules, and many of the faint yellow irregular bodies just mentioned, all of which, except the raphides, appear to have accidentally dropt into it from the mucus-layer.

Thus we have the internode of *Nitella* complete, and we have only to conceive the mucus-layer moving round the axial fluid and propelling it and its particles in the same direction (by the projections on its surface), to obtain a true idea of the motion which takes place within the cell of the Characeæ.

Let us now follow the passage of the cell-contents into gonidia.

All are aware, that in the freshwater Algæ commonly called Confervæ, the formation of the spore is preceded by a breaking up or displacement of the cell-contents, after which a condensation and re-arrangement of them takes place, and they are then invested with a capsule which remains entire, until the time arrives for the spore thus formed to germinate. Now, under certain circumstances, which appear to be the approaching dissolution or death of the cell-wall, a similar process takes place in the cells of the Characeæ, and following this from the beginning, we find, that it first commences with a cessation of the circulation, after which the lines of green disks forming the green layer become displaced, and, as if obeying a still continued but inappreciable movement of the mucus-layer, they roll themselves up into lines which assume a more or less irregular arrangement *across* the internode, or into groups of different sizes, more or less connected by narrow lines of mucus and single disks, so as to present an areolar structure in contact with the inner surface of the cell-wall. The next stage is the separation of the disks into still more distinct groups, which, having become more circumscribed and circular, leave the cell-wall and evince a certain amount of polymorphism and locomotion. The cavity of the internode, hitherto rendered turbid by the breaking up of the green layer, now clears off and becomes transparent, save where the circular masses, which have changed from their original green into a brownish-green yellow colour, intercept the light. After a day or two,—but the time seems to vary,—the green disks become entirely brown, and the group, assuming a more circumscribed and circular form, shows that it is surrounded by a transparent globular cell; this we shall henceforth call the gonidial cell. A new substance, consisting of a bluish semitransparent mucus, more or less charged with minute granules (from which its colour appears to be derived), and refractive globules of a faint yellowish-green and sapphire-blue colour, makes its appearance in different parts of the brown mass, or to one side of it, and afterwards, becoming botryoidal or mulberry-shaped, separates into gonidia. The brown chlorophyll with the other effete contents then shrinks up into a structureless, homogeneous, more or less defined, circular nucleus, of a dark brown colour, and the cell, frequently projecting on one side in a conical form, bursts at the apex and gives exit to the gonidia.

The gonidia are globular, ovate or spindle-shaped, and of a light blue colour. They average 1–4300th of an inch in diameter, and contain, together with the blue substance mentioned, more or less also of the refractive globules, and a transparent vesicle. Each gonidium is provided with one or two cilia according to its form, that is to say, the globular ones present one and the spindle-shaped two, which may be perceived while they are yet grouped or separate in the transparent gonidial cell, where they already exhibit a certain amount of polymorphism. Shortly after they have become free in the internode, the wall of the latter gives way and they pass into the water, where, for a certain time, they remain so active, that it is almost impossible to describe their form; but here and there, that which I have stated may be seen in those which are less active in their movements than the rest.

There are, however, certain peculiarities about the elongated and spindle-shaped gonidia which it is desirable to notice, viz. that one cilium appears longer than the other, and that while the short one floats almost motionless backwards, so as to appear as if it proceeded from the posterior extremity, the latter, for the most part, keeps up a constant whipping-movement in front which frequently renders it imperceptible. Both cilia however appear to be of the same length, if we add the length of the gonidium to the one which floats behind, and which is concealed in the first part of its course by lying in contact with or underneath the body of the gonidium; both also appear to be occasionally brought together anteriorly. There is also frequently a kind of proboscis extended from the rostrum or beak of the gonidium which moves incessantly, both in the ovate and spindle-shaped forms, and seems to have a suctorial extremity by means of which it fixes the gonidium to the glass, while the floating cilium also appears to be provided with a similar power and to exert it for detaching the gonidium, when so fixed, by pulling it backwards, which it does with a peculiar jerk; when this little proboscis has been present, I do not think I have ever observed the anterior or active cilium.

After a while, perhaps some hours, the gonidia become stationary, and while they appear to be fixed by the proboscis mentioned, the long cilium floats motionless, or presents a languid kind of whip-like undulation; the latter then disappears, and a day or two after, the gonidia both small and great, for there are many sizes, as will presently be mentioned, are seen creeping about the watch-glass (into which they were transferred for observation) under as active polymorphism as any amœbous cell could present; diffluent, digitated, and in the form of that beautifully radiated figure called *Actinophrys Sol* (Ehr.). They also now present the "contracting vesicle," as well as other vesicles, which do not appear to alter their dimensions, but vary, like the former, in distinctness with their change of position and the varying form of the gonidium. After a few days' existence in this state their polymorphism becomes very sluggish, they remain for some time under a slowly changing rhizopodous figure, which is more or less common to all, and then disappear.

Whether they germinate or not, I have not been able to determine.

Lastly, a development of transparent mucus which becomes filled with vibrios and *Bacterium termo* (Dujar.), immediately follows the elimination of the gonidia both in the gonidial cell and in the internode, presenting itself in a mass or branched organized form, more particularly at those parts of the latter which have become ruptured. This also disappears after a few days, and a thorough dissolution of the internode and its original contents seems thus to be completed.

We have now then seen that a breaking up or displacement of the green layer, a grouping of its green disks, the investment of the groups with a mucus-covering, their complete separation, their endowment with a certain amount of polymorphism and locomotion, the turning brown of the chlorophyll, and the passage of the investing mucus into a globular transparent cell, precede the evolution of the gonidial substance and its subsequent self-division into gonidia; let us now see if there be anything else within the gonidial cell during the time this process is going on.

It will be remembered, that a great number of discoidal bodies exist in the mucus-layer of the internode, and that many of these are loose, while others are fixed singly in the wall of a transparent vesicle; now (apparently under an arrest of development), a gonidial cell frequently presents itself, in which a single disk, with or without its vesicles, precisely similar to one of these, is seen within or to one side of the brown chlorophyll, surrounded by a shrivelled, crenulated membrane, appearing, from its irregular mulberry-like surface, want of motion, dingy colour, and absence of refractive granules, as if it were the remains of the gonidial substance which had perished from some cause or other just before it began to separate into gonidia. Moreover, in many of the disks, the nucleus is not only seen to be separated from its capsule by an annular interspace, but its granules have become larger and more distinct, and an irregular cavity like a contracted vesicle appears to exist in its centre. When the circular disk is enclosed within the brown matter, it may be rendered more evident by the addition of alcohol, which extracts the colouring matter completely, while the application of iodine deepens the colour of the brown matter, and gives a dark brown tint only to the nucleus of the disk.

That the gonidial cells should contain a nucleus within the brown matter is easily conceived, for on truncating a young internode, sometimes, in the way which I have mentioned, particularly where the green layer is soft and previously disturbed, the whole of the contents rush out together, and all the vesicles, both large and small, become surrounded with green disks, which, under these circumstances, present a similar appearance to that which is witnessed in the internode when the green layer has been broken up and its green disks separated into groups, preparatory to the development of the gonidia.

But many of the gonidial cells are too small to contain the circular disk, and we have still to account for the disappearance of the irregular bodies of a faint yellow colour and granular structure, which appear to form a much larger proportion of the cell-contents than the circular disks.

As the smallest of the gonidial cells, which may appear in the internode, is but a very little larger than the single gonidium which it contains, and others are sometimes present which may contain fifty or more, it is obvious, that although the latter may also contain a circular disk, there is no room for it in the former. Nevertheless, the small gonidial cells containing one, two, and three gonidia, as they vary in size from the 4300th to the 2150th of an inch in diameter, are provided with a body precisely similar to the irregular ones mentioned, which is not in the interior, but attached to or imbedded in their cell-wall, and with the latter seems to comprise all the elements of which the small gonidial cells are composed. In this way then we can account for the disappearance of the irregular bodies.

It is also not unusual to see in the older internodes, when their contents are passing into gonidial cells, a few of the green disks *in situ*, as well as loose in the cavity, and their disappearance also calls for explanation, which would be difficult, if we did not frequently see some of them actually *in situ*, under the form of gonidia, among the other green disks which have not passed into this state or departed from their original linear arrangement. Whether the gonidium has here taken the place of the green disk, or whether it has been developed in its transparent vesicle, I have not been able to determine; but in an old internode, where the basal structure of the green layer has become more or less hardened, the remains of the transparent vesicles may occasionally be seen in their original position, while the green disks have disappeared. In the fan-shaped groups of cells too, which form part of the capsule of the globule, the red granules, which are equivalent to the green disks, may frequently be seen attached, like the irregular bodies, singly or in groups, to the periphery of small gonidial cells which contain one or more gonidia. This appears to be invariably the case at the dehiscence of the *globule*, while the absence of circulation in these cells from the commencement would indicate a corresponding scarcity of the mucus-layer and its contents. With the exception of the central cavities of the *globule* and *nucule*, I have not seen any kind of cell in the species of *Chara* and *Nitella*, which I have had under observation, that has not produced gonidia.

Lastly, we have to account for the genuine starch-globules and raphides, both of which may be seen lying among the gonidial cells; but in no instance have I seen the former *in* the gonidial cell, or been able to produce a blue colour in the nucleus of the latter by the application of iodine.

Thus we have followed the contents of the internode of *Nitella* from the breaking up of the green layer to the development of the gonidia. Let us now direct our attention to the different parts of the gonidial cell analytically, more however with the object of adding to rather than recapitulating what has already been stated respecting it.

We have seen that the mucus-investment, which appears to be derived from the mucus-layer, gives the cell the power, not only of limited polymorphism, but also of locomotion; in addition to this also, the cell possesses for some time the power of projecting thread-like filaments of extreme tenuity from its surface that adhere to neighbouring objects, and thus form a *point d'appui* towards which the cell can then move itself. Subsequently, however, these processes, apparently following the same law of development as the cell, become stiff, and then stand out like short, straight hairs, more or less thinly scattered over its circumference, and resembling a parasitic growth,—which some might consider them, as they do not appear on all the cells, but my impression is that they are what I have stated. I have also seen, now and then, a small gonidial cell in which the hardening process appeared not to be about to take place, but, from the rhizopodous prolongations of a part of its periphery, and its containing nothing besides the gonidial substance, presenting rather the appearance of a polymorphic spore about to germinate than to pass into a fixed cell. Occasionally the gonidial cell, after it has become stiff and transparent, presents itself under a lenticular form; at others, as if a notch had been cut in it, and sometimes with a plane surface, &c., but all these irregularities appear to be caused by objects against which the cell rests while passing from its flexible into its hardened cellulose state. Iodine alone does not appear to impart any colour to the gonidial cell.

Immediately within the transparent globular cell is a layer of brown matter, which, as before shown, is composed of the green disks in which the chlorophyll has thus become changed in colour. This layer is also globular, and encloses the circular disk alone or with its vesicle. It often presents a botryoidal surface, which appears to be occasioned by the presence of the gonidia inside or in the midst of its substance; when the gonidia have been developed, this as well as its granular contents disappear, leaving a homogeneous, brown substance, which shrinks up into a more or less defined nucleus of a much darker colour. The brown matter is deepened in colour by the addition of iodine, and extracted by that of alcohol. In the small gonidial cells there appears to be no brown matter, but from the red granules, which are the equivalents of the green disks in the fan-shaped group of cells forming part of the capsule of the *globule*, being attached singly or in groups to their periphery, it may reasonably be inferred that this is the position of the so-called brown matter in them.

After a certain time, the gonidial substance with its bright refractive granules makes its appearance in different parts of the brown matter, as if it were rising out of it, and then to one side in a distinct mass which acquires a mulberry-form and separates into gonidia; or the gonidia may be fully developed inside or in the midst of the brown matter before they make their appearance. The gonidial substance has already been described, as well as the bright refractive globules, which do not alter in colour by contact with iodine. Making its appearance then in this way, it is not extraordinary that the gonidia, in addition to their own peculiar blue-coloured mucus, which colour, as before stated, appears to depend on its granular contents, should, for the most part, also contain more or less of the refractive globules, and occasionally a fragment of the brown matter, which is the case.

I have already described the commonest form of gonidium, but there is still another about twice the size, viz. 2150th of an inch in diameter, which although not so frequent, is nevertheless sufficiently so to show, that there are two sizes more common than the rest; for we shall presently see, that the gonidial substance may occasionally come out as a whole, or in gonidia of all sizes below its original bulk. This large gonidium generally presents itself under a circular or globular form, with a single cilium, but it is sometimes seen ovate or spindle-shaped like the smaller one. It must be obvious to all, that a polymorphic cell, such as the gonidium is, can have no constant figure while in a state of activity; hence at one time it may be of one shape, and at another of another; but when under polymorphism and the cilium has disappeared, a group of gonidia will evince a strong tendency to assume the same kind of figure generally, whatever that may be. Thus, just after they become stationary, the form of *Actinophrys Sol* seems to prevail; then the digitated form for progression; then the diffluent form, which appears to be produced by the more internal protoplasm bursting through that which is becoming hardened on the surface; and lastly, the tardy, rhizopodous form which I have mentioned; but I will not vouch for this sequence, and only instance it for example.

I have already alluded to the variety in size of the gonidia, but this is an exception to the general rule, for the smallest gonidial cell, in which only one gonidium is developed, yields a gonidium equal in size to the one first mentioned. It may however yield a smaller one, and occasionally, in the same mulberry-group, may be seen gonidia of different sizes; again, sometimes a whole group is composed of the same-sized gonidia, which are not more than half the size of the common form, that is 1–8600th of an inch in diameter; while occasionally a large mass is seen creeping about which seems equal in size to the whole of the gonidial substance of a large gonidial cell. Sometimes a compound mass of gonidia, composed of three or more which appear to have flowed into each other, may be seen, with their cilia projecting from different parts of the circumference.

I have already alluded also to the variable contents of the gonidia. In addition to the dull, bluish-green mucus, they also frequently contain more or less of the bright refractive globules, which, when the latter are beneath or in the midst of the mucus, may be mistaken for the transparent vesicles which I shall presently mention.

The gonidium may also contain more or less of the brown matter, and occasionally, when it is unusually large and of a Florence-flask shape, with the vesicle in front and a fragment of brown matter of a bright colour present, it is hardly distinguishable from *Astasia.*

Lastly, we come to the vesicles which are seen in the gonidium. While the gonidium retains its cilium and swimming motion, the vesicle is for the most part single, and though changeable in position with the movements of the cell-wall of the gonidium, does not appear to be endowed with contractility *per se*; but when it loses its cilium and sinks down to the reptant, polymorphic state, the vesicle becomes distinctly contractile, and the gonidium is then hardly distinguishable from the young *Amœba* or sponge-cell. Frequently in this state also it presents one or more hyaline vesicles which are not contractile, and only change their position with those parts of the gonidium to which they may be attached.

We now come to the nucleus of the gonidial cell, and of this I can state little more than has already been given. It is evident, that although the larger ones contain a nucleus, the smaller ones do not, unless the irregular body fixed to their periphery is to be considered its equivalent. I have mentioned that the nucleus of the large cells appears to be the circular disk of the mucus-layer, and that the latter is sometimes with and sometimes without its vesicle; also that frequently, under an arrest of development, it is surrounded by a crenulated membrane. The fine granules of which the central part is composed, appear also on these occasions to have become larger and more evident, and in one instance they were replaced by three or four large globules of a faint yellow colour, as if they had run together. In the larger gonidial cells, where a set of healthy gonidia of normal size have been developed, the nucleus shrinks up with the effete brown matter into a common, homogeneous-looking mass, from which it is then undistinguishable.

General Observations.

Having now described the gonidial cell synthetically and analytically, let us for a few moments direct our attention to the offices of the several elements of which it is composed.

The gonidial cell, originally a portion of the mucus-layer endowed with the power of motion, at first appears to gather up a number of the green disks and wrap them round the nucleus; after which it becomes separated from the contents which it has thus enclosed, and passes into a firm, transparent membrane of a globular form, which serves to isolate and protect the materials from which the gonidia are to be developed. Lastly, it frequently assumes a conical form, which bursts at the apex and then gives exit to its gonidia. Whether the bursting is an act of its own, or induced by the distension of the mucus before mentioned, which becomes developed in it immediately after the evolution of the gonidia, and subsequently throughout the internode, I have not been able to determine; but the mucus in question is frequently seen protruding from the ruptured parts of the cell in an organized, transparent, fungoid mass, or in a branched form, as if it had caused the rupture.

This mucus appears to me worthy of notice, from its great resemblance, under the organized forms mentioned, to the gonidial substance. When within the gonidial cells and in the internode, it swarms with vibrios; but when liberated, the vibrios, after moving about for some time in the water, settle down into a form like *Bacterium termo*. When in the massive or branched form mentioned, bright, refractive, blue-green granules are scattered through it, and there appears to be an abortive attempt at a cellular division of the mass generally. Can this be the remnants of germinating matter which are left about the gonidial cells and the internode?

The power of the green disks, as well as the irregular bodies of the mucus-layer, to produce gonidia, is incontestable, for we have seen gonidia developed in cells where nothing else but the green disk or the irregular body was present.

What is the office then of the circular disk?

This I can only suggest from inference. It is perfectly evident that there are corpuscles in the *nucule* besides the starch-globules, which corpuscles resist the blue colouring action of iodine, and it seems equally so, that there are only these two kinds of bodies in the *nucule*; again, these corpuscles very closely resemble in colour, and in not becoming blue by contact with iodine, the irregular bodies contained in the mucus-layer of the internode, while they bear in other respects also a strong analogy to them. Lastly, we now know, that a gonidial cell having one of these irregular bodies for its nucleus or peripheral appendage can develope a gonidium. Thus then, if the irregular bodies and the corpuscles be identical, we have the germs of gonidial substance and starch-globules as the contents of the *nucule*, the latter being designed for the nourishment of the former. May not the circular disk contain nutriment for the gonidia?—while the irregular bodies would seem to be identical with the green disks, and are indeed, in many instances, almost undistinguishable from them, even when both are present among the contents of the evacuated internode.

Thus we see a great resemblance between the formation of the gonidia and the germinating of the *nucule*, and in the formation of both with that of the "resting spore" of Algæ generally.

As yet, I have never seen a new plant developed from the gonidium of *Nitella*, nor have I ever been able to identify their germination with that of germinating cells, which I have frequently seen on the surface of an internode containing the gonidia; neither did Pringsheim see those germinate which came from *Spirogyra*, in which he has carefully described the same kind of gonidial development as that which takes place in *Nitella**. But Braun, who has followed the development of gonidia in *Hydrodictyon* †, states, that the larger gonidia (for there are two distinct sets, which he calls macrogonidia and microgonidia) germinate, that is, form the young water-net, while the smaller ones never do this, but unite into groups, forming a homogeneous green mass, which becomes covered with a distinct cell-membrane. This very much resembles the fungoid growth at the ruptures of and about the internode which follows the disappearance of the gonidia of *Nitella*, and which I have suggested might be the last efforts to form and to increase of the remnants of gonidial substance left in the gonidial cell and about the internode. Be this as it may, the dividing up of a body formed after the manner of a resting spore into smaller ones, resembling gonidia, which afterwards germinate, is the

* "On the Germination of Resting Spores and one form of Moving Spores in *Spirogyra*." Ann. and Mag. of Nat. Hist. vol. xi. p. 210, 1853.

† Pub. of Ray Society, Botan. and Phys. Mem., Phænom. of Rejuvenescence in Nature. Transl. by Henfrey, p. 261.

normal process of reproduction in *Achlya prolifera**, as well as in *Cladophora glomerata*†, &c.; and therefore it seems not impossible that, under certain circumstances, the gonidia of *Nitella* might produce a new plant; but this has not yet been proved; neither have we, I think, an instance on record of the resting spore, which commonly developes a new filament, dividing upon some occasions into small spores, which can also each produce a new filament. Although Agardh‡ saw the resting spore of *Spirogyra* divide up into small spores, while he was endeavouring to see the single filament developed from it which Vaucher had described, he does not state whether or not these sporules germinated. One difference between the resting spore and the gonidia is, that in the former the process of development is very slow, and in the latter very fast; hence it may be that the resting spore is only resolved into gonidia when it does not "go its full time," so to write, and therefore produces an abortive progeny; while in *Achlya prolifera*, where the spore does not wait until the next season for development, this is the normal process, and each small spore produces a new individual.

Since writing the above, I have been able to confirm some more observations which I had made some months since respecting another kind of passage of the cell-contents of *Nitella* into ciliated sacs, viz.—

About three weeks after gathering plants of *Nitella* and placing them in a basin of water, the green layer of the long slender internodes becomes separated from the cell-wall, and gathered up into dark, spherical bodies, averaging about the 100th part of an inch in diameter, or large enough to be seen by the unassisted eye.

These at first move up and down the internode with the rapidity of animalcules, but afterwards lose this power of locomotion and become stationary. They then present, under the microscope, the appearance of resting spores; that is to say, they consist of a dark green, globular, grumous mass, invested with a transparent spherical cell. This green mass, in all that I have examined, has been in an active state of rotation, first one way and then the other, by means of short cilia which covered its surface, like those on the spore of *Vaucheria Ungeri*§. On being crushed between two pieces of glass, this mass was found to consist chiefly of pellets of different sizes, of a deep green colour (formed of groups of green disks, respectively surrounded

* Thuret, Ann. des Sc. Nat. 3e Ser. t. 14. pl. 16, Botan.
† Unger, idem, 2e Ser. t. ii. p. 1, Botan.
‡ Ann. des Sc. Nat. 2e Ser. vi. 197.
§ Thuret, Ann. des Sc. Nat. 2e Ser. t. xix. p. 266, Botan.

by a mucus-investment), together with a few of the common-sized gonidia, some gonidial substance, and a great number of the bright refractive globules before mentioned. Iodine gave the green pellets a deep brown colour, but did not alter in appearance the rest of the contents.

Two days after I had collected a number of these globular bodies and placed them in a watch-glass for observation, partly in and partly out of their respective internodes, the green mass in many had become divided up into four or more sacs, which were ciliated like the parent one, and enclosed in a *second* transparent spherical cell. These also rotated individually and *en masse,* while the division appeared to have enabled them to throw off the greater portion of the dark green pellets, now become black, and lying loosely in a more or less flocculent state, like effete matter, in the inner cell.

The third day the spherical cells had burst, and the ciliated sacs, which averaged 1-430th of an inch in diameter, were set free in the water.

They now presented different appearances, according to their contents, shape and motions. All were filled with a colourless, granular mucus, charged with small vesicles, and each presented also a large "contracting vesicle." In some there was left only a trace of the dark matter, while in others there was a considerable quantity, either in an undefined shape, or in small globules. They presented both an undulatory motion of the cell-wall, and a ciliary motion of its surface. Sometimes the cilia were motionless, and lay like a halo of short radii round its circumference, though the sac was otherwise gradually changing its shape; while at others there was no appearance of cilia at all. On the other hand, sometimes the sac was rotating rapidly under a globular form, with its wall undulating and cilia playing over it with corresponding activity; the rotation of the sac appeared contrary to the movement of the cilia. Occasionally a sac might be seen under an elongated, oblong form, with a slowly undulatory change of shape at one end, and a languid movement of the cilia on its surface generally; again it might be seen with mucus-radii spread out in the same way as those of *Actinophrys Sol.*

It would, however, be endless to describe the forms which these sacs presented; but it is worthy of remark, that instead of being like those of the *Amœba,* they so closely resembled the order of one-celled ciliated animalcules, many of which were present in their largest forms, that, had it not been for the dark matter mentioned, I should have frequently been unable to determine the difference; and I cannot help thinking it probable, that many of these *quasi* animalcules have their origin in a similar way, and either germinate after having become stationary, or pass after a short time into dissolution, as the sacs have hitherto done which I have just described.

I had forgotten also to mention, that there is frequently a considerable space between the outer and inner spherical cell just described; and here, before the green mass has undergone division, may frequently be seen one or more of the common-sized gonidia, under their ciliated active form; which, after the division has taken place, passes into the diffluent one, when they may be seen, on the contrary, creeping slowly over the inner surface of the external spherical cell, in a polymorphic state.

The tenacity to life of the green matter and mucus-layer after the death of the cell-wall is so great in the species of *Zygnema*, to which I shall have occasion to allude presently, that although all the filaments broke down from the destruction and dissolution of the cell-wall a few days after they had been placed in a basin of water for examination, the mucus-layer continued to hold the spiral bands together, with but little alteration, except in form and position, for three weeks afterwards, when the whole began to break up into small parcels of green matter, of variable sizes, below the 700th part of an inch in diameter, each of which is now rounded with a mucus-investment that is carrying them about under the form of *Actinophrys Sol*; but with a halo of short cilia in many, immediately round the circumference, in addition to the long radii. Whether they will ultimately germinate, or their contents—now of a bright yellowish-green, but still presenting a tint of brown in it—pass into gonidia, time will show; but from the brownish tint, I should think the latter the most likely sequence.

Circulation.

What is commonly understood by the "circulation in the Characeæ," is, that the cell-contents move round the internode; but this is a very vague idea of the phænomenon. There is but one part that moves, viz. the mucus-layer; and another part which is circulated, namely the axial fluid; while the green layer, so long as it is uninjured, remains stationary.

The axial fluid, as before stated, is impelled by the uneven surface of the mucus-layer, as may be seen by watching the motion of a bunch of the raphides when struck by one of the mucus-prominences. It will then present not only an acceleration of its progress, but, the force having been communicated to the radiated crystals next the mucus-layer, causes it to rotate backwards, or in the contrary direction to that in which it is being transported. Hence, as I have before stated that the aggregations are most prominent midway between the lines of repose, so the greatest impetus is given to the axial fluid and its suspended bodies in this part, while at the sides, that is, close to the lines of repose, it is remarkably slow. This was the reason why Slack* thus designated them; but he was wrong when he conceived that the dark defined surface of the mucus-layer was a membrane which was fixed to these lines throughout their course, and therefore divided the ascending from the descending current, inasmuch as the opposite currents, which are closely approximated at these parts of the internode, frequently take from each other the particles which are lingering along their direction, and thus whirl them backwards and forwards, or up and down, according to the position of the internode, until, by chance, they get into a more powerful part of the stream, and are then carried round the internode with the rest,—which would not be the case if a partition existed along the lines of repose.

Easy, however, as it is to describe the way in which the axial fluid is circulated, it is not so easy to describe the property by which the mucus-layer travels round the internode.

That Amici and Dutrochet should have ever considered the green disks instrumental in any way in effecting this in the internode of the stem, shows that neither of them recollected at this time, that the mucus-layer moves round the internode of the roots of the Characeæ in just the same manner, where there are no green disks present; while the total absence, or rare occurrence, of gonidial cells in the internodes of the roots of Characeæ, we now know to be an additional reason for inferring the absence also of the green disks there, even if they were present without their green colour to make them more visible.

That the green disk is occasionally seen to move *per se*, and to rotate actively *in situ*, has been observed by others as well as myself†; and the observations of Donné, confirmed by Dutrochet‡, prove, that under certain circumstances, viz. when in a globule of the mucus-layer, they will rotate also out of the internode; but these are exceptions to the general rule. Again, out of many scores of observations, I have seen only two instances in which the green disk (in an old internode, where most of the contents had passed into gonidial cells) presented each a cilium; also, on one other occasion, three green disks *in situ*, in an internode where the circulation was going on rapidly, presented each a short thick cilium in active motion; but these,

* Trans. Soc. of Arts, vol. xlix. pt. 1, 1833.

† Varley, Trans. Soc. of Arts, vol. xlix. pt. 2, 1833.

‡ Ann. des Sc. Nat. 2e Ser. t. x. 1838.

again, may be conceived, from what I have stated, to be very rare occurrences, and, as such, are only worth remembering. The only change in the green disk which is frequently observed, is its transition from its common elliptical to a circular form, which generally accompanies a cessation of the circulation; but not always, for the former is sometimes seen when the circulation has been permanently arrested, and the latter when it is going on with great activity.

The contraction, however, of the green layer as a whole, when the internode sustains even a slight injury, is worthy of notice. The same thing takes place in *Zygnema* (*nitidum*, mihi). On one occasion, when testing the evacuated contents of a truncated internode with tincture of iodine, I observed a fragment of the green layer, which was projecting from the orifice of the internode, to tremble rapidly when the iodine touched it; this motion, after a few seconds, became rhythmical, and then slower and slower, until it altogether ceased; thus exhibiting the same kind of convulsive motions as muscular fibre under similar circumstances. When one end of an internode is truncated with a sharp instrument, as before stated, the whole of the loose contents rush out, while the green layer remains within the internode, but retracted both from the orifice and sides of the cell-wall; and it is this contraction which appears to be the principal agency in causing the rapid expulsion of the mucus-layer, which I may here mention is every now and then drawn back into the internode spasmodically, from a contraction, apparently, of its own substance, and perhaps a momentary relaxation of the green layer at the same time. In what part of the green layer this contractile power resides, I am not able to state; but as the green disks are appended to vesicles which thus make up the green layer, and the irregular bodies of the mucus layer, which appear to be almost identical with them, have also an appended vesicle, which, a certain time after they have been exposed to the water, contracts to such an extent as to become undistinguishable from the irregular body itself, it may be the contraction of the vesicles of the green disks which produces the general contraction of the green layer.

Be this as it may, the movement which is the chief object of our consideration here is that of the mucus-layer. It has already been shown, that this is independent of the green layer; and this, combined with the power of polymorphism and locomotive agency which it presents when investing the groups of green disks preparatory to passing into the firm gonidial cell-wall, seems conclusive of its possessing an inherent power of mobility independent of any other influence, so long as it remains unaltered, and within an uninjured internode. The movement of rotation may appear both peculiar and unaccountable; but that of the sponge-cell, when under progression, particularly in an elongated form, is identical with it. If we watch the latter, we shall see the granules that are attached to the upper part of the cell move rapidly forwards until they arrive at the advancing boundary, where they sink down, become stationary, and remain there until the rest of the cell has passed over them, when they again ascend from behind, and again are carried on to the anterior border; and so on, as the cell progresses, after the manner of a flexible wheel. Thus the mucus-layer in the internode of *Nitella* rolls round an imaginary oblong axial plane, whose edges correspond with the lines of repose, where, as a matter of course, there is a long linear eddy, in which the mucus is almost stationary, as well as the axial fluid and its particles immediately beneath.

Were any further proof wanted of the independent contraction or movement of the mucus-layer, that might be cited which I have mentioned when endeavouring to account for the contractility of the green layer; but, in addition to this, I have seen the mucus-layer in an internode of the root of *Chara verticillata*, when the rotatory movement has been returning after having been arrested, stretch itself directly *across* the internode, from one part where it had become aggregated into a large mass. The jerking movements which are seen in this mucus after it has been allowed to escape from the internode in the way mentioned, seem to be owing to the successive bursting of the vesicles with which it is filled; but its diminution in bulk is indicative of something more than common contractility. Lastly, in the cells of the species of *Zygnema* mentioned, there is not only a ceaseless irritable contractility exhibited in the mucus-layer next the cell-wall, but also throughout the mucus-threads suspending the cytoblast; and although this motion is not rotatory, which indeed it could hardly be, with the cytoblast so suspended, yet here and there, and particularly against the septa at the extremities of the cell, aggregations of granular mucus, enclosing one or more faint yellow-coloured bodies, like that of the cytoblast, frequently present themselves, which are as unceasingly active in their polymorphism (stretching out their processes here and there) as any portions of *Spongilla* or *Amœba* that the eye meets with.

I have since seen in the youngest, or terminal cell of a filament of introverted *Zygnema* with single spiral band, a distinct but very irregular travelling up and down of the mucus-layer, exactly like that of the Characeæ. It can only be seen in the long delicate young cell, where the spiral band is stretched out, and where the minute granules of the mucus are congregated to such an extent as to indicate the presence of the moving transparent protoplasm.

Thus the phænomenon of motion in *Zygnema*, in *Spongilla*, and in the Characeæ being exhibited by the same kind of substance, in organisms so nearly allied, and in instances where there is evidently no direct connexion between it and the parent plant, leads me to view it in all as modifications of one common property, and that property a vital endowment of the same nature as contractility or power of motion generally throughout the animal kingdom.

Bombay, January 1855.

Postscript.—Since this paper was written, I have taken a different view of the nature of the so-called "gonidia" in it, viz. that they may be Infusoria, perhaps of the family *Astasiæa* (Ehr.), and that the "ciliated sacs" may have had a similar origin.

Contrary to what Pringsheim has stated (Ann. and Mag. Nat. Hist. vol. xi. 1853, p. 294 *et seq.*) respecting the integrity of the cells of *Spirogyra*, wherein he witnessed a similar process of development of gonidia to that which I have described above in *Nitella*, viz. that a supposition of such gonidia being "foreign structures, not belonging to the *Spirogyra*, would be an altogether inadmissible hypothesis, *since they are formed in the interior of the closed filament-cells of the* Spirogyræ, *directly from their contents*," &c.;—contrary also to what I have myself stated above respecting the formation of the same kind of gonidia in the cells of *Nitella*, and where I might have also added that the cell-wall did not show any signs of decay or unsoundness until the "gonidia" were developed in the one instance, and the "ciliated sacs" in the other;—I have nevertheless, from recent observations, been induced to doubt the correctness of this view.

While examining some filaments of *Conferva* in which the cells had become divided into resting spores, I perceived that one of the capsules was so far empty, that it contained nothing but a single large *Astasia*, which was filled with the chlorophyll and other granules of the spore, part of which had turned brown; and although the capsule of the spore was fresh and the vaginal sheath of the filament unruptured, there was a small round hole in one part passing through both that was not more than the 1–4300th of an inch in diameter, and about which the *Astasia* was lingering for the purpose of making its exit, but having gorged the whole of the contents of the spore, this was of course impossible.

Here then was an infusorium with a transparent flask-shaped sac terminated by a long cilium, distended by the granular contents of the spore, and so incarcerated, that it must either die in the spore-capsule or pass into an ovarian sac and develope its progeny much in the same manner as we have seen the "gonidial cells" in the internode of *Nitella*. At all events, the hole by which the *Astasia* entered was visible, and from its minuteness indicated a very minute size of the *Astasia* originally compared with that which it presented when I saw it.

Again, from Stein's valuable observations on the development of *Vorticellæ* (Ann. and Mag. Nat. Hist. vol. ix. 1852, p. 471), and latterly my own observations on this family, I can easily conceive, from the extreme minuteness with which the germs might leave the ovary of *Vorticella*, their rapid development under favourable circumstances, and their multiplication by fissiparation and gemmation, even when barely changed from their larval or infant, monadic form, how accidental holes may exist in the internode of *Nitella*, or in the cell of *Spirogyra*, *Cladophora*, or any other filamentous or thalloid Algæ, large enough to admit such germs and gemmæ, and yet pass unnoticed by the microscopist, though not by the voracious young of Infusoria.

Whenever a cell in the filamentous Algæ shows by derangement of the granular chlorophyll or gonimic contents that its functions have ceased or become interrupted, several gonidia similar to those developed in the cells of *Nitella* may be seen swimming about it and trying to get into it, which they do immediately the cell-wall gives way, and then fixing on its mucus-contents devour them.

All this seems to point out that the so-called gonidial development within the cells of *Nitella* is anything but spontaneous, while it favours the view which I have now taken, that it is infusorial.

But as we see the fragments of the contracted chlorophyll-bands of *Spirogyra* retaining their freshness and greenness while wrapped in their mucus, for weeks after the cell-wall has passed into dissolution, a question may suggest itself, whether the contents of a resting spore when quickly swallowed by an infusorium which dies soon afterwards, might not germinate to a certain extent, under such circumstances—the sac of the infusorium supplying the place of the capsule of the spore. If so, indeed, then an infusorium would *after this manner* appear to develope a plant. On the other hand, if the chlorophyll turns brown, that may be considered a sign of the death of the spore-contents; and if anything arise out of this, it must be viewed as the progeny of the infusorium, such as the so-called "gonidia" appear to be which I had described above as developed from the cell-contents of the Characeæ.

This "postscript" will not invalidate the facts in my paper, although it may affect the reasoning, from tending to change our view of the nature of the "gonidium" so called therein, and make it an infusorium instead of a zoospore, of which much more might be said in support if this were the place for it; and although one of the facts brought forward in proof of the independent movement of the mucus, was the polymorphism and locomotion of the gonidial cells which it was supposed to have composed, there are sufficient reasons left for my still retaining the opinion, that its contractility is not the effect of any chemical process of nutrition that is going on in the cell, though it may not be uninfluential as a physical agent in this process.

II.—*Descriptions of the Animals of certain Genera of Conchifera.* By S. P. Woodward, Esq., F.G.S.

My dear Sir,

I herewith send you some more figures of the animals of certain genera of Bivalve shells (*Conchifera*), which Mr. Woodward has made for me, and the notes he has appended to them.

These animals have been shortly noticed by me in my paper on the Arrangement of Bivalves in the 'Annals,' vol. xiv. p. 21.

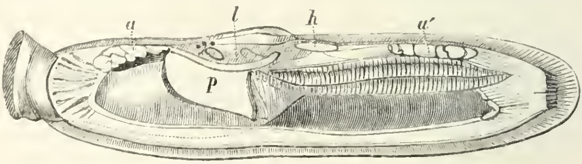
I am, my dear Sir, yours truly,

J. E. Gray.

Dr. Francis.

Solen (*Cultellus* ?) *Javanicus*. Singapore.

Mantle-lobes united, covered with wrinkled epidermis; *siphons* very short, fringed; no ventral orifice; *pedal* opening terminal. *Foot* straight, compressed, truncated, attached by small suspen-



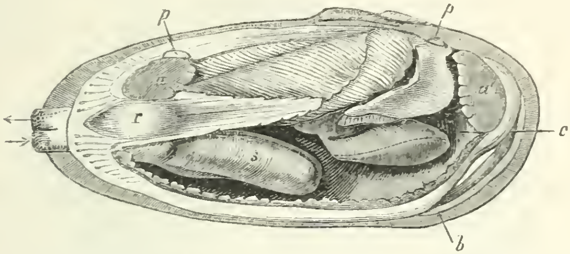
a, *a*′, adductor muscles; *l*, liver; *h*, heart; *p*, palpi.

sors—two beneath the hinge, and two in front of posterior adductor. *Palpi* very large, oblong, pointed, attached lengthwise. *Gills* long, narrow, equal, plaited transversely. A long curved portion of the intestine lies close to the left side, bordering the palpi.

[This is a species of the genus *Pharus*.—J. E. G.]

Glauconome rugosa. Philippines.

Mantle-margins plain, united; pedal opening anterior, rather large. *Siphons* longer than the shell, moderately thick, united nearly to their ends, retracted, by inversion at half-length, into the branchial cavity, where they project beyond the centre of the



a', *a*, adductor muscles; *p*, *p*, pedal muscles; *r*, retractor of siphons; *b*, *c*, pedal opening.

shell; orifices fringed. *Foot* moderately large, thick, linguiform, heeled; suspensor muscle attached close to, but distinct from, the adductors. *Palpi* very large, broadly falciform. *Gills* two on each side, long and plaited, rounded in front, the outer pair shorter and furnished with a plaited dorsal flap.

In *G. curta* the siphons are much shorter and more deeply divided; the branchial was introverted at its extremity in the specimen examined.

Anomia ephippium.

Animal unsymmetrical; mouth and byssus twisted to the right side. *Mantle* quite open, except for a space of five lines at the hinge; its margin double, slightly fringed (no *ocelli*). *Gills* two on each side, unsymmetrical (the right pair shortest in front), very delicate, flat (destitute of internal partitions or gill-tubes), crescent-shaped, tapering to a point and united posteriorly; suspended by two falciform membranes (*m*) forming three dorsal channels, the lateral incomplete; outermost gill-laminæ free at the dorsal edge, and furnished with a broad reflected margin or supplementary gill (*r*, *r*); innermost laminæ also unattached, but united to each other throughout their length, the united edges passing to the *left* side of the body in front. *Mouth* on the under side, between the ligament and byssal plug. *Lips* narrow, plain, longest on the right side, confluent with the gills; (*palpi* obsolete). *Foot* small, cylindrical, expanded at the end and grooved, supported by two muscles from the left valve. *Byssus* large, laminar, passing through a nearly complete foramen in the right mantle-lobe, and attached by a powerful muscle to the centre of the left valve. *Adductor* moderate, indistinctly composed of two elements; pallial line continuous. *Sexes* di-

Fig. 1.

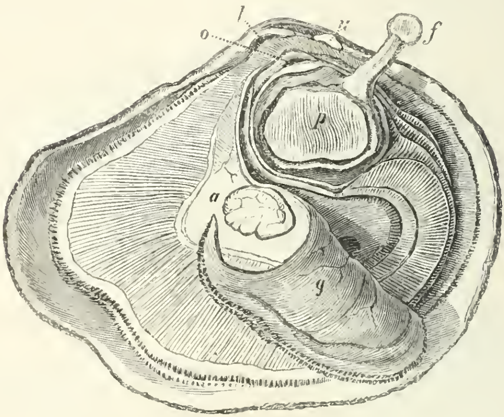


Fig. 2. Fig. 3.

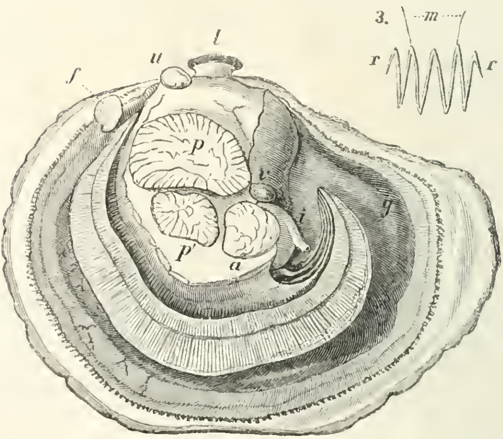


Fig. 1. Animal lying in its upper (*left*) valve; right mantle-lobe turned back in front.

Fig. 2. Animal in right valve, with left mantle-lobe removed.

Fig. 3. Section of gills.

l, ligament; *o*, mouth; *f*, foot; *u*, anterior; *p′*, posterior pedal muscles; *p*, *p*, byssus and byssal muscle; *a*, adductor; *v*, ventricle; *i*, rectum; *g*, generative organ; *m*, gill-suspensors; *r*, *r*, reflected gill-margins.

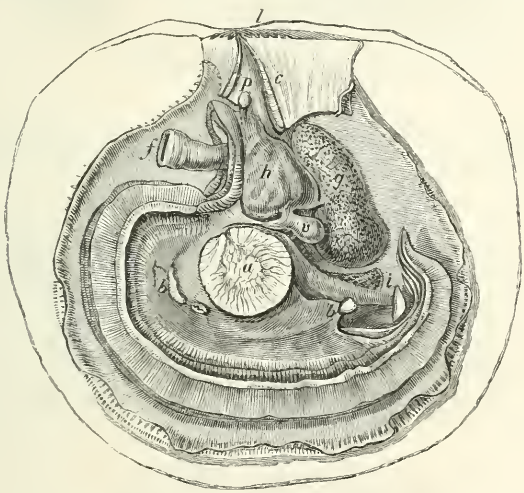
stinct; generative organs combined with the right mantle-lobe. *Ventricle* exposed, not perforated by the rectum.

There is an admirable memoir on the structure of *Anomia* by Dr. Lacaze-Duthiers, in the Ann. Sc. Nat. 1854, t. ii. p. 1, with figures. These and some drawings by Mr. Albany Hancock have been compared with the example here represented.

[This description differs in many particulars from that given by Mr. Clark in the 'British Marine Mollusca.'—J. E. G.]

Placuna placenta. Singapore.

Animal nearly symmetrical, free (or attached by a byssus when very young). *Mantle* quite open, its margin fringed with large and small cirri, and furnished with an inner pendent border. *Adductor* round, subcentral. *Gills* as in *Anomia*, their outer margins grooved. *Pallial* muscle reduced to two fasciculi in



Right valve with the animal, as seen on removing the left mantle-lobe. *l*, ligament; *c*, cartilage; *p*, pedal muscle; *f*, foot; *h*, liver; *g*, generative gland; *v*, ventricle; *a*, adductor; *i*, rectum; *b*, *b*, branchio-pallial muscles.

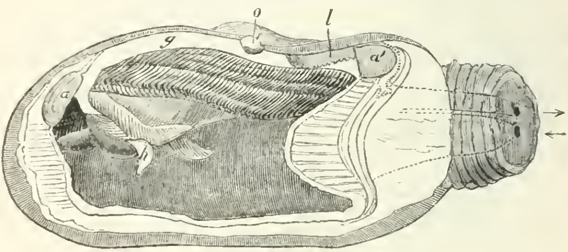
front of, and one behind, the adductor. *Pedal* muscle minute, anterior, attached to the upper (left) valve. *Foot* small, cylindrical, tubular (very extensile?). *Lips* short and wide, becoming striated inside near the gills. *Generative* organ and rectum attached to the right mantle-lobe. *Ventricle* exposed, not perforated.

It will be seen by the figures that *Placuna* is essentially like *Anomia*; both are very different from *Ostrea*, and more like the

Scallops. *Carolia* (*Hemiplacuna*) is a *Placuna* with the hinge and byssus of *Anomia; Placunomia* has no pedal muscle, like *Placuna sella*; whilst *Anomia pernoides* has an anterior pedal sac in *each valve*, as pointed out by Dr. Gray.

Anatina subrostrata. Philippines.

Mantle-margins united; no ventral orifice; pedal opening quite anterior, minute. *Siphons* united, thick, not entirely retractile into the shell, covered with rugose epidermis; orifices small

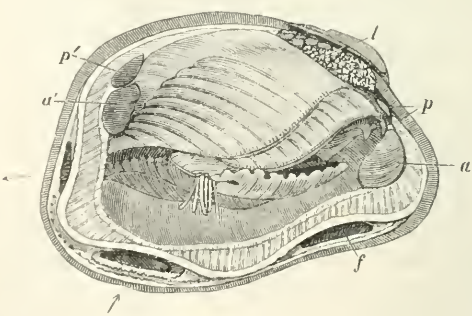


a, *a'*, adductors; *g*, single gill; *o*, cavity of ossicle; *l*, liver; *h*, palpi: the termination of the alimentary canal in the exhalent siphon is indicated by dotted lines.

(fringed?). *Foot* very small, compressed. *Gills* one on each side, long, narrow, very thick and deeply plaited, furrowed at the lower edge, not continued into the branchial siphon; dorsal border free, nearly as wide as the gill. *Palpi* very long, narrow, free, striated inside.

Modiolarca trapezina. Falkland Islands.

Mantle-lobes united, leaving only three small, subequal ori-



a, *a'*, adductors; *p*, *p'*, pedal muscles; *f*, pedal opening; *l*, liver; the gill-tubes are distended with spawn.

fices, the interspaces with two rows of cirri; branchial opening with a fringed border, the others plain. Anterior *adductor* muscle larger than the posterior. *Foot* with a small flat sole, crenulated at the edge, deeply grooved behind and byssiferous; pedal muscles small in front, large behind, close to the adductors. *Palpi* very small. *Gills* oblong, finely striated; the outer ones not quite so deep, furnished with a dorsal border, their free edge grooved only in the middle.

This remarkable shell, which resembles the Palæozoic *Modiolopsis* in the large size of the anterior adductor, is found attached by its byssus to floating weed in many parts of the Southern Ocean.

III.—*Notes on some new or little-known Marine Animals.* By Philip Henry Gosse, A.L.S.

[With two Plates.]

(Fascis II.*)

Class ARACHNIDA.

Order Acarina. Fam. Oribatadæ.

Genus Halacarus (mihi).

Body covered above with a well-defined shield, either entire or transversely sulcated; under surface divided across the middle: rostrum head-like, consisting of a bulbous lip tapering to a point, divided longitudinally beneath, allowing the protrusion of a pair of slender filiform mandibles; palpi terminated by a fang-like unguis: feet cursorious, tipped with two falcate ungues; directed two forward and two backward; thighs remote. Marine. Name from ἅλς, the sea, and ἄκαρι, a mite.

Sp. 1. *H. rhodostigma* (mihi). Plate III. figs. 1–5.

Body divided above and below; claw of palpus slender, little curved; legs nearly equal; thighs of first pair ventricose; claws of all simple; whole surface minutely punctured.

Description.—Length $\frac{1}{72}$nd of an inch from anus to tip of rostrum; colour pellucid whitish, stained with pale red on the anterior half; above and below studded with punctures, which, under a high power, take the form of rosettes (whence the specific name, from ῥόδον, a rose, and στιγμὴ, a point), or the spots on a panther's coat (fig. 4); the punctures are conspicuous on the first thighs, but are scarcely visible on the other limbs. The

* Fasc. I. appeared in the 'Annals' for August 1853.

haunches are moderately distant at their origin, springing from the margin of the body, the shield being notched to give them exit; the third joint of the legs is the largest, much swollen in the first pair (fig. 1); the fifth is also large, and the sixth (the terminal one) is long, but slender, tapering abruptly from the middle; the claws (fig. 5) are simple hooks, much curved, neither pectinated nor tipped with an accessory piece, but the joint from which they spring is tipped with two nearly parallel styles: the legs are equal in length.

The shield of the body above is subtruncate in front, but projects in a small medial point (fig. 2); its general form is long-oval, with a transverse sulcus at the origin of the second legs; this sulcus, however, does not extend across the whole breadth, being met on each side by a bent longitudinal sulcus, which cuts off a wing-like portion, on which is seated a large crescent-shaped dark eye. Below, the body has two transverse divisions (fig. 1); one at the origin of the first legs, another at the origin of the third; these two impart the aspect of the division into head, thorax and abdomen, of a beetle: there is also a narrow longitudinal portion separated on each side.

The rostrum (fig. 3) forms a thick bulb tapering to a point, from which during life I observed two apparently soft, flexible, filiform, divergent organs (mandibles ?) protruded and retracted (fig. 1). At a strong shoulder on each side of the rostrum, about one-third from its point, is articulated a palpus of four joints, of which the second is by far the largest; the terminal one is a style, slightly curved, pointed, and furnished near the base with two strong bristles on the inner side, and one on the outer. All the joints of the legs are armed with a few short bristles. The vulva (fig. 1) occupies a large oval area at the hind part of the venter, and the anus is terminal.

This little species is not uncommon at Weymouth, among sea-weeds from low-water-mark; and I find it in my tanks, crawling up the glass, always immersed; doubtless introduced with weed-covered stones.

Sp. 2. *H. ctenopus* (mihi). Plate III. figs. 6–10.

Body divided below only; claw of palpus a stout pointed hook; hind legs longest, but otherwise alike; claws of all pectinate; whole surface smooth.

Description.—Length of body to tip of rostrum $\frac{1}{32}$nd of an inch; colour dark-red above with a white line down the centre of the back; under parts cream-white, very satiny; legs transparent-corneous. The shield of the upper parts (Pl. III. fig. 6) is entire, nearly oval, but projecting into a point over the rostrum;

its margins are sinuated and notched at the emission of the legs, and the excavations at those parts are still more strongly marked on the under surface. Beneath (fig. 7) there is a transverse sulcus opposite the origin of the third pair of legs, but bent forward on each side to the second pair; a longitudinal bent sulcus exists on each side, whose limits are undefined. The vulva and anus are both on the under surface, the latter small and situated behind the former, which is large and oval, and both are enclosed in an oval area.

The rostrum (fig. 8) is a globose bulb, drawn out to a more lengthened point than in the former species, its tip extending to the third joint of the palpi. The palpi (fig. 9) are usually projected parallel to the rostrum, but are capable of divergence; the joints have nearly the same relation to each other as in *H. rhodostigma*; but the third bears a stout spur-like spine on its inner face; and the fourth, which is stout at the base, much curved inward and acute, is armed with another spine, but longer and more slender, which likewise points inward and forward.

The legs (fig. 6) are consimilar, except in length; the first and second being to the length of the body as $4\frac{1}{4}$ to $5\frac{1}{2}$, the third and fourth as $6\frac{3}{8}$ to $5\frac{1}{2}$; hence the hind pairs are just half as long again as the fore pairs. The coxæ of the first and second originate close together, but the others are remote from them and from each other. The joints are nearly cylindrical, but diminish slightly to the last, which bears two very moveable sickle-shaped ungues. Each unguis (Pl. III. fig. 10) has an accessory piece set on the under side of its extremity, and is strongly pectinated all along its concave edge. Hence the name, from κτεὶς, a comb, and ποῦς, a foot.

No eyes were visible, unless a black speck on each side of the bulb of the rostrum was an eye, which I much doubt, from the position of the conspicuous organs of vision in the former species. Found (a single specimen) with the preceding.

Whether either of these species has been described before I cannot certainly say. Fabricius (Spec. Insect. ii. 491; ed. Hamb. 1781) has included two Norwegian marine Mites, *Acarus zosteræ* and *A. fucorum*, which he briefly describes;—the former as "*A.* subrotundus, albidus, abdomine rufo;" the latter as "*A.* pallidus, lineis duabus flexuosis nigris, pedibus posticis brevissimis incurvis." Meagre as these characters are, they are sufficient to show that neither of my species was intended.

M. Paul Gervais in his 'Aptères' (iii. 253) mentions that M. Dujardin had described a marine *Oribates*, in the 'Journ. de l'Institut' for 1842; but he has not given the characters, and I have not been able to find any trace of such a species in the 'Comptes Rendus' for that period.

The only British marine Mite yet recognized, so far as I am aware, is the *Halarachne halichœri* of Professor Allman, which is widely different from these in form and habit, being parasitic within the nostrils of a Seal.

The form now described I cannot refer to any of the published genera: the dorsal shield seems to locate it among the *Oribatadæ,* and near to *Belba* and *Galumna*; but in the form and structure of the rostrum, there is a curious affinity with *Raphignathus* among the *Trombidiadæ.*

Class CRUSTACEA.

Order Podosomata. Fam. Pycnogonidæ.

Genus Phoxichilidium (M.-Edw.).

P. olivaceum (mihi). Plate III. figs. 12, 13.

Rostrum thickened at each extremity, hollowed in the middle, $\frac{2}{3}$rds as long as first joint of mandibles; the portion of the first segment of body anterior to the first pair of legs, about as long as rostrum; fourth joint of first pair of legs dilated; all the legs four times as long as the body; colour olive.

This species is perhaps one of the *many* British forms of this family, which Leach says were in his possession, but which he had not had an opportunity of determining. I found it at Weymouth, in the low spring-tides of April. The characters above given are those in which the specimen differed conspicuously from the *P. coccineum* of Dr. Johnston, by comparison with his figures in the 'Mag. of Zool. and Bot.' i. pl. 13. My specimen was $\frac{1}{8}$th of an inch in length, exclusive of the members; a female, bearing the globose egg-masses that characterize the genus. Fig. 12 represents it of the nat. size; and fig. 13, the fore-parts magnified.

Order Edriophthalma. Fam. Cyamidæ.

Genus Cyamus (Fabr.).

C. Thompsoni (mihi). Plate III. fig. 11.

Body about $\frac{1}{6}$th of an inch in length. Five pairs of feet equally developed; all 5-jointed; all with the penultimate joint large and ovate. Third and fourth segments each furnished with a single small oval appendage.

This species was obtained by Mr. Wm. Thompson of Weymouth, after whom I have named it. It was attached to one of two specimens of *Hyperoodon bidens*, the capture of which in Portland Roads was recorded in the 'Annals of Nat. Hist.' for November 1854. Four species of *Cyamus* are enumerated by M. Milne-Edwards in his 'Hist. Nat. des Crustacés' (iii. 113), from all of which this specimen differs signally. Indeed that eminent carcinologist's *résumé* of the generic characters must be modified to include this species, which yet is an indubitable *Cyamus.* "The first pair of feet," he observes, "are difficult to perceive when we look at the animal from above;—they are composed of five joints, and are terminated by a *minute* sub-cheliform hand, *slightly* oval. The second pair are very large, hooked, and composed of only four distinct pieces." Now in this new species, the first pair do not differ either in form or size from the second, third, fourth or fifth pair; the hand is as stout, as ovate, and the claw as strong and as much hooked as in the second pair, while this latter pair are composed of five joints as distinct as in the others, and in no wise differing from them.

Class ANNELIDA.

Order Chætopoda. Fam. Nereidæ.

Genus Syllis (Sav.).

Sp. 1. *S. tubifex* (mihi).

Head lobed; post-occipital segment equal to the following; antennæ moniliform; tentacular cirri antenniform; feet lobed, armed with one pencil of hooked setæ; superior cirrus shorter than the breadth of the segment, not moniliform: animal fissiparous, minute, inhabiting a membranous tube.

Description.—Body $\frac{1}{3}$rd of an inch long, dirty-white, composed of about forty-five segments.

Head small, the lobes well developed and deeply divided, clothed with short hairs. Eyes large, widely diverging; those of each lateral pair about equal in size, and placed so close as to be sometimes in contact. Antennæ three, moniliform, clothed with short bristles; the central one nearly twice as long as the others, composed of about twenty-five well-marked joints; the outer pair having about twelve each.

Proboscis long, the outer portion about $\frac{3}{4}$ the length of the inner. Frontal margin of outer part serrated; inner part covered with small oval tubercles, set closely in quincunx, and in transverse rows.

Post-occipital segment not larger than the rest; furnished with two tentacular cirri on each side, of which the upper is about twice as long as the lower, equalling respectively the antennæ. Those of the two following segments are similar in length and structure, being all antenniform.

Segments slightly incised, much broader than long. Foot short, subconical, obtuse, and divided at the tip into three or four lobes; armed with a bundle of bristles, each of which bears a terminal hook very freely jointed on an oblique knob. Superior cirrus shorter than the breadth of the segment, tapering, not moniliform. Inferior cirrus scarcely projecting beyond the foot, ovate and leaf-like.

The bundles of hooked bristles consist of about sixteen each, but those near the tail appear to have only about twelve. I cannot find any accessory pencil of fine hairs by the closest pressure; but the long slender pair of internal plates are present.

The internal surface of the head-lobes is clothed with vibratile cilia, by the action of which a strong uniform current is drawn into the mouth. The current passing down along the antennæ may at first be supposed to be produced by cilia on these organs, but I could not detect any on close examination. The inferior surface of each foot is also strongly ciliated, and vortices are produced on each of these organs, the whole forming a powerful current from head to tail.

This is one of the species that increase by spontaneous division from the posterior portion of the body. There was, at the tail of the specimen described, an incipient young one of about five or six segments, triangular in its general form and little developed, but well separated, by an incision, from the parent.

This species I frequently found in my glass jars of sea-water at Ilfracombe, especially in those in which I was keeping the Hydroid zoophytes. It climbs to the surface, and then along the very edge of the water, forms a slender membranous tube attached to the glass, open at each end, within which it dwells. If touched at either extremity, it issues forth at the other with much agility, wriggling its segments in lateral undulations. No drawing was made of this species.

Sp. 2. *S. longiseta* (mihi). Plate IV. figs. 14–21.

Head not lobed; antennæ short, not moniliform; no tentacular cirri; feet obtuse, simple, armed with two pencils of bristles, of which the inferior are twice the breadth of the segments; superior and inferior cirri equal, minute; inhabits a membranous tube. (Fig. 14, nat. size; 15, magnified.)

Description. — Head round, not distinctly lobed (fig. 16); three antennæ, slightly fusiform, not moniliform, shorter than the breadth of the head, set in a transverse line: four eyes, brick-red, reniform, the inner pair set a little behind the outer, and rather smaller: no tentacles or tentacular cirri.

Segments about thirty-eight, nearly alike in size, but those of the middle parts more separable; diminishing abruptly at the tail.

Feet slightly developed for the first five or six segments; thence thick, with a semi-oval lobe projecting from the upper portion (Pl. IV. figs. 17 & 20), from which protrudes a fan-like pencil of bristles, which are short (about as long as the foot), slightly curved, consisting of a slender shaft with a terminal notched knob, bearing a short curved blade set in the notch; this blade is longer in the upper bristles (fig. 18) of the pencil than in the lower ones (fig. 19). The lower pencil (figs. 17 & 21) consists of very long, simple, finely-pointed bristles (about twice as long as the breadth of the body), which project laterally or posteriorly, and are not retractile; these long bristles do not appear till the 10th segment, and disappear at the 32nd.

The tail consists of two fusiform appendages, much resembling the antennæ, about half as long as the greatest width of the body.

Colour hyaline, slightly tinged with yellow. Total length $\frac{1}{6}$th of an inch.

Found at Weymouth on the side of a glass in which I had placed a tuft of *Rhytiphlœa*. It makes a gelatinous tube attached to the glass (fig. 14), in which it moves freely backwards and forwards by means of its long setæ.

Order Chætopoda. Fam. Sabelladæ.

Genus Othonia (Johnston).

Gill-fans two, composed of several soft, thick, curled-inward, pectinated, ciliated stems set like a star around the mouth: body composed of twelve to thirty-five segments, all furnished with lateral pencils of bristles, but without hooks. Animal inhabits a membranous tube, open at both ends, which it often forsakes.

The discovery of two other species of this genus renders necessary a revision of the generic characters; as some of those enumerated by Dr. Johnston (Loudon's Mag. N. H. viii. 183) are merely those of the single species then known, *O. Fabricii*.

Sp. 1. *O. Fabricii* (Johnst.). Plate IV. fig. 22.

Segments fourteen; first and last with a pair of eye-like spots: pinnæ of gills graduated in length; bristles simple.

Description.—Head with two well-defined eyes, and a ring of vibratile uncinate cilia. Gill-fans wrinkled; pinnated; the pinnæ long, and so graduated that the tips are level; they often curl inward at the tips; their colour is a clear green. Segments fourteen, all but the last two furnished on each side with a pencil of stiff long bristles, few, converging to their tips, deeply seated, nearly straight, but curved forward at the points, simple; wholly retractile. Last segment round, with a pair of well-defined eye-like spots.

Length $\frac{1}{12}$th of an inch.

This little species is common at Weymouth, coming out of tufts of *Rhytiphlœa pinastroides* when these are kept in glass vases. The little Annelid crawls up the side of the glass, often going tail-foremost; a curious fact, when considered in connexion with the eye-like spots on the last segment, which cannot be distinguished from the true eyes of the anterior extremity.

It is possible that this may be the immature condition of one of the succeeding species. The ring of uncinate cilia suggests youth.

Sp. 2. *O. Bairdii* (mihi). Plate IV. figs. 23, 24.

Segments above thirty, without eye-spots at either extremity; gills each composed of five or six stems, set with a double row of short pinnæ: bristles with an oval expansion at their base.

Description.—Gill-fans two, ample, each consisting of five (or six) stems divided almost to the base, each set with a double row of short ciliated pinnæ, not graduated, curling inwards in a plumose manner. Segments (in the specimen described) thirty-four, all but the last two with pencils of bristles; three in each pencil (fig. 24) very short, finely-pointed, with an oval blade-like dilatation at the base of each. The segments diminish quickly but gradually to the last, which forms a blunt point, and is unspotted. No eyes are visible on the head, nor any ring of cilia.

Length $\frac{1}{6}$th of an inch; colour whitish-green, opaque; gill-fans hyaline.

A single specimen was found with the preceding, at Weymouth, in April. I have dedicated the species to my esteemed friend, Dr. William Baird of the British Museum.

Sp. 3. *O. Johnstoni* (mihi). Plate IV. figs. 25–28.

Segments above thirty, without eye-spots; gills each of about sixteen stems, some of which are simple, others set with graduated pinnæ: bristles with an expansion near the tip.

Description.—The gill-fans are composed of many (about sixteen) stems, some of which are quite simple, others set with numerous long, but graduated pinnæ in two rows, and others in an intermediate condition, the pinnæ being rudimentary or short (fig. 26). The stems (fig. 28) are hollow, with close-set transverse lines (*septa* ?); and the pinnæ are covered with small vibratile cilia. These fans are very deciduous, for, in captivity, I have seen the animals voluntarily throw off in succession more than a dozen of the stems, separating them at the base: probably they are renewable, as I know to be the case, from repeated observations, in *Sabella*.

Segments about thirty-three; nearly equal, except that they diminish rapidly at the posterior extremity, tapering somewhat abruptly to a blunt point. All but the last two are furnished with graduated pencils of bristles, about eight or ten in each pencil. In those of the anterior segments the bristles are of two forms (fig. 27), the shorter consisting of a slender, acutely-pointed stem, which is dilated near the tip into an oval plate, through the centre of which the stem passes; the longer ones are of essentially the same structure, but the dilatation is gradual and elongate, and therefore blade-like or lanceolate. Both kinds end in finely-drawn points, which are much curved. Towards the hinder part of the body all the bristles take the latter form.

The animal throws off at will a transparent gelatinous membrane, which forms a tube just large enough to hold its body, and the sides of which are pushed out by the bristles during their movements.

Length $\frac{1}{2}$ an inch; colour greenish-white.

I have named this species after Dr. George Johnston, who may be called the father of our marine invertebrate zoology. It is the most common of the three at Weymouth, being found abundantly in shells and stones, dense sea-weeds, &c., from tide-marks and deep water.

Class POLYZOA.

Order Infundibulata. Fam. Vesiculariadæ.

Genus Nolella (mihi).

Cells erect, subcylindrical, springing singly, but closely, from an undefined polymorphous incrusting mat; tentacles eighteen, forming a bell. Name from *nola*, a little bell.

N. stipata (mihi). Plate IV. fig. 29.

Cells about $\frac{1}{36}$th of an inch long, whitish, sub-opaque.

I found this species numerous in mats on the fronds of *Phyllophora rubens*, dredged between the Abergavenny and Portland Breakwater, in Weymouth Bay. It is very near *Bowerbankia*, but the number of its tentacles distinguishes it from all recognized genera, except *Avenella* (Dalyell), from which, however, it totally differs in habit and form. The opacity of the cell prevented me from discerning whether it has a gizzard.

EXPLANATION OF PLATES III. AND IV.

PLATE III.

Fig. 1. *Halacarus rhodostigma*, magnified, ventral surface.
— 2. *Ibid.* dorsal surface of trunk.
— 3. *Ibid.* rostrum and palpi.
— 4. *Ibid.* punctures of surface.
— 5. *Ibid.* ungues of foot.
— 6. *H. ctenopus*, magnified, dorsal surface.
— 7. *Ibid.* ventral surface.
— 8. *Ibid.* rostrum and palpi.
— 9. *Ibid.* right palpus.
— 10. *Ibid.* one unguis of a foot.
— 11. *Cyamus Thompsoni*, magnified, ventral surface.
— 12. *Phoxichilidium olivaceum*, nat. size.
— 13. *Ibid.* fore-parts magnified.

PLATE IV.

Fig. 14. *Syllis longiseta*, in its tube, nat. size.
— 15. *Ibid.* magnified.
— 16. *Ibid.* head, somewhat laterally.
— 17. *Ibid.* a right foot seen from behind.
— 18, 19. *Ibid.* setæ of the upper pencil.
— 20. *Ibid.* a middle segment, from above.
— 21. *Ibid.* the same, from below.
— 22. *Othonia Fabricii*, magnified.
— 23. *O. Bairdii*, magnified.
— 24. *Ibid.* a pencil of setæ, more enlarged.
— 25. *O. Johnstoni*, nat. size.
— 26. *Ibid.* magnified (middle segments omitted).
— 27. *Ibid.* bristles of two forms.
— 28. *Ibid.* a portion from a stem of the gills, with two pinnæ.
— 29. *Nolella stipata*, magnified.

IV.—*On the Homologies of the Carapace and on the Structure and Function of the Antennæ in Crustacea.* By C. SPENCE BATE, F.L.S. &c.*

[With two Plates.]

IN the class Crustacea the most anterior articulation is that which supports the eyes. This is shown most conspicuously in the genus *Squilla*, in which animal it is united by a free joint with the next succeeding; but if this lucid example were wanting, the relative position of the ophthalmic ring in advance of any of the rest is clearly manifest in the larva and pupa stages of the Decapoda.

Dissection moreover leads to the same conclusion. Upon

* Communicated by the author, having been read at the Linnæan Society, April 17, 1855.

laying bare the cephalic ganglion, we find that the two anterior branches of nerves pass to the eyes, the central being the *motor oculi,* the outer the *ophthalmic,* and lead direct to the organs of vision.

In all the higher tribes, except the aberrant family of *Diastylidæ* (Say) (*Cuma* of M. Milne-Edwards), the eyes are borne on moveable pedicles. In the *Brachyura* the ring which bears these pedicles is free, but unlike *Squilla,* instead of being seen distinctly in advance of the animal, it is enclosed within and covered by the anterior portion of the carapace; I say that it is *covered* by, and not absorbed into, the structure of the integument which forms the anterior portion of the external skeleton of these animals.

If we throw off the carapace we shall find that the calcareous representation (Pl. I. fig. 1 *a*) of the ophthalmic ring occupies a position between and connecting the two eyes, lodged in a fossa (Pl. I. fig. 2 *w*) formed by the interspace between the dorsal and ventral arches of the second ring, the superior antennal, which arches approximate in the *Brachyura* so closely, that, as in the genus *Cancer,* they meet in front of and enclose the ophthalmic ring, leaving the point of union visible only by a distinct suture (Pl. I. fig. 3 *a*). Thus the ophthalmic ring is covered by and not fused with the rest of the testaceous skeleton;—it therefore takes no part in the development of the carapace of the Decapod Crustacea.

The superior antennæ succeed the eyes, and with the exception of the genus *Squilla,* the ring which supports them is always fused with the succeeding, the inferior antennal. These two form a closely associated part in the anterior structure of the animal, and together build up the whole of that portion of the carapace which is in advance of the cervical suture, and which, I think, I shall be able to show, forms almost the whole of the carapace in the *Brachyura,*—half of the same in *Macroura,*—and that it lessens in importance as the animal descends in the scale of nervous centralization.

If we turn our attention to the lower forms, we find that in the *Cuma* and other allied genera of the *Diastylidæ,* the eye (for the two coalesce so as to form but one) is developed nearly in the centre of the carapace; but this appearance is only the result of the great development of the lateral angles of the carapace, which meet in front and form what appears like a rostrum; they never unite, but are distinctly separated through the centre of the so-called rostrum, as well as on either side of that portion which supports the antennal rings, which occupies a small island as it were in the centre of the carapace (Pl. I. figs. 4, 5 & 6).

The fact which dissection has enabled us distinctly to make out, that the small central patch bears the two antennæ, that the external angles of the carapace which pass in front and surround it posteriorly, carry the mandibles, demonstrates the relation of one portion of the carapace to the other, and that the line of separation round the antennal centre homologizes with the cervical suture of the *Macroura*.

The constant position of this suture in all Crustacea when present is the same, and forms a line of demarcation between the third and the fourth rings, and therefore visible in its position external to the inferior antennæ; and M. Milne-Edwards is most assuredly wrong when he attributes the depressions on the carapace, which terminate in the central notch of the orbits of the *Brachyura*, to be the representatives of the cervical suture of the *Macroura*.

If we wish to judge of its position in the *Brachyura*, it is but just that we should make a careful investigation of the structure of the animal in its immature condition. In the so-called pupa stage of the Crab, we find that the inferior antennæ are attached to the extreme horns of the carapace (Pl. I. fig. 7), but these horns are folded beneath the animal; it is this reflexion which afterwards forms the orbit in which the eye is lodged.

The position of the antenna, anchylosed as it is with the dermal skeleton in all the *Brachyura*, still holds the same, therefore by inversion the cervical suture must be inferiorly inside, but still within the limits of the carapace; such a suture is plainly demonstrable in most of the *Brachyura* (Pl. I. fig. 10, and Pl. II. fig. 1), and separates the inferior antennal (*a*) from the mandibular ring (*b*); it extends posteriorly to the extreme limits of the carapace, forming as it were two side pieces, the epimerals of M. Milne-Edwards: this line unquestionably homologizes with the cervical suture of the *Macroura*.

If we turn our attention to the development of the nervous system in these various animals, we shall find that centralization decreases in an inverse ratio with the development of that portion of the carapace which is posterior to the cervical suture, and *vice versâ*, that centralization is most perfect when that portion of the carapace which is anterior to the cervical suture is largest.

In the *Brachyura* the nervous ganglia are in the highest degree consolidated, and in the Spider Crabs the most perfect centralization exists; there we shall find that the cervical suture, the line of union between the inferior antennal and mandibular rings, is so lateral, that the two side pieces of the incomplete mandibular ring are reduced to much less importance than is to be found in any other tribe of the whole class. In the genus *Cancer*, &c. the line of union remains but partially anchylosed, and splits when the animal throws off its exuviæ.

In the *Galatheadæ*, the development of the mandibular ring shows a closer approximation to the *Brachyura* than to the *Macroura*, in which latter the two antennal rings occupy but one-half of the whole carapace, the mandibular ring furnishing the remainder; whereas the *Paguridæ* assimilate closer in the development of the same portion to the *Macroura*,—a circumstance in its position among Crustacca corroborated by the fact, that previous to their taking possession of the shell of the mollusca, they exhibit all the characteristics of a perfect *Macroura*. Here, when the nervous centre commences its first tendency to separate into numerous distinct but less important ganglia, we find those rings which carry distinct organs of sense, and furnished by nervous filaments from the cephalic ganglion, decrease in a relative proportion to the rest of the animal: this, which we see very apparent in the *Macroura*, is carried to the greatest extent in the *Diastylidæ*, where the carapace is constructed almost wholly of the mandibular ring, having but a small area in the centre which bears the antennæ. And more, the carapace extends posteriorly so as to envelope only the Gnathopods; the rest of the thorax being complete in the development of each separate ring.

Lower in the scale we find that the whole thorax, including the Gnathopods, is perfect in its distinction from the cephalic ring, which latter is so reduced in importance as to differ little in appearance from that of a single ring; whereas consolidation still remains, and embraces within the compass of this one ring the whole of the seven anterior.

But we have seen in the descending scale of nervous force the rings which carry the organs of consciousness degenerate in importance, and yield to a corresponding development of the mandibular ring; this law appears still to be in force in the Amphipoda, the lowest type of the *Macroura* form, in which I am inclined to believe that the mandibular ring represents the whole of the upper portion of the cephalic articulation; the anterior three being so diminished in importance, that they are to be found only in the perpendicular anterior wall of the head *, or perhaps represented by their appendages only.

Since the present paper was communicated to the Linnæan Society, the author has had the opportunity, through the kindness of Mr. J. Lubbock, of perusing Dana's great work on Crustacea, and it is but just he should state, that the conclusions, which careful and long-continued observation of the homologies

* An example of which may be seen in the manner in which the two first joints of the external antennæ are absorbed in the frontal aspect of *Talitra*; a circumstance overlooked by naturalists, who have invariably described this genus as having but three instead of the constant five articulations to the peduncle of the inferior antennæ.

of the carapace of Crustacea had induced him to arrive at, are in some of the most important points anticipated in the work of the United States' Exploring Expedition.

But since they have been arrived at by independent research, the regret with which the author found his deductions forestalled, are to a considerable extent removed by the important testimony of so learned and correct a naturalist as Mr. Dana. The following two sentences are taken from the first volume of that author; the italics being in the original text:—

"We are therefore led to believe, *that the so-called epimerals*, or ventral pieces of the carapax, *are in fact the posterior extensions of the mandibular segment*." (Page 27.)

Again—

". . . . Milne-Edwards thus makes the larger part of the carapax epimeral in character.

"Excepting that we consider what is here called epimeral, *the mandibular segment*, we agree with Edwards, for the most part, in the above-mentioned deduction; so that while the mandibular segment is confined to the ventral pieces of the Brachyural carapax, it constitutes its posterior half in *Macroura*." (Page 32.)

The author also has had the opportunity at the British Museum of seeing the plates in Kroyer's great work on the Natural History of Scandinavia, where he finds the carapace of *Cuma Rathkii* (Kroyer) (the *Alauna rostrata* of Goodsir) is figured with the so-called rostrum separated from the antennal region, as drawn and described in this paper.

The Anterior or Internal Antennæ.

These organs are borne by the second ring, and supplied with nerves from the cephalic ganglion.

The anterior antenna is evidently of importance to the animal, and is always present in aquatic Crustacea: as a general law it consists of an articulated peduncle of three joints, which I believe I am correct in asserting, unlike those of the external antenna, are never anchylosed together or with the carapace, and a terminating filament, which is generally double, often treble, but I believe never single, above the Amphipoda. This appendage is various as well as unequal in length, and in every species that I have examined, whether in *Brachyura*, *Macroura*, Amphipod or Isopod, will invariably be found furnished, in addition to the small hairs common to other parts of the animal, with long, delicate, membranous cilia, in form varying in genera and species; they are always larger than the ordinary hairs, but much more delicate in structure. These vary in number and in thickness of clusters, but, as far as my experience goes, are invariably present on the upper antenna.

In the *Anomoura, Macroura,* and all below, the antenna gradually increases at the base. In the *Brachyura* this increase is immensely developed in the first or basal articulation. Examining this organ in the larva, I thought I observed what I took to be an otolithe*; this led my attention to the same in the adult *Brachyura,* and there I found, upon breaking open the basal articulation, what appeared to be an imperfect kind of cochlea. Afterwards, in company and with the assistance of my friend Mr. Howard Stewart, we were enabled to trace distinctly the nerve which supplied this antenna directly to the centre of the cochlea (for such I believe it is), as I feel convinced that the upper antennæ are auditory organs.

But since the general opinion up to the present time has been that they are olfactory and not auditory, and as the external antennæ are invariably considered as auditory and not olfactory, I shall withhold any further discussion until those organs have been described.

In the lower forms of *Podophthalmia,* as also in the Sessile-eyed Crustacea, the basal joint of the antenna is not enlarged, neither have I been enabled to find any structure answering to the internal cell; on the other hand, the whole organ increases in length, as if to gain by external surface what is lost by internal development.

Among the land Crustacea this antenna is obsolete, and in *Ligia* and other amphibious marine ones it is rudimentary.

The Inferior or External Antennæ.

These are borne upon the third ring, and are among the most constant organs present. One of these antennæ is formed of a peduncle consisting as a general law of five articulations and a filament, generally multiarticulate and very long; these are sometimes anchylosed together so as to be even as few as a single articulation.

The five joints of the peduncle are all distinct in the *Macroura.* In Amphipoda the first and second are closely associated, but

* In *Macroura,* Dr. Farre states that he found sand deposited in the base of the internal antenna, which he assumes to act the part of otolithes; this the author has failed to find, and, from the fact that the membrane over the orifice spoken of by Dr. Farre is imperforate, thinks it probable that the specimen examined by that observer must have been injured.

It may be, that in this communication sufficient justice is scarcely done to Dr. Farre's researches, since the short abstract published in the 'Annals' for 1843 has been the only means the author had at his disposal to become acquainted with them. But if, as he thinks, Dr. Farre's researches on the *Macroura* corroborate his on the *Brachyura,* then the evidence is strong against the generally received opinion of naturalists and physiologists, including among them Edwards and Siebold.

scarcely fused. In *Brachyura* the whole, more or less, certainly the four first, almost always coalesce, and are generally formed into a very compact mass, so that their position can only be indicated in *Sternorhynchus* by the presence of the olfactory operculum.

In the *Macroura* this operculum is absent, and an orifice protected by a thin membrane represents the position of the organ. In the Amphipoda the organ is developed in the form of a strong spine or tooth with an orifice at the extremity*. In the Isopoda I have not been able to decipher with confidence the organ of sense in the inferior antenna, but that it exists can scarcely be doubted, since the lower antenna, except in parasitic Crustacea, as the female of *Bopyrus* and *Iona*, is I believe never rudimentary.

The nerve which supplies this organ is a fifth pair or a branch of the fourth. In the *Brachyura*, in which our dissections have chiefly been made, the fourth pair of nerves extends beyond the inferior antenna, and then terminates in the muscles which raise and close the olfactory operculum.

This organ, which is described by M. Milne-Edwards as an organ of hearing, differs in its construction in the different families of Crustacea. In the *Brachyura* it is a small moveable appendage, situated at the point of articulation between the third and second joints; it is attached to a long calcareous lever-like tendon, at the extreme limit of which is attached a set of muscles by which it is opened and closed, to assist in which operation at the angle of the operculum most distant from the central line of the animal are fixed two small hinges. When the operculum is raised, the internal surface is found to be perforated by a small circular opening protected by a thin membrane.

Among the *Macroura* this orifice exists at the extremity of a small protuberance, and is not capable of being withdrawn into the cavity of the antenna, as in the *Brachyura*.

The next question which we have to consider is, to which sense either of these two sets of organs belongs;—whether the upper belongs to the auditory and the lower to the olfactory, as I shall endeavour to prove, or *vice versâ*, as maintained by Prof. Milne-Edwards.

We shall divide the evidences on either side under two heads; the first, that which is derived from an external observation; and the second, that which is derived from its internal organization.

First then from external circumstances: An auditory apparatus is an organ furnished to an animal for one or both of two objects; first, for protection from danger; secondly, for the plea-

* This will be more enlarged upon in the forthcoming Report at the next Meeting of the British Association.

sure derivable from sounds. To animals so low in the scale of beings as the Crustacea, placed as they are in a medium which must considerably modify its character, sound can convey little to the consciousness of the animal beyond a sense of security or danger.

To enable this to be of the most extensive value, the auditory organ must and always is so placed as to be most exposed to external impressions at all periods; particularly when the animal is at rest or pre-occupied.

Now if we look at the organ the present state of science attributes to the sense of hearing, we find that in the most perfectly formed animals, the *Brachyura*, it is enclosed within a bony case and secured by a calcareous operculum; that it is always so in a state of rest, and only exposed when especially required. Not only is this the case throughout the order, but in some genera, as *Corystes*, *Cancer*, &c., it is again covered by the supplying organs of the mouth.

If we take into consideration that the inferior antenna is frequently developed into organs assimilating to feet, and frequently used for the purpose of assisting to climb, &c., it seems difficult to admit that it is an organ capable of protecting the animal by its quick detection of the sound of approaching danger.

If we turn our attention to the superior antenna, we find that in the living animal it is always elevated in the water and never at rest,—always playing with a constant vibration and a jerking motion peculiar to itself in the higher orders. Among the Amphipoda, though constantly erect, the motion is more regular and graceful; this probably is consequent upon the greater relative length of the organ.

This organ is one that appears as if always on the watch;—let the animal be at rest, let it be feeding, no matter, the superior antenna is ever elevated and on constant guard.

Again, if we turn our attention to the land Crustacea, we find the organ as an antenna disappear; and in *Ligia* and the amphibious *Orchestidæ* they are rudimentary, as if the organ, passing from water into a less dense medium, required modification in order to adapt it to the change of circumstances.

If we take into consideration the nature of sound, and its difference of character when conveyed under water from that of passing through air, the obtuse character of the former, which can scarcely be more than a vibratory action of particles of water, which conveys to us a very modified and imperfect idea of sound, we find it difficult to understand that the organ situated at the base of the under antenna is capable of receiving impressions of sound, enclosed as it is within and covered by a stout calcareous operculum.

But if we view it as an organ of smell, every objection previously becomes evidence in favour of the idea. The small door when it is raised exposes the orifice in a direction pointing to the mouth; this also is the direction of the same organ in all the higher orders. In Amphipoda it is directed inwards and forwards. In every animal it is so situated that it is impossible for any food to be conveyed into the mouth without passing under this organ, and of this the animal has the power to judge its suitability for food by raising the operculum at will, and exposing to it the hidden organ—the olfactory.

If we turn to the upper antenna, we find that its position, form and power are as capable of fulfilling the office of conducting the sensation of sound, as the lower is that of smell. As I before observed, it is always placed erect, and continually feeling in the water for the first approximation of sensation. The filamentary appendages are always two or more, one of which is supplied with singularly delicate membranous cilia, being apparently prolongations of a similar membrane to that which covers the larger orifice of the olfactory organ. These lengthened and delicate cilia are peculiarly adapted to receive and convey the most minute vibratory sensation of the medium in which they are suspended. These organs when spoken of may conveniently be designated as auditory cilia, and have been found in every species of Crustacea that has been searched for them.

If we turn our attention to the internal structure of this antenna, we shall find that it supports the idea of its being an auditory organ more forcibly than its external analysis.

In the *Brachyura*, as before observed, the first or basal articulation is largely developed; if it be removed from its connexion with the animal and broken open, the basal articulation will be found occupied by a still smaller chamber having calcareous walls of a much more delicate character than the integumentary structure. This internal chamber or cell is that which in this paper is supposed to be a cochlea, from its analogy both in its structure and supposed use to that organ in higher animals. It is situated in the cavity of the basal articulation of the antenna, and attached to the walls furthest from the median line of the Crab. It presents a tendency to a spiral form, but passes not beyond the limits of a single convolution. The calcareous walls extend across the axis of the ideal spire, and the internal cavity is one continuous irregular chamber, the walls of which at the centre of the axis closely approximate so as almost to meet. Pl. II. figs. 3, 4, 5, 6.

This internal cell represents, we think, the cochlea of higher animals, to which it bears some resemblance both in form and structure. If so, then beyond dispute it identifies the superior antenna as an organ of hearing.

The internal structure of the inferior antenna differs very materially from the appearances we have just described. In the *Brachyura*, where the organs are most fully developed, there is attached to the operculum a long osseous tendon or lever, by which the attached muscles raise or close the entire organ, but there is no internal structure of any kind which could identify it as being an organ of sound. The aqueous sac mentioned by Edwards I have entirely failed to discover.

Viewing the two antennæ each as a whole, in their relative positions and connexion with the rest of the animal, we are forcibly led to the conviction that the upper antenna is an organ of hearing, and the lower antenna is an organ of smell.

EXPLANATION OF PLATES I. AND II.

PLATE I.

Fig. 1. The ophthalmic ring and appendages of *Cancer Pagurus* isolated from its position.

Fig. 2. The internal aspect of the two antennal and the anterior portion of the mandibular rings of *Cancer Pagurus*.

F F F shows the line of fracture in consequence of the removal of the upper portion of the carapace.

A A A. The inner or anterior antennal ring, the supposed limits of which are shown in dotted lines.

w. The fossa which is exposed by the removal of the ophthalmic segment.

x, *x*. The internal extremities of the orbits.

y, *y*. Cavity exposed by the removal of internal antennæ.

B B B B. The external or posterior antennal ring, the limit of which is defined anteriorly where it is fused with the anterior antennal ring by the dotted line, posteriorly by the margin of the œsophageal opening Æ, by a ridge between B and C, where a line of separation is often, if not always visible, and the line P, which splits in some of the *Brachyura* when they throw off the exuviæ.

z. The white spot in the deep hollow shows the position of the olfactory organ (auditory of M. Milne-Edwards, Von Siebold, &c.).

C C C C. The fourth or mandibular ring; epimeral of Prof. Milne-Edwards*.

m, *m*. Calcareous tendon of mandible.

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* The author anticipates being able to demonstrate, in the Report on the Amphipod Crustacea for the British Association, that the so-called epimerals of the thorax, in the Sessile-eyed Crustacea, are in fact the first joint of the leg. If this be correct, and the so-called epimerals in the *Brachyura* be admitted as the fourth or mandibular ring, the side pieces or epimerals of authors will be found to have no existence,—*a circumstance which the author affirms to be the case.*

Fig. 3. The anterior aspect of the internal or first antennal ring isolated from the rest of the carapace, answering to A A A in fig. 2, which is the internal aspect of the same.

a. The line of demarcation between the dorsal and ventral arches, which enlarges at (*e*) to permit the organ of vision to pass through.

b, b. Portions of the orbits.

c. The superior antenna *in situ.*

f. The foramen through which the nerves and muscles pass to the superior or internal antenna, which is here removed.

d, d. Depressions left by the removal of the external antennæ, the extremity of the third joint of the peduncle of which here rests, with which it is almost fused.

Fig. 4. Carapace of *Diastylis* (Say) *Rathkii,* Kroyer, = *Alauna rostrata,* Goodsir, Bell: dorsal aspect.

Fig. 5. Ditto: ventral aspect.

Fig. 6. Lateral view.

Fig. 7. Carapace of *Cancer Pagurus*: pupa stage; ventral aspect.

Fig. 8. Carapace of *Astacus fluviatilis*: dorsal aspect.

Fig. 9. Do. do. do. : lateral view.

Fig. 10. Carapace of *Corystes Cassivelaunus*: lateral view.

PLATE II.

Fig. 1. Carapace of *Cancer Pagurus*: ventral aspect.

Fig. 2. Cephalic ring of *Erichthonius difformis,* to show the relation in which it stands to the carapace of *Podophthalmia.* The antennal rings, which in the Sessile-eyed order are absorbed within the posterior, are here produced in dotted lines (*a*)*. The letters in all define the homological divisions.

a. The two antennal rings.

b. The mandibular.

The line between *a* and *b* is the limit of separation between the rings and homologies in *Brachyura* with the cervical suture in *Macroura.*

Fig. 3. The anterior or internal antenna of *Cancer Pagurus.* The dotted line at (*a*) shows the position of the internal cell.

Fig. 4. Posterior view of the basal articulation of the antenna, showing the internal or auditory cell (the presumed cochlea of the author).

Fig. 5. Anterior view of the internal cell; the outer or dermal walls of the antenna being broken away.

Fig. 6. Internal view of the cell, which is broken to show the relative arrangements of its walls.

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* The author would wish this passage to be accepted only provisionally for the present, as, since the paper has been in the hands of the printer, on examining some specimens of *Gammarus* which had been saturated in dilute acid, he thinks he has identified a line or suture which must homologize with the cervical suture in the higher types. Should further research establish the fact, then it must result that the inferior antennal, as well as the mandibular segment, enters into the structure of the first or cephalic ring of the Amphipoda; but this he hopes to discuss soon more at large elsewhere.

V.—*On Double Monstrosity in Fishes.*

On the 19th March last, M. de Quatrefages exhibited to the French Academy of Sciences a living specimen of a double monstrous Fish. The observations made by M. de Quatrefages on the occasion of this exhibition have given rise to a discussion upon the phænomenon of double monstrosity in Fishes, in which several of the most distinguished physiologists of France have taken part, and although, as might be expected from the nature of the subject, no very decisive results have been obtained, there seems to be every reason to hope, from the zeal with which these gentlemen appear to be devoting their attention to the solution of the interesting question of the mode of production of these monstrosities, that their researches may eventually throw considerable light, not only upon the particular phænomenon in question, but also upon the origin and development of the normal embryo. For this reason we have thought it advisable to give a short account of some of the leading statements that have been made, in the hope that by so doing we may call the attention of some of our readers to this interesting subject.

The monster exhibited by M. de Quatrefages had been observed by him for a period of nearly two months. When he first received it, it consisted of two young fishes, completely separated from each other and adhering to the opposite sides of a vitellus, which exhibited a deep notch in front. Each of these embryos exhibited a certain amount of deformity,—one, the largest, had the face deformed and the eyes entirely wanting, whilst the other parts of the body were perfectly developed;—in the other the head was well-formed, the body humped and the tail twisted. The two abdominal veins (afterwards converted into the *venæ portæ*) were in their usual position, and their ramifications spread over the whole surface of the vitellus, communicating at their extremities with the roots of the vitelline veins, which afterwards form the hepatic veins. It is remarkable also that numerous anastomoses united the last ramifications of the abdominal vein of each embryo with those of the vitelline vein of the other, so that a continual interchange of blood took place. [According to M. Coste the circulation in double monsters is common to the two embryos,—the greater part of the blood which has circulated in the body of one passing into the vessels of the umbilical vesicle [abdominal vein], whence the greater part of it is conveyed by the vitelline vein to the auricle of the other embryo and so on, and in accordance with this reciprocal circulation the contractions of the two ventricles take place alternately.

M. de Quatrefages, however, states that such was not the case in two instances observed by him.]

On the 19th February, nearly a month after the specimen came into the possession of M. de Quatrefages, and about six weeks after its exclusion from the egg, the two embryos were close together and ready to unite on one side of the abdomen, whilst on the other they were still separated by a considerable space occupied by the vitellus. When exhibited to the Academy, the vitellus was nearly gone, and the larger of the two was nearly ready to feed. It had originally been placed to the right of the vitellus, but had become superior, lying somewhat across the smaller and more deformed individual, which it carried about with it.

The conclusion at which M. de Quatrefages arrives with regard to this monster is, that it is formed by the coalescence of two originally distinct embryos, and that the vitellus from which it was developed was also double, the point of junction being in his opinion indicated by the deep notch already mentioned at the anterior part of the vitellus. This opinion is also shared by M. Serres.

M. Coste however maintains that there is only a single vitellus and umbilical vesicle, since at whatever period these monsters may be observed, the vesicle is always simple; and this view is further supported by the intimate connexion between the circulatory systems of the two embryos. He considers that as the external lamina of the umbilical vesicle really forms a common abdominal wall enclosing the vitellus, it is impossible to regard the two embryos as distinct individuals developed at the poles of a double vitellus and becoming coalescent at a late period of their growth, as they are actually united from the first into a single organism by this membrane, and their subsequent union is only effected by the gradual contraction of this membrane as the vitellus becomes absorbed. This conjugation is consequently a primordial phænomenon, and of a much more intimate nature than one of simple adherence, such as the case cited by M. Geoffroy Saint-Hilaire, in which two chickens, hatched from two separate yelks contained in the same egg, were found to adhere to one another by the belly.

M. Lereboullet holds the same opinion with M. Coste, regarding the primitive simplicity of the vitellus, and his observations (made upon the eggs of the Pike) appear to be tolerably conclusive upon this point. He states that in the eggs of the Pike the development of the embryo commences at the moment when the blastoderm has almost completely enclosed the vitellus, by the formation of a small triangular tubercle on the blastodermal ridge (*bourrelet blastodermique*), and that from this centre the embryonic fillet takes its rise. In many cases the ridge of the blastoderm bears two tubercles, from each of which an embryonic fillet is produced, and the further development of these gives rise to double embryos of various kinds. It appears from a statement of M. Lereboullet, that the formation of these monsters may be determined at pleasure by placing the eggs in unfavourable conditions for development.

M. Lereboullet describes the formation of several varieties of these double monsters. 1. In some instances two tubercles were produced on the margin of the blastoderm, from each of which proceeded a fillet furnished with a dorsal furrow, forming two embryos adhering to the marginal ridge. Soon afterwards the divisions of the vertebræ made their appearance, the external ones having their ordinary form and dimensions, whilst the internal gradually became confounded, passing from the body of one embryo to that of the other, thus causing the partial amalgamation of the two embryos. In this manner a double fish is formed, arising from two primitive germinating points produced upon the blastodermal ridge, so as to become partially joined; it has therefore two separate bodies with a common tail. A specimen of this description, in which the fusion of the double embryo had extended to about the middle of the body, lived for four days after exclusion from the egg.

2. In other eggs the blastodermal ridge gave rise to a long and broad fillet terminated anteriorly by two rounded lobes. *Two* parallel furrows made their appearance in the fillet, and soon exhibited the vertebral divisions, whilst the anterior lobes acquired a determinate form, and each produced two ocular vesicles, constituting an embryo with a single body and two distinct heads. In these cases however the duplicity was transitory; the two heads soon came in contact, and became soldered together in such a manner as to form only a single head. M. Lereboullet has observed these phænomena in about fifteen instances, but could never ascertain in what manner the fusion of the two heads was effected. In some cases the two heads appear to remain distinct.

3. One of the most remarkable monstrosities is that presented by some embryos with a single head, two separate bodies, and one or two tails. These are formed in the following manner:—the ridge of the blastoderm, which has the form of a gaping button-hole, produces a single cephalic tubercle, but the formative process goes on in the whole circumference of the margin, each half of which acquires a *chorda dorsalis* and a nervous cord, and soon exhibits the divisions of the vertebræ. When the cephalic tubercle is short and only gives rise to the true head, each of the two bodies is furnished with two auditory capsules,

two pectoral fins and a heart; but when this tubercle is more elongated, the anterior part of the body is simple, and bears two eyes, two auditory capsules and a single heart, and the body is terminated posteriorly by two short branches.

4. This organization of the ridge of the blastoderm into a double embryo seems to explain an extremely curious form which only occurred once in M. Lereboullet's observations. This consisted of a simple embryo, bearing on the right side of its body a small tubercle, directed backwards, and terminated by an auditory capsule and an active heart. The production of this form is accounted for by the resorption of the parts of the body posterior to the heart in one of the embryos, and M. Lereboullet has witnessed the complete disappearance of one of the bodies in other instances.

5. In another egg the ridge of the blastoderm exhibited two contiguous tubercles, of which one had the ordinary form of the cephalic tubercle, whilst the other was smaller and irregular. The former alone acquired a furrow and gave rise to an embryo, on one side of which the smaller tubercle was borne.

6. Occasionally bodies furnished with three heads make their appearance. One of these is described by M. Lereboullet. It was a double embryo, composed of two bodies united behind, but quite free in front. One of these bodies was of the normal form; the other bore two heads, of which that on the left was of the normal form and furnished with two eyes, whilst that on the right only bore the right eye, the union of the two heads being effected at the point where the left eye ought to have been. This singular embryo was still in the egg when described; it had two hearts, one common to the two principal bodies, situated at their bifurcation, the other placed in the angle of union of the two heads.

M. Lereboullet explains the formation of this anomalous creature in the following way. He considers that two fillets have been formed, one of which has been terminated by two cephalic lobes and acquired two furrows (as described under 2.), whilst the other has remained simple. These two embryos have then united posteriorly (as under 1.), producing an embryo with one tail, two bodies and three heads.

7. An extraordinary result was obtained when the development of the eggs was retarded by a considerable diminution of temperature. In this case the ridge of the blastoderm produced no embryo, but contracted gradually like the opening of a bag, its substance becoming condensed and forming a mammillated tubercle projecting from the surface of the vitellus. This tubercle continued living, rose more and more from the surface, acquired a lingulate form, and at last constituted an elon-

gated body, narrowed in front, divided transversely into vertebral lamellæ, *without dorsal cord, or sensitive organs, but furnished with a heart,* of which the contractions were sometimes very lively.

These observations, as M. Lereboullet well observes, appear to prove that the generally received opinion that double monsters are produced by the fusion of two embryos is perfectly correct, whilst that which attributes a separate vitellus to each of these embryos is not founded in fact. He considers that his observations, with those of Valentin, show that there is only a single germ, but that this, by becoming developed in two directions, instead of one as in normal cases, gives rise to two more or less distinct embryos. In his opinion the ridge of the blastoderm (*bourrelet blastodermique*) plays a most important part in the formation of the embryo, and in fact constitutes the "true embryonic germ, which is always simple and single, like the vitellus which is covered by the blastoderm, but when its development is deranged from its regular course, is capable of vegetating like the substance of which the bodies of polypes are composed, so as to produce various forms, which however, in their subsequent development, always show a distinct tendency to return to the original type of the species."

PROCEEDINGS OF LEARNED SOCIETIES.

LINNÆAN SOCIETY.

December 5, 1854.—William Yarrell, Esq., V.P., in the Chair.

Mr. Ward, F.L.S., exhibited two sets of specimens of *Asplenium lanceolatum,* from Jersey, both found growing on disintegrated sandstone, exhibiting a striking difference between the growth of the same species on an open sunny bank and in dense shade.

Mr. John Hogg, F.R.S., F.L.S., exhibited some scales, and a piece of the scaly covering which was cut from the back of a large fish found in the river Tees, in September of this year. He stated that two fishermen observed a great fish—such as they had never before seen—left by the tide on a sand-bank, in the estuary of the river Tees. They described it as having the head of a salmon, with the back-fin like that of a perch, erect, and somewhat spiny, and the tail spreading and much curved. The colour they did not mention, except that of the back, which was represented as being of a purplish-black. They likewise particularly observed some large scales on the front of the fish near the gill-covers, one of which Mr. J. Hogg also exhibited, and which is of a very strong bony texture. From the account of this fish so given, Mr. Hogg conceived that it could only have been a large Tunny (*Thynnus vulgaris* of Cuvier), which had been stranded whilst in pursuit of herrings or other small fishes. MM. Cuvier and Valenciennes in their 'Hist. Nat. des Poissons,' tom. viii. p. 57, separated the Tunnies from the Mackerels (*Scomber*), in consequence of the "remarkable disposition of the scales on the thorax, which are larger and more unpolished than the others, and form around that part a sort of corselet?" They also describe the corselet of the Common Tunny thus:—"Le corselet, c'est-à-dire cette portion du tronc couverte d'écailles plus grandes et moins absorbées dans la peau, est considérable." (p. 62.) This, however, would seem to lead to an incorrect view of the smaller scales on the back, which are, as it were, enclosed between two skins, and are placed in a somewhat imbricated manner, resembling the arrangement of the slates upon a roof, and cannot properly be termed "absorbées dans la peau." Mr. Hogg showed the nature of the piece of the external covering which the fishermen had cut off the back; the outside skin being of a dark, or nearly black colour, and of a coriaceous substance. The white scales, imbedded in it, are similar to those forming the corselet near the gill-covers, but they are much smaller, and so closely placed by one overlapping the other, that they constitute a perfect defence against nearly every kind of danger. The piece so cut off the back of the fish, which was done with some difficulty, resembling a portion of a shield, would seem to be (from the close disposition of the osseous plates or scales enclosed between two skins) proof against large shot, or even a ball from a musket. Both the external large plate-like scales forming the corselet, and those, arranged in a slate-like manner, between the skins, are of an irregular, but somewhat round, or oval, shape. When seen from the outside of the external black skin, the plain parts between the extremities of four scales, present, by the overlapping of their edges, a somewhat regular appearance, and are of a nearly uniform size, viz. about half an inch in length, by a little more than one-eighth of an inch in width, and they thus exhibit much of a diamond pattern.

Mr. Hogg observed, that ichthyologists seem not to have described this remarkable protection, presented by the thick skins, and strong bony interlaminated scales, which is evidently a beautiful provision of Nature to defend these fishes from the attacks of their enemies, and especially those of their greatest foe, the sword-fish.

Read a paper "On *Decaisnea*, a remarkable new genus of the tribe *Lardizabaleæ*," by J. D. Hooker, Esq., M.D., F.R.S., F.L.S., and Thomas Thomson, Esq., M.D., F.L.S.

The small family of *Lardizabaleæ*, which was first instituted many years ago by Mr. Brown, and characterized by the distribution of the ovules over the whole surface of the ovary, was afterwards admirably illustrated by M. Decaisne in a memoir in the 'Archives du Muséum.' Though the peculiar distribution of the ovules has always been justly regarded as the most striking characteristic of *Lardizabaleæ*, it is by no means the only peculiarity of the order, which may be distinguished from all its near allies by a considerable number of very striking characters, sufficiently proving the distinctness of the order even where the prominent characters of the insertion of the ovules and the digitate leaves are absent. This is remarkably the case in the plant to which the authors of this paper called the attention of the Society, and of which a figure was placed on the table.

This interesting plant, which was originally discovered in Bhotan, by Mr. Griffith, is briefly referred to in his 'Itinerary Notes,' under the name of *Slackia insignis*, a name evidently imposed on a conviction that the many striking characters which it presents warranted the establishment of a new genus, to which, however, no characters were assigned. That name having (before the publication of these 'Itinerary Notes,' in which it was only a manuscript designation,) been applied by Griffith himself, in his 'Essay on Palms,' to a genus of that order, the authors proposed to designate the plant now described, *Decaisnea*, after the distinguished monographist of the group to which it belongs, as the two genera of *Orchideæ* which have been so called have both proved to have had earlier names.

Decaisnea, *Hf. & Thoms.*

Sepala 6, lineari-subulata. *Petala* 0. *Stamina* in flore masculo monadelpha, in hermaphrodito parva libera. *Ovaria* 3, lineari-oblonga. *Ovula* placentis 2 filiformibus parallelis, suturæ ventrali approximatis sed ab eâ discretis, inserta, indefinita, anatropa. *Folliculi* pulpâ repleti. *Semina* indefinita, compressa; testâ lævi, nitidâ, crustaceâ, atrofuscâ.

Frutex *Himalaicus erectus*; foliis *alternis, pinnatis*; inflorescentiâ *racemosâ, terminali*; floribus *pallidè viridescentibus.*

Decaisnea insignis is a native of the temperate parts of the Eastern Himalaya, at elevations between 8000 and 10,000 feet. As mentioned above, it was first discovered in Bhotan by Griffith. Dr. Hooker's specimens are from the interior of Sikkim. It is an erect shrub, with large simply pinnated leaves, and a nearly simple trunk, marked by large scars after the leaves fall away, as in many *Araliaceæ*. The nearest analogy is no doubt with the section *Mahonia*, of the genus *Berberis*, but the leaves of *Decaisnea* are soft and thin, not rigid and prickly as in *Berberis*. The flowers are arranged in elongated racemes, and closely resemble those of other *Lardizabaleæ*. Their colour is pale green, slightly tinged with purple towards the apex. The sepals are elongated to a subulate point, and there are no petals. The stamens on the male flower are monadelphous, and very like those of *Stauntonia* or *Parvatia*. In the fertile flower the stamens are free and very small, but the anthers always contain pollen, so that the flowers are rather polygamous than dioicous. The most remarkable character is exhibited by the ovaries, which, though externally not unlike those of *Hollböllia*, have the ovules arranged in a double series along two elevated lines, one on each side of the ventral suture, and not scattered over the whole surface of the ovary as in all the other genera. The same arrangement is preserved in the ripe fruit, which consists of three large follicles full of an agreeably-flavoured solid pulp, dehiscing along the ventral suture, so as to expose to view the numerous shining black seeds, in structure like those of *Hollböllia*.

The characters of this remarkable plant are so striking that no lengthened detail is necessary. It will suffice to call attention to its importance, as affording an indication of the value of characters in the class of plants to which it belongs. An inspection of the figure (which is intended to form one of the plates of Dr. Hooker's 'Illustrations of Himalayan Plants' now in preparation) shows that, notwithstanding its remarkable alteration from the character which has hitherto been considered as most essential to *Lardizabaleæ*, it is an undoubted member of that group. At the same time it illustrates, by many points of structure, the relationship of that tribe to all the surrounding orders. The proof which it affords that the apparently very aberrant structure of fruit in which the ovules are scattered over the whole surface of the ovarium, is compatible in the same order with the normal structure, and is therefore reducible to it, and as it were only a modification of it, is especially interesting, and sufficiently, the authors trust, justify them in bringing the plate just completed to the notice of the Society.

Read also observations "On the Identity of *Pinus hirtella* and *Pinus religiosa* of Humboldt, Bonpland, and Kunth." By Berthold Seemann, Esq., Ph.D., F.L.S.

Dr. Seemann states that a short time ago, when determining the *Coniferæ* gathered by himself in the western parts of Mexico, he was glad to find that he had amongst them specimens of the *Pinus* (*Abies*) *hirtella*; but on comparing them with those named *Pinus* (*Abies*) *religiosa* in the herbaria of Sir W. J. Hooker and Mr. Bentham, he observed that the latter too, without exception, had *hirtellous* branches; and again, on examining specimens of *P. religiosa* growing in the Royal Botanic Gardens of Kew, as well as at various other horticultural establishments, he found that they did not differ in any way from those of *hirtella* collected by himself. As the only difference between *P. religiosa* and *P. hirtella* insisted upon by writers on *Coniferæ* consists in the former having glabrous, the latter hirtellous branches, he was forced to conclude that all the specimens of *P. religiosa* which he had seen in this country ought to be called *P. hirtella*, unless it could be shown that *P. religiosa* had (notwithstanding Humboldt's, Bonpland's, and Kunth's description) hirtellous branches. In order to ascertain this point, he addressed a letter on the subject to Mr. George Gordon, at the Horticultural Society's Gardens at Chiswick, a gentleman of great practical experience, who, in a letter dated Chiswick, Nov. 11, 1854, kindly replied, that "having taken a good deal of interest and pains in the matter, when Mr. Hartweg was collecting in Mexico, and begged him to examine minutely Humboldt's and Bonpland's localities, and see what their *A. hirtella* was, he did so, and could discover no other species than the 'Oyamel,' or *Abies religiosa*. He found *Abies religiosa*, and carefully examined the same in various places between 15° and 22° S. Lat.; but its chief range was about 19° and at an elevation of 9000 feet. He found it on the 'Campanario,' the highest point of the mountains of Angangues, 5 or 6 feet in diameter, and 150 feet high; at other places very much smaller and stunted, but still the same species; and I have, as well as Hartweg, after carefully examining all these facts, come to the decided conclusion that both names, *P. hirtella* and *P. religiosa*, belong to the same species; and that the error arose from describing imperfect specimens, and not having cones of *A. hirtella* to compare with the 'Oyamel' of the Mexicans."

Finding that Mr. Gordon's opinion coincided so entirely with his own, in order to settle the point definitively, Dr. Seemann requested his friend Dr. Charles Bolle, at Berlin, to examine Humboldt and Bonpland's original specimens of *P. religiosa*, and to ascertain whether they had glabrous or hirtellous branches. In a letter just received from that botanist, dated Berlin, Nov. 24, he says,—"I congratulate you upon your power of divination, for the authentic specimens of *P. religiosa* in the Royal Herbarium have certainly hirtellous branches." We may therefore conclude that *P. religiosa* and *P. hirtella* are identical, and consider the difference thought to exist between them as entirely attributable to imperfect descriptions. As the names were both given at the same time, it becomes a question which of the two ought to be adopted. The name *hirtella* might appear the most appropriate, as indicating a botanical character; but as that of *religiosa* is so much more diffused, and as the plant is used in Mexico, on account of its elegant branches, for ornamental purposes on religious festivities, Dr. Seemann determines in favour of the name *P. religiosa*.

Read further "Remarks on Fossil Palms." By Dr. Göppert, Professor of Botany in the University of Breslau.

These remarks are the result of a letter addressed by Dr. Seemann to Dr. Göppert, requesting to be favoured with a brief summary of all that is known of fossil Palms, and they have appeared to Dr. Seemann of so much interest as to induce him to lay them before the Linnæan Society. They are as follows:—

"During the last, and even the first quarter of the present century," says Dr. Göppert, "so little was known of the structure of Palms, and all that was known appeared so abnormal to the scientific men of those days, that they were only too readily inclined to class with the Palms almost all fossil plants presenting strange and anomalous forms. This remark applies with full force to *Sigillaria* and *Lepidodendron*, genera belonging to the Palæozoic formation; and startling as it may be, it cannot be very surprising to us, when we consider that even in our own times notions equally erroneous prevail to an almost incredible extent. For instance, a principal share in the formation of coal is still ascribed by the generality of geologists to the *Ferns*, although it has been proved by me, by a series of careful observations on numerous carboniferous formations, that such can be claimed only for the *Sigillarias* and *Stigmarias*; that a subordinate share only is due to the *Araucarias* and *Calamites*, contained in the anthracite coal; and a still less significant portion to the *Lepidodendrons*, the *Ferns*, and the remaining members of the flora of the Carboniferous period.

"A diligent study of the extinct flora has demonstrated that the Palms occur more *rarely* than was thought in the transition rocks and the Carboniferous formation, and more *frequently* than was believed in more recent formations. Generally speaking, we know at present only trunks, leaves (both fan-shaped and pinnatisect), and a few fruits of fossil Palms; flowers have as yet not been discovered, and the spathes collected have hitherto not been satisfactorily proved to belong to the natural order under consideration. These fragments, remnants of members of former creations, have been distributed under nine genera and seventy-eight species. For the trunks, there have been adopted the genera *Palmacites*, Brongn., and *Fasciculites*; for the leaves, *Flabellaria*, Sternb., *Zeugophyllites*, Brongn., *Phœnicites*, Brongn., and *Amesoneuron*, Göpp.; for the spathes, *Palæospatha*, Unger (founded, as has been stated, upon doubtful materials); for the fruits, *Baccites*, Zenk, and *Castellinia*, Massal. The genus *Burtinia* of Endlicher, placed by Unger among Palms, belongs without a doubt to *Pandaneæ*, and is identical with *Nipadites*.

"Although our present imperfect knowledge of fossil plants renders it an almost useless task to speak of the proportion which the number of Palms bears to that of the other members of the extinct flora, yet it may be remarked that, if the number of species of the fossil flora is assumed to be 4000,—there are actually 3945 described,—Palms constitute about the eighty-fourth part of the whole. In the transition rocks no remnants of Palms have as yet been discovered; in the Carboniferous formation five species have been noticed; in 'Kupfersandstein,' or the Permian formation, only two species have been collected; in the secondary class of rocks which succeeds (Keuper, Bunter-Sandstein, Muschelkalk, Lias-Jura, and Wealden formation), none have been collected except three species in the Cretaceous formation, especially in Quadersandstein. The greatest number has been found in the Tertiary class of rocks, viz. sixty; twenty-nine of which belong to the Eocene system, and thirty-one to the Miocene formation. The habitat of nine species is unknown.

"It will be seen from this synopsis that there was a geological period when Palms were entirely wanting in the extinct flora, or when, after their first appearance on the globe, they vanished again, and after a lapse of time reappeared; a state of things, which if confirmed by future investigations, would certainly be highly curious, and is one never before observed in a like manner in any large group of plants. No species is common to two formations. Several species show a remarkable degree of resemblance with those of the flora now existing, especially some of those collected by Junghuhn in Java, as for instance, *Amesoneuron calyptro-calyx*, Göpp., *A. dracophyllum*, Göpp., *A. fagifolium*, Göpp., and *A. anceps*, Göpp. But it would be rather bold, perhaps injudicious, to attempt identifying them, from the fragments hitherto collected, with those of the present flora. The results hitherto obtained only entitle us to say,—Palms make no exception to the rule generally received, that the laws governing the vegetable kingdom were the same in all periods of our earth's history when plants existed; and that the species of Palms have a very local geological, as they have a very local geographical distribution."

December 19.—Thomas Bell, Esq., President, in the Chair.

Read a Memoir "On the Food of certain Gregarious Fishes." By Robert Knox, Esq., M.D.

Dr. Knox's inquiries were commenced about thirty years ago, and the results then arrived at were communicated to the Royal Society of Edinburgh, in whose 'Transactions' a notice of the paper was published. Since that period the observations have been repeated on many occasions, and the author does not find it necessary to alter or modify the statements which he originally made. His attention was first directed to the fact, that in the stomachs of Salmon, fresh from the recesses of the ocean, nothing is ever found except a small quantity of a peculiar reddish substance, unlike anything known to possess life. Practical fishermen agreed in the opinion, that the food of the Salmon, while resident in the ocean, was altogether unknown; neither could they give any satisfactory account of that of the Herring. Having learned accidentally, that in a lake or lakes near Lochmaben there existed in great abundance a small fish (the Vendace) which could not be tempted by any bait, and whose food was entirely unknown, he determined to visit Lochmaben, and make this fish, so easily procured, the subject of his researches. Dozens of Vendace were taken in nets, and immediately opened; and their stomachs were found crammed with thousands of *Entomostraca*, which were immediately recognized on placing a portion of the contents of the stomach under a strong lens. The species first discovered belonged to the genus *Lynceus*; but several other genera were subsequently observed; and in winter, that is to say, on the 14th of December 1832, several species of *Cyclops*, Müll., most abounded. The notion that the Vendace dies immediately on being taken out of the water, Dr. Knox found to be quite erroneous. It is by no means a very delicate fish, and could easily be transplanted to other lakes; but its good qualities have been much exaggerated.

The author next enters into some detail on the distinctive characters of a number of Vendace, both males and females, caught partly in the Castle Loch and partly in the Mill Loch, and which were carefully examined by his brother with a view to their supposed specific distinction. He treats as a delusion the idea that the males live apart from the females in deeper water, for a single draw of the net in the Castle Loch, in the presence of Mr. Murray and himself, was found to produce nine females and six males, although of forty taken in the Mill Loch at one time only two were males.

Dr. Knox then turned his attention to the food of the Char, of which some fine specimens were obtained from Windermere; and the food of these, which also proved to consist of *Entomostraca*, was exhibited to the Royal Society of Edinburgh. The Char is a gregarious, deep-swimming fish, and shy of taking any bait; but nevertheless it will rise to a fly, and the common food of the Trout may be found in its stomach, although the author has not himself met with it. It does not seem to feed so exclusively on *Entomostraca*, although these unquestionably form the larger portion of its natural food. The observations on this fish were several times repeated, and always with the same results.

The Early-spring or Grey Trout of Lochleven form the subject of the next series of observations. Dr. Knox had many years ago remarked a distinction, which he is still disposed to believe may be specific, although anatomical investigation has not hitherto confirmed it, between the ordinary Trout of the lake and this, which is in the highest condition at the end of December, and in the months of January, February and March, a period in which all other descriptions of Trout are worthless as food for man. On an examination of these Trout in the month of January, they were found to be filled with *Entomostraca*, which the author has always found to constitute the food of the early spring Trout of Lochleven. During the remainder of the year, the ordinary Lochleven Trout live on the *Buccinum* and the common food of Trout, with which the lake abounds; they rise readily to a fly, and may be taken with worms or minnows, or any of the ordinary bait used for Trout.

In regard to the Herring, which next formed the subject of Dr. Knox's investigations, the great difficulty was to obtain specimens from the deep sea in fine order, and as remote as possible from the spawning condition, inasmuch as when found near the coast the Herring is either about to spawn or has already spawned; and in these states it is more or less of a foul fish, and the food taken by it at these times is not to be regarded as its natural food in the ordinary state. Of the hundreds and hundreds of deep-sea Herrings examined with this view, the author remembers only three in whose stomachs anything was found excepting *Entomostraca* of various species. Of these three, one had been feeding on sand-eels, another on what appeared to be small herrings, and the third on a small shell-fish, apparently a *Buccinum*. When near the coast, and before spawning, the Herring is frequently not feeding. The stomachs of a great number of Herrings taken in the Frith of Forth in January and February 1834, were found quite empty. After spawning, and while still close to the shores, they seem to take to other food, such as sand-eels and shrimps. This was the case with Herrings taken off Dunbar in June 1831, at which time the stomach and intestines were loaded with putrescence, and the fish worthless and insipid. The author's own repeated observations and those of his brother confirm the fact, already well ascertained by practical men, that shore-fisheries of fish whose habitat is the deep sea, seldom produce the fish in prime condition. Of this truth the deep-sea fisheries of Cod and Haddock, as compared with those caught high in estuaries, also afford good examples. A long series of observations, establishing this position in regard to the Herring, are then given. And lastly, Dr. Knox states that his friend and former pupil, Mr. H. D. Goodsir, one of the enterprising companions of Sir John Franklin in his last fatal expedition, having been requested by him to push the inquiry to the utmost, that lamented naturalist undertook a series of excursions in the fishing-boats, not only in the Frith of Forth, but also to the fishing-ground near the Isle of May, and in the open sea. The author transcribes one of Mr. Goodsir's letters, dated "Anstruther, June 15, 1843," in which he states, first, that "the *Entomostraca* are at certain seasons the almost exclusive food of the Herring. There can be no doubt that they follow shoals of these *Crustacea* to prey upon them, for it is only when the latter make their appearance on this coast that the former are seen, and when the food is most plentiful the Herrings are in best condition. It is during the summer months also that we find the larvæ of the more common species of *Decapoda*, along with those of *Balani*, and occasionally a minute shell-fish, among the contents of the stomach. Secondly, it appears to be chiefly during the winter and spring months that the Herrings take other kinds of food than the *Entomostraca*; during these months we find the stomach oftener empty, and only occasionally filled with *Crustacea*, such as shrimps, &c.; in other cases with *Entomostraca*. Thirdly, as to *Entomostraca* being the partial or exclusive food of other fish besides the Herring, there can be no doubt that during the summer months, when the shoals of *Entomostraca*, or what our fishermen term *Maidre*, are in great abundance, they form the food of a great number of other animals besides the Herring. The common Coal-fish is particularly the species which, next to the Herring, preys on the *Maidre*. It appears to me also that the shoals of *Cetacea*, which make their appearance in the Frith during the Herring season, are in pursuit of the *Maidre*, and not of the Herring, as is most generally thought." To these facts, thus confirmed, Dr. Knox would especially call the attention of M. Valenciennes; they are most important to man in regard to the Herring-fisheries, and explain certain œconomic statistics bearing on the great fisheries of Holland, otherwise wholly unintelligible. The naval power of the ancient Republic of Holland was connected with, and based on, a deep-sea Herring-fishery; while the modern Herring-fisheries of France and England and the Scandinavian States are shore- and boat-fisheries, of little value as a food-producing employment, and of no value whatever in a naval point of view. Dr. Knox concludes this branch of the subject with extracts from the works of Sir Gilbert Blane, Dr. M'Culloch, and Leeuwenhoek, showing the total obscurity in which the food of the Herring was involved prior to the time when he first communicated the result of his observations.

Lastly, the author proceeds to examine the question as regards the Salmon. From about midsummer, but more especially with the autumnal floods, Salmon and Sea Trout of various sizes begin to rush up the freshwater streams and rivers, their object being clearly to make their way to the place of their birth, there to provide for the propagation of their species. From the time the Salmon enters the fresh water it ceases to feed, properly speaking, although it may occasionally rise to a fly, or be tempted to attack a worm or minnow, in accordance seemingly with its original habits as a smolt. But after first descending to the ocean and tasting its marine food, it never again resorts to its infantile food as a constant mode of nourishment. This great fact, well understood by fishermen and anglers, has been placed by Mr. Young of Invershaw beyond all doubt. Nothing is ever found in the stomach or intestines of the fresh sea Salmon but a little reddish substance, and this Dr. Knox, after a careful microscopic examination, concluded to be the ova of some species of *Echinodermata*. Of the Salmon, while in the sea, this is therefore the sole and constant food. Sea Trout also live on it, but they readily take to other food even in the sea, such as sand-eels, herring-fry, &c. The absence of this kind of food forms an insurmountable obstacle to the preservation of Salmon and of some kinds of Sea Trout in freshwater lakes. M. Valenciennes describes the Salmon as voracious, and states that its food consists of fishes—*Ammodytes Tobianus*; but Dr. Knox maintains that there exists not a single fact in the history of British Salmon to support this opinion. He refers to various fanciful theories suggested by fishermen and others in regard to the marine food of the Salmon; and concludes by stating that in spring, as the spawn fish are descending with the smolts, they may occasionally be tempted with an artificial fly or lob-worm, but as to their feeding regularly in rivers, Mr. Young's experiments have negatived the assumption beyond all doubt.

With regard to the *Entomostraca* themselves, they are abundant in the sea as well as in freshwater lakes; and it is easy to see by their remains in the limestone of Burdiehouse and of other quarters that they played an important, perhaps the same, part in the œconomy of the ancient world as they do in this, serving as food namely to countless shoals of gregarious fishes, which abounded then as now in fresh and in marine waters. The *Entomostraca* of the Southern Hemisphere differ seemingly from those of the Northern; that they serve there also as the food of gregarious fishes was proved by the author's brother many years ago in respect of the so-called Herring of the Bay of Islands. They vary considerably in size, and seem to extend from pole to pole, consuming the organic remains, which but for them might speedily infect the ocean itself.

The paper was accompanied by magnified drawings of the species of *Entomostraca* found in the stomachs of the Vendace and of the Herring.

ZOOLOGICAL SOCIETY.

February 14, 1854.—Dr. Gray, Vice-President, in the Chair.

Notes on the Habits of Indian Birds. Part II. By Lieutenant Burgess.

Family Strigidæ.

Genus Urrua, Hodgs.

Urrua Bengalensis.

I have found this large Owl common on the banks of the large rivers, as also amongst the low jungly hills and patches of brushwood in the Central Deccan. It appears to prefer the small bushy ravines covered with high grass, which lead down from the high banks into the beds of the larger streams and rivers. When seated on the top of a bush in the dim twilight, it forms quite a formidable object, the gloom making it appear larger than it really is. It does not appear to be strictly nocturnal, as I met with one sitting on the sandy shore of the river Bheema some time after the sun had risen. I never found the eggs of this bird; but I have been informed, on good authority, that they make their nest at the foot of bushes in the tall grass, and lay four white eggs. I kept three nestlings of this species for some time. When brought to me out of the nest, they were covered with down of a chestnut colour, spotted and streaked with dark brown. This Owl breeds during the months of March and April.

Genus Noctua.

Noctua Indica, Frank.

This is a very common Owl in Western India, so much so that every grove, and almost every large tree, appears to have some of this clamorous family inhabiting its holes and crevices. It is a most noisy bird, screeching and screaming ere the shades of evening draw on, and becoming quite a nuisance to any one pitched under the tree frequented by them. It appears to be very little incommoded by a strong light, moving out of its hiding-place before the sun is down, flitting backwards and forwards amongst the branches and from tree to tree. In the month of June I saw a pair of these little Owls sitting on the bare branch of a tree, with the brilliant morning sun shining full on them; in fact, they appeared to be sunning themselves. On another occasion I shot a pair, sitting on a ledge of rock, in the full blaze of the setting sun. If disturbed during the day, they fly about with the greatest activity, uttering their squabbling note, and look down on the intruder from above with eyes that appear in no way incommoded by the light. In the stomachs of the last pair above mentioned, I found the wing-cases and legs of beetles. This little owl breeds during the months of February and March, laying three or four eggs of a pure white colour, nearly $1\frac{3}{10}$ in. long and $1\frac{1}{10}$ in. broad. They lay their eggs in holes of trees.

Order II. INSESSORES.

Tribe DENTIROSTRES.

Family LANIADÆ.

Subfamily LANIANA.

Genus LANIUS.

LANIUS HARDWICKII.

This handsome little Shrike migrates, I believe, from the Deccan for the purpose of breeding, probably resorting to the thickets and ravines of the Western Ghauts, and returning to the Deccan about September. I could not find its nest when on the hills in the month of October; but I shot a young bird, which may probably be the young of this species. I give a description of its plumage. Beak rich deep brown; chin and throat dirty brownish-white; under plumage and under tail-coverts white; flanks dull grey; white streak passing from the beak over the eye and ear-coverts; ear-coverts and patch behind the eye dull black; top of the head and nape of the neck brownish-grey, the feathers having very pale whitish ferruginous tips; feathers on the lower part of the neck and back are on their basal half grey, and the remaining portion greyish-brown with light tips. On the lower part of the back the feathers are very filmy and thick-set, of a grey colour, with a dark band near their ends, and tipped with white. Primaries hair-brown; bastard wing brown; greater coverts lighter brown with pale tips; secondaries hair-brown; tertials paler brown, with light edges. Tail consists of twelve feathers; the two outer are white, with pale brown near the ends on the outer webs. The next feather has also a dark spot near the tip on the inner web; the third feather is nearly black, with a white spot on the inner web about half an inch from the end; the remaining feathers are of a black-brown, being nearly black on the inner webs; lesser coverts pale brown with light tips; feathers on the thighs of a pale grey-brown with white tips; legs and feet lead-colour; claws pale brown; the legs and claws have a white powdered look in several places, especially near the junction of the scales. This may perhaps have been the young bird of the large rufous-backed Shrike, *Lanius erythronotus*.

LANIUS EXCUBITOR. LARGE GREY SHRIKE.

This is very common in the Deccan. It is generally seen seated on the top of small babool trees, or other thorny bushes, in open country, and may be distinguished at some distance by its silvery-white breast. When disturbed, it flies low to some neighbouring bush, on the top of which it alights, uttering its harsh and grating cry. The Grey Shrike begins to breed as early as January, as a boy brought me a pair of nearly fledged young ones on the 2nd of February. They almost, if not invariably build in a thorn bush, and generally well into the centre. I subjoin a note penned at the time of finding one of their nests:—" 15th May. Saw a pair of Grey Shrikes building in a place I never saw this species building in before, viz. on the *outside* branches of the babool tree. The nest was composed of a thorny twig or two of babool and thick bents of grass." Another nest was made in a thorny bush, about 5 feet from the ground, and *close* to the stem of the bush; it was composed of twigs of the thorn bush, pieces of cotton and a piece of rag, with grass interwoven into it. This nest contained three eggs. It is now in the Museum of the Zoological Society. The eggs are a little less than an inch in length, by a little less than $\frac{8}{10}$ in. wide, of a white ground, spotted and mottled, especially at the large end, with grey and red-brown.

I believe that this Butcher Bird, like the last-mentioned, migrates from the Deccan during the monsoon, returning about September. It would form a very interesting subject for investigation, as to what families of birds leave the Deccan during the monsoon, whither they betake themselves, and for what purposes. I have frequently made inquiries, but could not learn anything satisfactory on the subject.

Subfamily Dicrurinæ.

Genus Dicrurus.

Dicrurus macrocercus. Drongo Shrike.

This bird is not much indebted to variety or richness of colouring in its plumage, for bringing it into notice; but its pleasant cheerful note and active habits must have been remarked by all observers of nature in India. Ere the peep of day it commences its pleasant twitter, and from sunrise to sunset it may be seen, now sitting on a bare spray watching for some passing insect, now perched on the back of a browsing cow or sheep, and then off in an instant in pursuit of a fly. I have seen one chase and capture a large white butterfly, which it appeared to have some difficulty in swallowing when caught, as it did not attempt to pull it to pieces, but was endeavouring to bolt it entire. They appear to have great antipathy to crows, chasing them with great vigour and boldness whenever one enters within their domain. I subjoin a note, made at the time, of the curious flight of these birds when hawking after flies. "Saw one of them (Drongo) perched on the outside branch of a tree hanging over a field of wheat; suddenly the Shrike descended close to the ears of corn on which the flies had settled in the heat of the sun, and commenced a most curious jerking flight up and down, as if it had been tossed up and down on the waves of the sea. After performing this dancing flight for some little time, it returned to its seat, and after remaining there a short time, descended and repeated its jerking flight." The Marahta name is Kolsa, the word for charcoal, alluding I suppose to its jet-black colour. The Drongo begins to build in the month of May, and Dr. Jerdon mentions having found its nest as late as August. I found its nest in a bush in a thick hedgerow; it was composed of roots, and contained three eggs of a rather reddish creamy-white ground, spotted with red spots; the egg is $\frac{9}{10}$ in. long by rather more than $\frac{7}{10}$ broad. The food of the Drongo consists of insects, moths, and butterflies.

Genus Phœnicornis, Swains.

Phœnicornis Peregrinus, Vig.

I have not met with the nest and eggs of the small red bird, but I believe the description given below is that of a young bird soon after it had left the nest. "18th September 1849. Whole of the upper plumage olive-green, mottled about the head with pale yellow, a large spot of which is behind the eye; tips of the lesser wing-coverts pale. Primaries and secondaries dark, with pale edges; breast and belly pale whitish-yellow, with yellow streaks; legs and feet pale lead-colour; claws soft, as also the edges of the beak."

Genus Iora.

Iora tiphia.

I have never met with the nest or eggs of this handsome little bird; but Dr. Jerdon, in his Catalogue of Indian Birds, says, "I once, on the west coast, in the month of September, met with a nest of this species in the fork of a low tree; it was more neatly and carefully made than any other of the few nests I have seen in this country. It contained young ones." The Iora has a most wonderful power of voice. At one moment it is heard uttering a low plaintive cry, at the next a shrill whistle; no one could have believed the notes to have issued from the same throat. On the 29th of August, 1849, I shot a female. The eggs in the ovaries were very large. The gizzard contained the remains of a curious green insect, partly covered with black hair. The tongue of this bird is furnished with two long muscles, as in the woodpecker.

Genus Hæmatornis.

Hæmatornis cafer. Common Bulbul.

This sprightly and truly Indian bird breeds during the months of August and September. The first time that I noticed them building in August was on the 11th, and I found a nest with one fresh-laid egg on the 25th of September. They build in thick bushes in gardens. I found two nests in my garden at Ahmednuggur, one built in a guava tree, and the other in a mass of creepers. The nest is composed of fine twigs, bound together here and there with cobwebs, and lined with fibres. The nest I send is lined with the fibre of the cocoa-nut picked off a cocoa-fibre mat. I observed the old birds picking at the mat when it was put out of doors. I do not know the number of eggs which their nest generally contains. The egg is $\frac{9}{10}$ in. in length by a little more than $\frac{6}{10}$ wide, of a rich madder colour, spotted and blotched with grey and madder-brown. The only egg which I possessed is unfortunately broken; but a drawing in my possession, most accurately painted by my sister-in-law, Miss Gardiner, gives it very correctly.

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

Descriptions of some new and little-known species of Birds from Northern India, contained in the Museum of the Hon. East India Company. By Frederic Moore, Assist. Hon. Comp. Museum.

Fam. Merulidæ, Vigors.

Subfam. Myiotherina, Swains.

Genus Pnoëpyga, Hodgs.

Syn. *Microura*, Gould (nec Ehrenb.).

1. Pnoëpyga longicaudata, nobis.

Colour of the upper parts deep olive-brown, the feathers slightly margined with black, and having blackish shafts; wings and tail inclined to ferruginous brown; upper tail-coverts long; throat whitish; breast and sides of abdomen pale dusky ferruginous, the feathers having pale centres and blackish margins; centre of lower part of breast and abdomen white; flanks the same as the back; vent and under tail-coverts dark ferruginous; bill dark horn colour, legs paler.

Length, $4\frac{1}{2}$ inches; of wing, 2; the tail is rounded, the central feathers being $2\frac{1}{4}$ inches long, and the outer $1\frac{1}{2}$ inch; bill to front, through the feathers, $\frac{1}{2}$ inch; to gape, $\frac{6}{10}$; tarse, $\frac{8}{10}$.

Hab. N. India.

Genus Brachypteryx, Horsfield, p. s. d.

2. Brachypteryx nipalensis, Hodgson.

Male: colour above a greyish cyaneous, or light greyish blue, as are also the cheeks, sides of breast and flanks, and paling to greyish white on the centre of the breast; throat, middle of belly, vent and under tail-coverts, streak over but not extending beyond the eye, white. Female: ferruginous brown above, paling on the sides; throat, breast, belly, under tail-coverts and streak over the eye, whitish, the feathers on the breast and sides fringed with brown; bill dark horn colour, legs paler.

Length, $4\frac{1}{4}$ inches; of wing, $2\frac{1}{2}$; tail, $1\frac{3}{8}$; bill to gape, $\frac{6}{8}$; tarse, 1.

Hab. Nepal (No. 943, *Hodgs. Catal.*).

This species is allied to *Br. cruralis*, Blyth, but may readily be distinguished by its smaller size, shorter tail, paler colour of the upper parts, and by its white throat and belly.

Genus Callene, Blyth, Journ. A. S. Beng. p. 136 (1847).

Syn. *Cinclidium*, Blyth (nec Gould).

Gen. Char. "Bill shorter than the head, straight, slender, higher than broad, the ridge of the upper mandible tolerably acute, and its tip very slightly emarginated; inferior gonys ascending for the terminal half, imparting to the bill the appearance of a tendency to bend upward: naral apertures in the form of elongate-oval fissures in the lateral nasal membrane, and partially impended by the short semireflected frontal feathers; gape armed with a few small setæ; wings and tail rounded, the 4th, 5th and 6th primaries equal and longest; legs and toes slender, the tarsi smooth, unscutellate, and very long, as is also the middle toe; claws but moderately curved, and of little more than mean length; plumage light, soft and full, having a scale-like appearance on the crown, breast and belly."

3. Callene frontale, Blyth.

Syn. *Cinclidium frontale*, Blyth, Journ. A. S. Beng. xi. p. 181, xii. p. 954. t. p. 1010. Bonap. C. G. Av. p. 301.

Callene frontale, Blyth, Journ. A. S. Beng. xvi. p. 136; Catal. B. Mus. A. S. Beng. p. 178.

Ruticilla frontalis, G. R. Gray, Gen. of Birds, i. p. 180.

Brachypteryx scapularis, Horsf. MS.

Hab. Nepal (No. 950, *Hodgs. Catal.*).

Spec. Char. "Plumage dark fusco-cyaneous, the rump dusky; flanks somewhat ashy, and middle of the belly slightly grey-edged; lores and immediately above the beak blackish, contrasting with a bright cærulean forehead; bend of the wing also cærulean, but less bright; and winglet, primaries and their coverts, secondaries and tertiaries, dark olive-brown; a white spot on the under surface of the wing, beneath the winglet; bill black; legs dusky brown.

"Length, $7\frac{5}{8}$ inches; of wing from bend, $3\frac{3}{8}$; middle tail-feathers, $3\frac{1}{2}$, the outermost $\frac{3}{4}$ of an inch shorter; bill to forehead nearly $\frac{5}{8}$, to gape $\frac{13}{16}$; tarse, $1\frac{3}{8}$; middle toe and claw, $1\frac{3}{16}$; hind toe and claw, $\frac{3}{4}$; the last, $\frac{3}{8}$.

"This bird is reported to be a fine songster, and heard chiefly in the evening."—*Blyth*.

Subfam. Timalina.

Genus Trichastoma, Blyth.

Syn. *Malacocincla*, Blyth.

Gen. Char. "Bill as long as the head, rather stout, high, much compressed, the tip of the upper mandible pretty strongly hooked, but indistinctly emarginated, and its ridge obtusely angulated towards the base, the remainder scarcely angulated; gape but little widened, and feebly bristled; nostrils large and subovate, with oval aperture to the front, a little removed from the base of the bill; tarse of mean length and strength, as long as the middle toe with its claw; the claws suited for perching, compressed, and moderately curved, that of the hind toe rather large; wings moderate, with the first primary reaching to about their middle, the second much shorter than the third, and the fourth longest; tail rather short, weak and even, except that its outermost feathers are a little shorter than the rest; plumage full and lax, the coronal feathers somewhat elongated and of a spatulate form."

4. Trichastoma Abbotti, Blyth.

Syn. *Malacocincla Abbotti*, Blyth, Journ. A. S. Beng. xiv. p. 601 (1845).

Trichastoma Abbotti, Blyth, J. A. S. Beng. xvi. p. 462; Catal. B. Mus. A. S. Beng. p. 147. Bonap. C. G. Av. p. 259.

Malacopteron Abbotti, G. R. Gray, Gen. of Birds, iii. App. p. 9.

Hab. Arracan (No. 919, *Hodgs. Catal.*).

Spec. Char. "Colour above plain olive-brown, tinged with rufous on the rump and tail; the upper tail-coverts ferruginous brown, under parts paler; the throat and middle of the belly white; the ear-coverts, sides of the breast and flanks rufescent; the lower tail-coverts weak ferruginous; bill horn-colour, paler beneath.

"Length, 6 inches; of wing, 3; tail, $2\frac{1}{8}$; bill to gape, $\frac{11}{12}$; and tarse the same."—*Blyth.*

Mr. Blyth states Arracan to be the habitat of this bird. Specimens have lately been presented to the Company's Museum by B. H. Hodgson, Esq., from Nepal, and by Capt. R. C. Tytler from Dacca.

Fam. Sylviadæ, Vigors.

Subfam. Saxicolina, Vigors.

Genus Nemura, Hodgson.

Syn. *Ianthia*, Blyth.

5. Nemura Hodgsoni, nobis.

Male: colour of the upper parts purplish blue, brightening to vivid ultramarine on the crown; forehead, lores and sides of head, wings and tail black, the two latter margined with blue externally; on the rump some of the feathers are tipped with white; upper tail-coverts blue; lower parts yellowish ferruginous; under wing-coverts, flanks and under tail-coverts white. Female: ferruginous brown, richer on the rump; wings and tail dusky, margined with ferruginous brown externally; lores, ear-coverts and under parts pale dusky ferruginous; under tail-coverts white; bill black; legs pale horn colour.

Length, $3\frac{3}{8}$ths of an inch; wing, $3\frac{1}{8}$; tail, $1\frac{1}{4}$; bill to front, $\frac{2}{8}$; to gape, $\frac{3\frac{1}{2}}{8}$; tarse, $\frac{1}{2}$ an inch.

Hab. Nepal (No. 949, *Hodgs. Catal.*).

Subfam. Philomelina, Swains.

Genus Tarsiger, Hodgson.

6. Tarsiger superciliaris, Hodgson.

Male: above deep cyaneous; wings brown, margined with cyaneous and rufous on the shoulder, primaries also margined with rufous, secondaries with cyaneous; tail brown, margined with cyaneous; a white superciliary streak extending one inch and a half from the nares to the back of the neck; lores and cheeks black; beneath rufous; centre of belly white. Female: olive-brown above; wings and tail brown, margined with rusty olive; superciliary streak not so clear as in the male; beneath pale dull rufous; centre of belly and shafts of the underside of tail white; bill black; legs horn colour.

Length, $5\frac{1}{2}$ inches; of wing, $3\frac{2}{8}$; tail, $2\frac{5}{8}$; bill to gape, $\frac{5}{8}$; tarse, $1\frac{1}{8}$.

Hab. Nepal (No. 924, *Hodgs. Catal.*).

Subfam. SYLVIANA, Vigors.

Genus PRINIA, Horsfield, p. s. d.

7. PRINIA CINEREOCAPILLA, Hodgson.

Crown of the head grey, the shaft and margin of the feathers being darker; naral and frontal plumes, a streak over and beyond the eye, and the whole under parts rufescent, brightest on the flanks and thighs; lores and upper part of ear-coverts greyish; nape, back, rump and wings bright rufous brown, the tips of the latter dusky; tail the same colour as the back, paler beneath, with a terminal dusky band and rufescent white tips; bill black; legs pale horn colour.

Length, $4\frac{1}{4}$ inches; wing, $1\frac{8}{12}$; tail, 2; bill to front, $\frac{3}{8}$; to gape, $\frac{5}{8}$; tarsus, $\frac{3}{4}$; middle toe and claw, $\frac{7}{12}$; hind ditto, $\frac{6}{12}$.

Hab. Nepal (No. 890*, *Hodgs. Catal.*).

Genus SUYA, Hodgson.

8. SUYA ATROGULARIS, nobis.

Colour above dusky brown, in some specimens ashy brown; edge of wing at shoulder and under wing-coverts buff; primaries margined with buffish and secondaries with rufescent brown; a whitish streak extending from the base of the lower mandible to the end and under the ear-covert; chin, throat, side of neck, breast and centre of abdomen black, the feathers of the two latter broadly centred with white; flanks and sides of abdomen mixed grey, brown and rufescent; vent buff; thighs buffy rufous; tail paler than the back, and has no perceptible terminal band; bill horn colour, feet paler.

Length, $6\frac{1}{2}$ inches, including the tail; wings, from $1\frac{3}{4}$ to 2 inches in some specimens; central feathers of tail from $3\frac{1}{2}$ to 4, its outermost being only 1 inch; bill to gape, $\frac{8}{12}$; to front, $\frac{5}{12}$; height from chin to front, $\frac{1}{10}$; width at chin, $\frac{2}{10}$; tarsi, $\frac{7}{8}$.

Hab. Darjeeling; Nepal (No. 893, *Hodgs. Catal.*).

A single specimen of this beautiful bird has been in the Museum of the East India Company for a number of years, collected in Darjeeling by F. T. Pearson, Esq.; and B. H. Hodgson, Esq., has brought home several examples from Nepal.

Genus DRYMOICA, Swains. p. s. d.

9. DRYMOICA NIPALENSIS, Hodgson.

Above rufous brown; wings dusky brown, the primaries exteriorly and secondaries interiorly and exteriorly margined with bright rufous brown; tail rufous brown, paler beneath, and distinctly rayed, has a terminal dusky band, the tips being pale but not white; the whole under parts rufescent, as in *Prinia socialis*, Sykes; bill dusky horn colour, paler below at base; legs pale horn colour.

Length, $4\frac{1}{2}$ to 5 inches; wing, $1\frac{10}{12}$; tail varying from $2\frac{1}{2}$ to 3 bill to front, $\frac{4}{12}$; to gape, $\frac{7}{12}$; tarsi, $\frac{10}{12}$; middle toe and claw, $\frac{8}{12}$ hind ditto, $\frac{7}{12}$.

Hab. Nepal (No. 913, *Hodgs. Catal.*).

ROYAL INSTITUTION OF GREAT BRITAIN.

April 20, 1855.—William Robert Grove, Esq., M.A., Q.C., F.R.S., Vice-President, in the Chair.

On certain Zoological Arguments commonly adduced in favour of the hypothesis of the Progressive Development of Animal Life in Time. By T. H. Huxley, Esq., F.R.S.

When the fact that fossilized animal forms are no *lusus naturæ*, but are truly the remains of ancient living worlds, was once fully admitted, it became a highly interesting problem to determine what relation these ancient forms of life bore to those now in existence.

The general result of inquiries made in this direction is, that the further we go back in time, the more different are the forms of life from those which now inhabit the globe, though this rule is by no means without exceptions. Admitting the difference, however, the next question is, what is its amount? Now it appears, that while the Palæozoic *species* are probably always distinct from the modern, and the *genera* are very commonly so, the *orders* are but rarely different, and the great *classes* and *sub-kingdoms* never. In all past time we find no animal about whose proper sub-kingdom, whether that of the *Protozoa, Radiata, Annulosa, Mollusca,* and *Vertebrata,* there can be the slightest doubt; and these great divisions are those which we have represented at the present day.

In the same way, if we consider the Classes, *e. g. Mammalia, Aves, Insecta, Cephalopoda, Actinozoa,* &c., we find absolutely no remains which lead us to establish a class type distinct from those now existing, and it is only when we descend to groups having the rank of Orders that we meet with types which no longer possess any living representatives. It is curious to remark again, that, notwithstanding the enormous lapse of time of which we possess authentic records, the extinct ordinal types are exceedingly few, and more than half of them belong to the same class—*Reptilia.*

The extinct ordinal Reptilian types are those of the *Pachypoda, Pterodactyla, Enaliosaurea,* and *Labyrinthodonta*; nor are we at present acquainted with any other extinct order of Vertebrata. Among the *Annulosa* (including in this division the *Echinodermata*) we find two extinct ordinal types only, the *Trilobita* and the *Cystideæ*.

Among the *Mollusca* there is absolutely *no* extinct ordinal type; nor among the *Radiata* (*Actinozoa* and *Hydrozoa*); nor is there any among the *Protozoa*.

The naturalist who takes a wide view of fossil forms, in connection with existing life, can hardly recognize in these results anything but strong evidence in favour of the belief that a general uniformity has prevailed among the operations of Nature, through all time of which we have any record.

Nevertheless, whatever the amount of the difference, and however one may be inclined to estimate its value, there is no doubt that the living beings of the past differed from those of the present period; and again, that those of each great epoch have differed from those which preceded and from those which followed them. That there has been a succession of living forms in time, in fact, is admitted by all; but to the inquiry—What is the law of that succession? different answers are given; one school affirming that the law is known, the other that it is for the present undiscovered.

According to the affirmative doctrine, commonly called the theory of Progressive Development, the history of life, as a whole, in the past, is analogous to the history of each individual life in the present; and as the law of progress of every living creature now, is from a less perfect to a more perfect, from a less complex to a more complex state—so the law of progress of living nature in the past, was of the same nature; and the earlier forms of life were less complex, more embryonic, than the later. In the general mind this theory finds ready acceptance, from its falling in with the popular notion, that one of the lower animals, *e. g.* a fish, is a higher one, *e. g.* a mammal, arrested in development; that it is, as it were, less trouble to make a fish than a mammal: but the speaker pointed out the extreme fallacy of this notion; the real law of development being, that the progress of a higher animal in development is not through the forms of the lower, but through forms which are common to both lower and higher: a fish, for instance, deviating as widely from the common Vertebrate plan as a mammal.

The Progression theory, however, after all, resolves itself very nearly into a question of the structure of fish-tails. If, in fact, we enumerate the oldest known undoubted animal remains, we find them to be *Graptolites, Lingulæ, Phyllopoda, Trilobites,* and *Cartilaginous fishes.*

The *Graptolites,* whether we regard them as *Hydrozoa, Anthozoa,* or *Polyzoa* (and the recent discoveries of Mr. Logan would strongly favour the opinion that they belong to the last division), are certainly in no respect embryonic forms. Nor have any traces of *Spongiadæ* or *Foraminifera* (creatures unquestionably far below them in organization) been yet found in the same or contemporaneous beds. *Lingulæ,* again, are very aberrant *Brachiopoda,* in nowise comparable to the embryonic forms of any mollusk; *Phyllopods* are the highest *Entomostraca*; and the *Hymenocaris vermicauda* discovered by Mr. Salter in the Lingula beds, is closely allied to *Nebalia,* the highest Phyllopod and that which approaches most nearly to the *Podopthalmia.* And just as *Hymenocaris* stands between the other *Entomostraca* and the *Podopthalmia,* so the *Trilobita* stand between the *Entomostraca* and the *Edriopthalmia.* Nor can anything be less founded than the comparison of the *Trilobita* with embryonic forms of *Crustacea*; the early development of the ventral surface and its appendages being characteristic of the latter, while it is precisely these parts which have not yet been discovered in the *Trilobita,* the dorsal surface, last formed in order of development, being extremely well developed.

The *Invertebrata* of the earliest period, then, afford no ground for the Progressionist doctrine. Do the Vertebrata?

These are cartilaginous fish. Now Mr. Huxley pointed out that it is admitted on all sides that the brain, organs of sense, and reproductive apparatus are much more highly developed in these fishes than any others; and he quoted the authority of Prof. Owen *, to the effect that no great weight is to be placed upon the cartilaginous nature of the skeleton as an embryonic character. There remained, therefore, only the heterocercality of the tail, upon which so much stress has been laid by Prof. Agassiz. The argument made use of by this philosopher may be thus shortly stated:—Homocercal fishes have in their embryonic state heterocercal tails; therefore, heterocercality is, so far, a mark of an embryonic state as compared with homocercality; and the earlier, heterocercal fish are embryonic as compared with the later, homocercal.

The whole of this argument was based upon M. Vogt's examination of the development of the *Coregonus*, one of the *Salmonidæ*; the tail of *Coregonus* being found to pass through a so-called heterocercal state in its passage to its perfect form †. For the argument to have any validity, however, two conditions are necessary:—1. That the tails of the *Salmonidæ* should be homocercal, in the same sense as those of other homocercal fish. 2. That they should be really heterocercal, and not homocercal, in their earliest condition. On examination, however, it turns out that neither of these conditions hold good. In the first place, the tails of the *Salmonidæ*, and very probably of all the *Physostomi*, are not homocercal at all, but to all intents and purposes intensely heterocercal; the chorda dorsalis in the Salmon, for instance, stretching far into the upper lobe of the tail. The wide difference of this structure from true homocercality is at once obvious, if the tails of the *Salmonidæ* be compared with those of *Scomber scombrus*, *Gadus æglefinus*, &c. In the latter, the tail is truly homocercal, the rays of the caudal fin being arranged symmetrically above and below the axis of the spinal column.

All M. Vogt's evidence, therefore, goes to show merely that a *heterocercal* fish is heterocercal at a given period of embryonic life; and in no way affects the truly homocercal fishes.

In the second place, it appears to have been forgotten that, as M. Vogt's own excellent observations abundantly demonstrate, this heterocercal state of the tail is a comparatively late one in *Coregonus*, and that, at first, the tail is perfectly symmetrical, *i. e.* homocercal.

In fact, all the evidence on fish development which we possess, is to the effect that Homocercality is the younger, Heterocercality the more advanced condition: a result which is diametrically opposed to that which has so long passed current, but which is in perfect accordance with the ordinary laws of development; the asymmetri-

* Lectures on the Comparative Anatomy of the Vertebrata, pp. 146–7.

† Von Bär had already pointed out this circumstance in *Cyprinus*, and the relation of the fœtal tail to the permanent condition in cartilaginous fishes. See his "Entwickelungsgeschichte der Fische," p. 36.

cal being, as a rule, subsequent in the order of development to the symmetrical.

The speaker then concluded by observing that a careful consideration of the facts of Palæontology seemed to lead to these results:—

1. That there is no real parallel between the successive forms assumed in the development of the life of the individual at present, and those which have appeared at different epochs in the past; and

2. That the particular argument supposed to be deduced from the heterocercality of the ancient fishes is based on an error, the evidence from this source, if worth anything, tending in the opposite direction.

At the same time, while freely criticising what he considered to be a fallacious doctrine, Mr. Huxley expressly disclaimed the slightest intention of desiring to depreciate the brilliant services which its original propounder had rendered to science.

BOTANICAL SOCIETY OF EDINBURGH.

April 12, 1855.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On Placentation," by John Cleland, Esq. See 'Annals,' vol. xv. p. 336.

2. "Notes on the Flora of the neighbourhood of Castle Taylor, in the county of Galway," by A. G. More, Esq., of Trinity College, Cambridge.

The author enters into a detailed account of the indigenous flora of that part of Ireland, contrasting it with that of other parts of the United Kingdom. The district is rendered interesting from its forming part of the singular limestone-country of the West of Ireland, the surface broken and rocky, and but slightly elevated above the sea-level: nevertheless several subalpine species are to be found in it, such as *Dryas octopetala*, *Saxifraga hypnoides*, *Hieracium cerinthoides*, *Arbutus Uva-ursi*, *Juniperus nana*.

He then arranges the produce of his district and the classes defined by Watson, and enumerates the more interesting or peculiar plants present or absent in each case. He points out the following species as seen by him, but not marked as Irish in 'Babington's Manual':—

Cardamine sylvatica.	Hieracium cerinthoides.
Viola stagnina.	Epipactis media.
Spiræa filipendula.	Potamogeton lanceolatus.
Geum intermedium.	Alopecurus agrestis.
Myriophyllum alterniflorum.	Lolium italicum.

3. "Notes on the Flora of the Bass Rock," by Prof. Balfour.

4. "Notice of Plants collected during a trip to Loch Lomond in July 1854," by Prof. Balfour.

5 "Register of the Flowering of Spring Plants in the Royal Botanic Garden, as compared with the four previous years," by Mr. M'Nab.

May 10.—Professor Balfour, President, in the Chair.

Mr. P. S. Robertson exhibited germinating plants of the following species of Coniferæ, to show the remarkable variation in the number of their cotyledonary leaves :—

"*Pinus nobilis* ; normal number of cotyledons 6, varying with 4, 5, and 7.

"*Pinus Sabiniana* ; 14, 15, 16 prevailing numbers ; variations 13, 17, 18, 19.

"*Pinus Jeffreyi* ; prevailing numbers 9 and 10, varying with 7, 8, 11.

"*Abies Hookeriana* ; usual number 4, varying from 3 to 5.

"*Pinus Beardsleyi* ; prevailing numbers 6 and 7, varying with 3, 5, 8, 9, and 10. This species occasionally produces two perfect plants from one seed.

"*Thuja Craigana* (*Libocedrus decurrens*) ; usual number 4, varying from 1 to 4.

"*Cryptomeria japonica* ; usual number 3, varying from 2 to 4.

"*Pinus Lambertiana* ; usual number 14, varying with 10, 12, and 13.

"*Pinus monticola* ; usual numbers 8 and 10, varying with 6, 7, 9, 11."

The following papers were read :—

1. "On some new species of British Freshwater Diatomaceæ, with remarks on the value of certain specific characters," by Prof. Gregory.

After some remarks on the distribution of Freshwater Diatoms, the author proceeded to consider the value of certain specific characters.

Species, among Diatoms, are generally distinguished by the following particulars, viz. the form ; the structure, where anything remarkable occurs ; the length of the individual frustule, within the usual limits ; the arrangement and number of the striæ, where these are visible, as well as their nature, whether moniliform or continuous, narrow or broad, close or distant, &c. ; and frequently the aspect of the median line, if present, and of the nodules at its centre and extremities.

The form or outline.—This varies so much, that, if we were guided by it, we should make many false species, as is shown by the fact, that these forms pass by gentle gradations into each other. This kind of variation occurs, for example, in *Navicula lacustris*, of which two very different forms occur ; but there is a third which is precisely intermediate. It is seen also in *Navicula elliptica*, some forms of which are oval, but of different proportions, others are constricted. *Navicula dubia* is believed to belong to the same species as *N. amphigomphus* and *N. dilatata*, and by some persons, all the three are united to *N. firma*. It is certain that all four agree in having the side lines, but they all differ in outline. *Navicula lepida*, a new species, exhibits three varieties, differing in form. But the most remarkable example is found in *Navicula varians*.

The number of striæ.—In some species, perhaps in many, this character is by no means constant. In *Navicula varians,* I find that in the smaller individuals there are often 24 to 26 striæ in 1-1000th of an inch, while in the larger there are only 14 to 16, and this in individuals of the same type of outline. Smith describes *Pinnularia divergens* with 11 striæ in 1-1000th inch, while I find it more frequently with from 22 to 26 in 1-1000th inch—the arrangement, which is peculiar, being the same in both. A very striking example occurs in *N. elliptica,* which, as we have seen, also varies in form. The species, as described by Kützing, has very coarse striæ, even coarser than appears by any of the figures. But in a variety to which I have directed attention, and which I regarded on this account as a distinct species, till I found a gradual transition to the first-named type, the striæ are so very much finer, being about three times more numerous, that the aspect of the frustule is totally changed. In comparing examples of the extreme types in regard to striation, I took individuals of equal size, and I found in one very coarse striæ; in the other, striæ so fine as not to be easily seen unless the valve was placed in the most favourable position with reference to the light.

The appearance of the median line and nodules.—In the coarsely striated variety of *N. elliptica,* there are lines on each side of the median line, forming a double cone, of which the bases meet near the centre. But in the finely striated variety, these lines are parallel to the median line; only bending outwards round the central nodule. This assists in giving a very different aspect to the two forms, which yet are connected by a graduated chain of transition forms.

We have then, if we consider only the three characters of form or outline, number of striæ, and aspect of medial line and nodules, evidence that great variations may occur in any one of them. Nay, in *N. elliptica* and *N. lepida,* variations occur in all three together. In such cases as these last, it is difficult to define the species by these characters in the usual way, and we have apparently no resource but to state the fact of the tendency to vary in one or more of these points, as one of the specific characters. In *N. varians* the arrangement of the striæ is always the same, as it is also in *Pinnularia divergens,* and many others; but in *N. elliptica* even this fails, for the striæ are highly radiate in the coarsely striated form, and nearly parallel in that with finer striæ.

Enormous variations in size occur, even in the same type of form. If *Pinnularia megaloptera* be referred to *P. lata,* we have a variation in length from about 20 ten-thousandths of an inch to nearly 80.

The distribution of Diatoms over the world is one of the most remarkable points about their history. Not only do we find, if we examine a gathering from any part of the world, that most of the forms are identical with those of our own waters; but in tracing these minute organisms through the latter to the earlier sedimentary rocks (and it is said that they occur in the lower Silurian strata, the oldest in which any organic remains occur), we find still the greater number of species to be the same as those of the present day.

Ehrenberg, in his last great work on the distribution of microscopic forms over the earth, both in the present period and in past geological times, has shown that in all soils in which plants grow, Diatoms are present, often in considerable quantity, and in great variety. He ascribes to them a great part in the formation of such soils, and it is probable that by their life and growth they extract much silica from the water in which they live, and transfer it at their death to the soil. The sediment of all rivers contains a considerable amount of Diatoms, as, for example, the mud of the Nile and that of the Ganges, which have formed the great Deltas of Egypt and Bengal.

2. "Remarks on specimens of *Megacarpæa polyandra*, Bentham," by Dr. Balfour.

The interest of the plant consists in its possessing a number of stamens (from 12 to 15), quite abnormal in the order of Cruciferæ, to which it otherwise belongs; and which might seem, taken alone, to place it between that order and Papaveraceæ; but when these extra stamens are viewed as developments of the glands which are present in the Cruciferæ on the disk or torus, between the petals and the ovary and ordinary stamens, the plant may well be referred to that order.

The genus *Megacarpæa* was first discovered, I believe, by Fischer, in the salt steppes and calcareous hills of Turkistan, in the neighbourhood of the Caspian Sea; and by Ledebour in Siberia; and was originally referred to *Biscutella*. Two species are described by DeCandolle (Prod. i. 183), but so imperfectly, that till further information is obtained, it is impossible to determine whether the plant before us, from the Himalaya, is identical with either of them, especially *M. laciniata* from the Altai Mountains, or a new species which is to bear the name of *M. polyandra*.

Megacarpæa (probably this very species) was next met with by Dr. Hugh Falconer in the Highlands of Little Tibet, on the Husora River, an affluent of the Indus, and in the same country by the late Mr. J. E. Winterbottom, who described it to me as growing 6 to 8 feet high on the Barzil Pass, upper glen of the Kishenganga River, between Kashmere and Astor; but neither of these botanists was, I believe, so fortunate as to obtain the flowers, which were first seen by Capt. R. Strachey in 1848, on a visit to the glacier sources of the Pindar River in Kumaon, up to which date the existence of the plant in the British Himalaya was unknown; nor has it been discovered, so far as I am aware, in any other of our provinces—at least those south of the Sutlej River. Here it occurs in three localities, where the climate resembles or approximates to that of Little Tibet, Turkistan, and the other habitats, viz. extreme cold in winter, and extreme heat and aridity in summer, conditions which have proved favourable to the migration or presence of many other Tibetan and Siberian plants on the dry northern slope of the Himalayan range, where a system of vegetation is established in marked contrast with what prevails on the Indian face, which is annually for three months deluged with rain*.

* A very instructive example of the manner in which plants are distributed in distant regions of similar physical character is afforded by *Calli-*

In Kumaon the plant occurs on the open sunny downs, at from 11,500 to 14,000 feet above the sea-level, where all arboreous vegetation has ceased. It is well known to the mountaineers by the name of *Roogee.* They eat the pounded root as a condiment; it has, like the whole plant, a strong permanent odour and flavour, something like horse-radish. The localities in which it grows are—1. Champwa, near the Kaphini glacier; 2. near the Soondurdhoongee glacier, the heads of the Pindar River; and 3. at Ralim, on one of the spurs of the snowy Panch—Choola Range, which bounds the next great valley to the east. Here the Roogee flowers in May—June, and ripens its fruit in September—October. The root is fusiform, a foot or more in girth at the collar, and from 1 to 2 feet long, forked below; internally of light cellular substance, externally exhibiting very numerous horizontal annular ridges. Several annual stems from 4 to 6 feet high. When young in winter protected by many erect, rectangular, straw-like scales. Radical leaves spreading, from 2 to $2\frac{1}{2}$ feet long, the exterior half occupied by 7 or 8 distant, distinct, subopposite or alternate pinnæ; petiole dilated at the base; cauline leaves scattered, erect, pinnato-pinnatifid, about a foot long, with 10 to 12 segments, linear-lanceolate, acuminate, incised, the lower ones more or less separate, terminal more confluent. Flowers in dense terminal and axillary leafy corymbs, shorter than the leaves; small, white or yellowish-white, with a sweet fragrance or strong odour of horse-radish (according to taste), and much frequented by bees, flies, &c. Peduncles and pedicels villous, the latter long and one-flowered. Sepals 4, oblong, obtuse, coloured, from 1-5th to 1-4th inch long; petals alternate, oval, veined, half the height of the sepals; stamens 12 to 15, hypogynous, erect, as long as the calyx, and disposed in 2 or 4 sets. Ovary one, flat, obcordate, resembling the silicle of *Capsella Bursa-Pastoris,* with 2 auriculate, 1-seeded cells; stigmas 2, on a very short style. The silicle is about $1\frac{3}{4}$ inch by $1\frac{1}{4}$, one of the cells being abortive."

gonum Pallasii. This, like the *Megacarpæa,* abounds in the Caspian province, and equally, or much more, in the sandy deserts of Western India, between the Jumna and the Indus rivers. The heat for many months annually is extreme, and one is at first surprised to find a plant flourishing here, which is also indigenous to the steppes of the Caspian, where the winter cold is equally extreme. But, as is now well known, the Caspian and its deserts occupy a deep hollow at the western end of a plain descending from the sources of the Oxus and Jaxartes, and, as a consequence of this low position on the earth's surface, possess a summer temperature as high as the winter one is low, and perhaps equal to that of the Indian desert above referred to. In the latter, during the months of April, May and June, when everything else is burnt up, the *Calligonum,* with its innumerable green leafless twigs, covers the waste of sand-hills with a mantle of verdure, yielding a favourite food to the camel, the proper beast of burden of the country. It is known to the people by the name of *Phoke,* and under this designation is first mentioned by Mr. Elphinstone in his account of the kingdom of Caubul. A species of *Ephedra* likewise occurs, which is also called by the same name; but the true plant is the *Calligonum,* and neither *Ephedra* nor *Asclepias acida* (the Soma plant) as some have supposed.

The following is a description of the plant taken from the specimen sent by Mr. Moore:—

Megacarpæa polyandra, Benth.—Leaf sent by Mr. Moore about a foot long—greatest breadth about 7 inches; deeply pinnatifid—lobes narrowish, tapering at the apex—toothed; upper surface dark green—under surface glaucous, covered with short hairs, many of which are glandular. Similar hairs occur on the petiole, which is thick, with ridges and grooves, flattened on the upper side and rounded below. Flowers in compact racemose clusters, of a yellowish-white colour, and having a strongish odour. Sepals whitish, with a yellowish and purplish tinge in some places, rugose, deciduous, broadly obovate, and convex externally. Petals smaller than the sepals—obovate, tapering below—rugose. Stamens varying from 11 to 13, some longer than others, but not apparently in any definite number; filaments thick—broader below. Anthers innate, two-lobed, yellow; green circle of glands round the base of the stamens, attached to a broadish thick receptacle. Ovary transversely elliptical, with a short style and large stigma—two-celled. Fruit a silicula, with the replum across its narrow part. Seed brownish, about $1\frac{1}{4}$ inch in length, and about the same in breadth—winged; the wing nearly a quarter of an inch deep—veined; hilum straight or slightly curved, about half an inch long.

3. "Lowest Temperature indicated by the Register Thermometer (Fahr.), kept at the Botanic Garden, during April 1855," by Mr. M'Nab.

Average lowest temperature for April $33\frac{3}{4}$°.

4. "Register of the Flowering of Plants in the Botanic Garden, compared with the four preceding years," by Mr. M'Nab.

5. "Remarks on Mr. Moore's notice of the effects of the late winter at Dublin," by Prof. Balfour.

6. "On the Disease of Finger and Toe in Root Crops," by Sir John S. Forbes.

7. "Notice of the origin of the name *Chenopodium Bonus Henricus*," by Mr. J. Hardy.

Lately, in turning over J. Bauhin's 'Historia Plantarum,' I met with the following, tom. ii. p. 965.—"Dodon. Gall. et Lat. in fol. qui sub Tota Bona describit et depingit; ait Bonum Henricum a singulari quadam utili facultate vocari; veluti et perniciosam quandam plantam Malum Henricum appellant, de quo alibi dicendum." I have not the Latin copy of Dodonæus, but in the English translation of Lyte, 1st ed. 1578, p. 561, this explanation is not given; we have, however, the English "Good Henry," being a translation of the Dutch and German name. The term *Bonus Henricus* it appears from Mentzel (Index sub Lapath.) occurs in Brunsfel's Herbal, printed in 1532. I suspect, however, that it will be found in the 'Herbarius' of 1484, or the Ortus Sanitatis, as in an early Herbal that I possess, without a date, but published by Egenolf, who is said to have given an improved edition of Cuba's work, I find the name *Gut Heinrich* over the figure of this plant. (This book of Egenolf has no text, being merely *coloured* figures.) The English names are attached in MS. in a very old hand. "Good *King* Harry" occurs for the first time in Gerard, who says it was so called in Cambridgeshire (Johnson's edit. 1633, p. 329). *Malus Henricus* seems to have been *Lathræa squamaria.*

MISCELLANEOUS.

NEREIS BILINEATA.

To the Editors of the Annals of Natural History.

Weymouth, May 15, 1855.

GENTLEMEN,—I beg to draw your attention to a fact I have not seen noticed in print. It is, that *Nereis bilineata* constructs a tube for its domicile. Its usual habitat is the upper coils of any dead whelk that may have been selected by a *Pagurus* for its domicile. This Annelid is well known to the fishermen here, and by whom it is much used as a killing bait for whiting. I was not aware of the fact of its constructing a tube for itself until lately, when, on breaking off the top coils, I found that the worm had constructed a tube, with which it had lined its lodgings. The tube is perfectly white, rather strong, and not attached to the whelk shell.

I am, Gentlemen, yours obediently,

WILLIAM THOMPSON.

On a New Species of Thalassidroma. By GEORGE ROBERT GRAY, F.L.S. & F.Z.S.

A specimen of a Stormy Petrel, from the north-west coast of America, which has lately been kindly presented to the British Museum by Miss Hornby, differs from all those that I am acquainted with.

In form it agrees best with *Thalassidroma furcata*, but the coloration differs much in several particulars. Front, cheeks, throat, collar round the hind part of the neck, breast and abdomen pure white; crown, hind head, a broad band in front of neck, bend of wing and lesser wing-coverts sooty grey; upper part of back grey; lower part of back and tail ashy grey; greater wing-coverts brownish grey; tertiaries and quills deep black.

Total length, $8\frac{1}{4}''$; bill from gape, $10\frac{1}{2}'''$, from front, $8\frac{1}{2}'''$; tail (outer feather), $3\frac{3}{4}''$; tarsus, $1''$; middle toe, $1''$.

I propose to give this species the appellation of *Thalassidroma Hornbyi*, after Admiral Hornby, who obtained it during his command on the Pacific station, where he collected many interesting animals for his brother-in-law, the late President of this Society.—*Proc. Zool. Soc.*, May 10, 1853.

On the Eggs of Otogyps *and* Prosthemadera. By H. F. WALTER, Esq.

Mr. H. F. Walter exhibited specimens of the eggs of *Otogyps* and *Prosthemadera novæ seelandiæ* from his own collection.

The egg of *Otogyps* was obtained by Herr Ludwig Parreyss of

Vienna from North Africa, and will therefore be that of *O. nubicus* (H. Smith; Bp. Consp. p. 10), if that species is really distinct from the southern *O. auricularis*. The long diameter of this egg is 3·9, the short diameter 2·8 inches.

The egg of the Parson-bird or Tui, *Prosthemadera novæ seelandiæ* (Gm.), was taken in New Zealand in 1852 by Dr. White. Its colouring is somewhat different from that of the other Honey-eaters with which we are acquainted, not presenting the usual rich red ground-colour which is the general characteristic of the eggs of that family of birds. The long diameter of this egg is 1·0, the short diameter 0·75 inch.—*Proc. Zool. Soc.*

METEOROLOGICAL OBSERVATIONS FOR MAY 1855.

Chiswick.—May 1. Densely clouded: dry haze: clear. 2. Clear: sharp frost at night. 3. Fine: densely overcast. 4. Cloudy and cold: frosty. 5. Excessively dry air, with bright sun. 6. Fine. 7. Fine: overcast: boisterous at night. 8. Cloudy: clear, with sharp frost at night. 9. Fine: rain at night. 10. Cloudy. 11. Cloudy and fine: thunder-storm in afternoon: clear. 12. Cloudy and cold: very clear: frosty. 13. Overcast: boisterous, with heavy rain at night. 14. Cloudy. 15. Cloudy: rain. 16. Cloudy: clear and frosty at night. 17—19. Very fine. 20. Foggy: very fine. 21. Overcast. 22. Cloudy. 23—25. Fine. 26. Very fine: hot and dry. 27. Slight haze: cloudy: rain. 28. Rain. 29. Cloudy: showery. 30. Cold showers. 31. Rain.

Mean temperature of the month .... 48°·88
Mean temperature of May 1854 .... 50 ·07
Mean temperature of May for the last twenty-nine years ... 53 ·72
Average amount of rain in May .... 1·85 inch.

Boston.—May 1. Cloudy. 2. Fine. 3. Cloudy: rain and snow P.M. 4—6. Cloudy. 7. Cloudy: rain A.M. and P.M. 8. Cloudy: rain, hail and snow P.M. 9. Cloudy. 10. Cloudy: rain A.M. and P.M. 11. Cloudy: rain P.M. 12. Fine. 13. Cloudy: rain P.M. 14. Cloudy. 15. Cloudy: rain A.M. 16, 17. Cloudy: rain P.M. 18—20. Cloudy. 21. Cloudy: rain A.M. and P.M. 22. Cloudy. 23—28. Fine. 29—31. Cloudy: rain A.M. and P.M.

Sandwick Manse, Orkney.—May 1. Cloudy A.M.: clear, fine P.M. 2. Drizzle A.M.: showers P.M. 3. Hail-showers A.M. and P.M. 4. Cloudy A.M.: clear P.M. 5. Cloudy A.M.: rain P.M. 6. Sleet-showers A.M. and P.M. 7, 8. Sleet-showers A.M.: cloudy P.M. 9. Hail, frost A.M.: clear P.M. 10. Bright A.M.: cloudy P.M. 11. Clear A.M. and P.M. 12, 13. Bright A.M.: cloudy P.M. 14. Cloudy A.M.: clear P.M. 15. Showers A.M.: cloudy P.M. 16. Cloudy A.M.: showers P.M. 17. Bright A.M.: drops P.M. 18. Bright A.M.: cloudy P.M. 19. Showers A.M.: cloudy P.M. 20. Bright A.M.: clear, fine P.M. 21. Cloudy A.M. and P.M. 22. Small rain A.M. and P.M. 23. Small rain A.M.: clear, fine P.M. 24, 25. Hazy A.M. and P.M. 26. Drops A.M.: cloudy P.M. 27. Hazy A.M. and P.M. 28. Cloudy A.M. and P.M. 29. Bright A.M.: clear P.M. 30. Cloudy A.M. and P.M. 31. Clear A.M. and P.M.

This month has been remarkably cold, the mean temperature being lower than that of any May during the twenty-eight years of my observations,—4°·18 below the average, and the first half of it was only about the average temperature of March.

Mean temperature of May for twenty-eight previous years . 47°·99
Mean temperature of this month .... 43 ·81
Mean temperature of May 1854 .... 48 ·39
Average quantity of rain in May for fourteen previous years 1·68 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.
1855. May.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·063	30·019	29·73	30·37	30·36	52	32	44	47	41	e.	nw.	calm	....	....	....
○ 2.	30·047	29·857	29·79	30·04	29·80	62	20	45	45½	37	ne.	ne.	nw.	....	....	·04
3.	29·702	29·638	29·37	29·99	29·86	64	35	46	33	33	n.	n.	nnw.	....	....	·10
4.	29·865	29·704	29·47	29·86	29·80	50	24	41·5	36½	37	ne.	nne.	sw.	....	·08	·09
5.	29·930	29·914	29·66	29·43	29·19	57	30	44	44½	40	ne.	nne.	sw.	....	....	....
6.	29·951	29·938	29·50	29·30	29·49	63	41	52	41	41	w.	wsw.	w.	....	....	·31
7.	29·884	29·719	29·52	29·54	29·47	60	33	50	44	40½	sw.	ssw.	nw.	·06	·08	·21
8.	29·830	29·772	29·33	29·63	29·69	56	21	46	42	39	nw.	nw.	wsw.	·04	·09	·19
☾ 9.	30·004	29·616	29·60	29·71	29·73	62	43	46·5	38½	35	sw.	ssw.	ne.	·09	·20	·09
10.	29·508	29·409	29·05	29·57	29·56	63	44	49	42½	39	sw.	nw.	e.	·04	....	....
11.	29·624	29·366	29·00	29·66	29·80	59	34	51·5	42½	38	sw.	n.	nnw.	·36	·24	....
12.	29·831	29·780	29·43	29·82	29·82	53	28	43·5	44½	39½	n.	n.	n.	....	·03	....
13.	29·618	29·406	29·27	29·77	29·84	50	38	51	44	39½	se.	s.	n.	·49	....	....
14.	29·678	29·615	29·38	29·83	29·77	57	35	47	44½	39	ne.	n.	n.	....	·02	·05
15.	29·572	29·551	29·26	29·75	29·77	48	41	48	45	44½	ne.	n.	n.	·05	....	·08
● 16.	29·832	29·696	29·34	29·74	29·72	50	30	48	47	43½	n.	n.	nw.	....	·05	....
17.	29·990	29·901	29·48	29·75	29·84	61	30	51	45	41½	nw.	nw.	nw.	·01	·02	·04
18.	30·109	30·078	29·70	29·94	29·92	64	39	49	49	43½	sw.	wsw.	e.	....	·15	....
19.	30·025	29·860	29·60	29·85	29·92	69	48	59·5	50	49	s.	sw.	sse.	....	....	·02
20.	29·883	29·800	29·47	30·04	30·14	68	35	61	54½	47	nw.	ne.	e.	....	....	....
21.	29·862	29·830	29·47	30·10	29·99	55	46	47	46	45	w.	n.	nne.	....	....	....
22.	29·840	29·779	29·45	29·83	29·70	64	31	50	47	47	n.	nw.	ne.	·01	·16	....
23.	29·819	29·780	29·40	29·62	29·67	60	40	50	49	47	sw.	ssw.	e.	....	....	·16
☽ 24.	29·766	29·759	29·36	29·72	29·81	71	44	58	46½	46	s.	sw.	ese.	....	....	....
25.	29·802	29·789	29·40	29·92	30·00	78	42	61	52½	49½	se.	se.	ese.	....	....	....
26.	29·876	29·759	29·46	30·08	30·13	82	58	63	52	45½	e.	e.	e.	....	....	....
27.	29·749	29·723	29·40	30·14	30·12	75	52	57·5	47	45	se.	e.	ne.	·10	....	....
28.	29·856	29·789	29·42	30·10	30·14	56	35	51	45½	44½	ne.	ne.	ne.	·09	....	....
29.	29·893	29·872	29·50	30·22	30·28	59	37	47	49½	44	n.	nnw.	nne.	·02	....	....
30.	29·949	29·879	29·62	30·27	30·25	50	40	42·5	46	45	n.	ne.	ne.	·14	·14	....
○ 31.	29·683	29·450	29·43	30·25	30·25	54	47	45·5	47	45½	ne.	ne.	e.	·46	....	....
Mean.	29·840	29·708	29·44	29·865	29·865	60·38	37·39	49·9	45·43	42·20				1·94	1·26	1·38

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VI.—*Notes on Palæozoic Bivalved Entomostraca.* No. I. *Some Species of* Beyrichia *from the Upper Silurian Limestones of Scandinavia.* By T. Rupert Jones, F.G.S.

[With a Plate.]

Amongst the small bivalved Entomostraca found in the Lower Palæozoic rocks are several species of the genus *Beyrichia*, for the elucidation of which we are chiefly indebted to MM. Klöden, Beyrich, M'Coy, and Salter. The *Beyrichiæ* occur very low down in the geologic series, though they are not the first to indicate the Crustacean class in the fossiliferous rocks.

The carapace-valves of these little Crustaceans are usually oblong in shape, and rarely exceed $\frac{1}{10}$th of an inch in length; the more typical forms have their surfaces embossed with two, three, or more transverse ridges or isolated protuberances. Some specimens in their general contour and in the arrangement of the inequalities on the surface of the valve offer a distant resemblance to a miniature human ear. Other varieties have smooth valves, more or less indented by a transverse furrow which divides the surface into two unequal parts.

The remains of *Beyrichiæ* are met with, both as calcareous carapace-valves (by far most usually separate), and as casts of single valves, scattered more or less abundantly in the substance of the rock or on the planes of stratification. Not unfrequently they have been distorted by the movements which the integral parts of the rock have suffered in the process of partial metamorphism. The carapaces themselves, generally as single valves, are frequently met with in the Upper Silurian rocks of Britain, though not in the Lower Silurian; and they abound in some of the Upper Silurian rocks of Sweden. Yet our observations are often necessarily limited to the casts of the exteriors and the moulds of the interiors of these minute valves. The substance of the valves being of the same thickness throughout, the internal casts represent with tolerable clearness the configuration of the exterior.

The Upper Silurian limestones of Gothland and the south of Sweden often abound in minute, symmetrical, semicircular, trilobed bodies, which are the heads and tails of little Trilobites of the genus *Agnostus* (particularly *A. pisiformis*). Together with these occur other somewhat similar trilobed forms, which however are smaller, longer in proportion, and not symmetrical. These are *Beyrichiæ*.

Drifted fragments of these fossiliferous Scandinavian limestones occur abundantly in the sands and gravels of Mecklenburg, Brandenburg, and Pomerania; and these blocks in their weathered condition have yielded plentiful supplies of fossils to the naturalists of North Germany. In 1769 C. F. Wilckens * figured specimens of *Agnostus pisiformis* from this source, referring them with doubt to Trilobites (and proposing the removal of Trilobites from amongst Mollusks to Insects). With these he also figures a *Beyrichia* † (*B. Wilckensiana*, nobis), from Havelberg, without however arriving at any conclusion as to its true nature.

L. von Buch in his 'Recueil de Planches de Pétrifactions remarquables ‡,' pl. 6, figures some *Beyrichiæ* in a limestone block from near Güstrow in Mecklenburg, and regards them as the young of his *Leptæna lata*, a view quite incompatible with every character of these creatures, as M. Klöden has well explained in his 'Die Versteinerungen der Mark Brandenburg §.'

Klöden met with numerous specimens in weathered fragments of the Scandinavian limestone from the gravels near Berlin; and he has given carefully executed (but evidently not quite correct) figures of the valves of at least two species, in different stages of growth, accompanied with a detailed description ‖. This observer remarked that these little fossils are not at all referable to the *Leptæna* which accompanies them, nor to any mollusk; and, guided by the apparently symmetrical, semicircular, three-lobed form of some of the specimens, he was led to regard them as being probably the cephalic and caudal portions of the carapace of small Trilobites, and to assign them to the genus *Battus* (=*Agnostus*), although he figures and describes the unsymmetrical contour and irregular distribution of the surface-lobes of

* Nachricht von seltenen Versteinerungen (8vo, Berlin), 1769, pl. 7. f. 38.

† *Op. cit.* p. 77. pl. 7. fig. 39. These specimens have been confounded by Dalman, Klöden, Burmeister, &c., with the foregoing.

‡ Fol. Berlin, 1831. These figures are too obscure for satisfactory recognition as to their specific relations.

§ Berlin, 8vo, 1834.

‖ *Op. cit.* pp. 112–119.

other specimens, and even shows the actually bivalved condition of at least one example. This author refers all his specimens to one species, under the name of *Battus tuberculatus*.

In 1843 Burmeister (Die Organiz. d. Trilobiten, p. 72) refers M. Klöden's figures, without any assigned reason and certainly erroneously, to *Odontopleura ovata*.

In 1846, M'Coy, describing the Silurian fossils of Ireland *, pointed out the really unsymmetrical arrangement of the lobes and furrows on these little bodies; and, finding them to correspond in pairs of dextral and sinistral valves, he rightly conjectured them to be the bivalved carapaces of Entomostraca. For these animals he therefore established a new genus, "*Beyrichia*," named from M. Beyrich, who also, in a work then lately published †, had stated his belief that M. Klöden's specimens were not referable to any Trilobite, but to some small bivalved Crustacean.

In 1851 ‡ Prof. M'Coy further illustrated the genus, referring it to the family "Limnadiadæ," of the Phyllopod order of Entomostraca; and remarking that "several species of this genus have been figured and described by Klöden, as varieties of his *Battus tuberculatus*."

Mr. Salter also has illustrated and described some British species of this genus, in the Memoirs of the Geological Survey of Great Britain, vol. ii. part 1, and in Appendix A. of 'Descript. Brit. Pal. Foss.' above referred to. There are a few other published notices of *Beyrichiæ*; but we now have to confine ourselves to an examination of the species from the Scandinavian limestone, postponing for the present the critical notice of other published species.

As M. Klöden's figures were nearly all that we had in this country for our guidance in the comparison of the *Beyrichiæ*, it was desirable that we should be able to test by the examination of good Scandinavian specimens the accuracy of these drawings and of the specific determinations that have been made by their help. Not long since Sir C. Lyell, when visiting Berlin, had the kindness to mention to Prof. Beyrich my desire to have an opportunity of examining some well-preserved specimens of M. Klöden's typical species; and a liberal supply of limestone fragments from the gravels of Prussia and Silesia, rich in *Beyrichiæ*, was most courteously granted by Prof. Beyrich and brought to England by Sir C. Lyell.

I now proceed to the results of the examination of these inter-

* Synopsis of the Silurian Fossils of Ireland (4to, Dublin), p. 57.

† Ueber Einige böhmische Trilobiten, p. 47.

‡ Description of Brit. Pal. Foss. in Sedgwick's Synopsis of the Classification of Brit. Pal. Rocks. 4to, Cambridge. Part II. Fasc. 1. p. 135.

esting specimens. They consist of five fragments of a bluish-gray limestone, full of organic remains; one of them from near Berlin, and the others from the neighbourhood of Breslau. (I shall refer to them as Nos. 1, 2, 3, 4, & 5, for the sake of convenience.) They differ somewhat among themselves in their lithological characters and in their organic contents; and no two of them contain exactly the same set of *Beyrichiæ*. Nos. 1, 2, & 4 have a weathered exterior of a whitish dun colour, in a more or less friable condition. On fracture this whitish external portion of the limestone exposes its fossils far more readily to the eye than the inner crystalline limestone does; and, indeed, the calcareous cement having been decomposed, the innumerable *Beyrichiæ* and other minute fossils start away in the breaking up of the mass, and may be readily picked out of the debris. Nos. 3 & 5 are rather darker in colour than the others, and have a rough concretionary structure. The weathered surface of these is not more friable than their interior, and the whole readily breaks up under the hammer, numbers of the little fossils becoming disengaged among the debris. All the fragments contain *Leptæna lata*. Nos. 1, 2, 3, & 4 are rich in this fossil, some of them contain fragments of heads of Trilobites, and No. 1 abounds with *Tentaculites* also. No. 5 is poorer in the *Leptæna*, &c., and contains Encrinital remains. Each of the limestones contains abundance of *Cytheres* or *Cytheropses*, the description of which is postponed for the present.

The relative distribution of these organic remains in each of the specimens is shown in the following Table:—

	Near Berlin.	Near Breslau.			
LIMESTONE SPECIMENS, Nos.	1.	2.	3.	4.	5.
Beyrichia Buchiana, n. sp.	***				
B. tuberculata, *Klöd.*, sp.	....	......	***	***	
Var. nuda	....	***			
Var. antiquata	....	......	......	......	*
B. Dalmaniana, n. sp.	....	......	*		
B. Maccoyiana, n. sp.	....	*	*		
B. Salteriana, n. sp.	....	......	......	......	**
B. Wilckensiana, n. sp.	***	......	......	***	***
Var. plicata	**				
B. siliqua	....	......	......	*	
B. mundula	*	......	......	*	**
Cytheres	***	***	**	*	***
Leptæna lata	**	**	**	**	*
Tentaculites	*				
Encrinital remains	....	......	......	......	*

[The asterisks by their relative numbers denote the comparative abundance of the fossils.]

The several forms of the *Beyrichiæ* obtained from the limestone fragments are illustrated in Plate V., and I now proceed to their description (premising that the figures represent the specimens magnified 4 diameters).

Class CRUSTACEA.

Subclass Entomostraca.

Order Phyllopoda?

Family Limnadiadæ?

Genus Beyrichia, M'Coy, 1846 (Synop. Sil. Fos. Ireland, p. 57).

Generic characters.—Animal enclosed in a vertical bivalved carapace. Carapace equivalved. Carapace-valves oblong; anterior (cephalic) and posterior (caudal) extremities somewhat rounded; inferior (ventral) border semicircular; superior (dorsal) border straight. Valves wider at the caudal than at the cephalic extremity; more or less convex; impressed with one or more transverse furrows, commencing on the dorsal or hinge border, and variously modifying the surface of the valve. Hingement not known; probably a simple adaptation of the thin dorsal edges and their union by membrane.

1*st Group:* Simplices.—Surface of valve simple, almost uniformly convex, but impressed with one, usually short, vertical, dorsal furrow on the anterior half of the valve, and (if extended) dividing the surface of the valve into two unequal parts (the anterior portion being the smaller). Valves either with simple edges, or bordered (except on the dorsal edge) by a narrow flattened rim; in the first case the margin of the one slightly overlapping that of the other valve, when united; in the second case, the opposite flat borders coming in contact.

2*nd Group:* Corrugatæ.—Surface of valve convex, impressed with two vertical furrows, not reaching across the valve, but marking out three unequal lobes on the surface and giving it a *crumpled* appearance. The anterior furrow holds the same relative position as the single furrow in the "Simplices." The valves are bordered (on three sides) by a narrow depressed margin.

3*rd Group:* Jugosæ.—Surface of valve impressed with two or three strong vertical furrows, extending from the back to the ventral portion of the valve, and dividing the surface into three or more unsymmetrical lobes, transverse ridges, or bosses, which vary considerably in their size, mode of subdivision, and relative position in different species, and, to some extent, in different stages of growth of individuals. The anterior, inferior, and posterior margins of each valve are turned sharply inwards, the angle so made being marked externally by a prominent ledge, either slightly rounded or trenchant (and sometimes spiny), forming a narrow depressed border along these three edges of the external surface of the valve. These edges of the valves close together by the marginal flange of the one valve being received within that of the other,—somewhat like the fitting of the lid and body of a circular snuff-box. United valves are very rare; one such specimen shows the ventral margin of the left valve overlapping that of the right. There is no marked difference in the shape of the two valves; and the size of the valve that is received within and overlapped by the other is very little less than that of its fellow.

(Jugosæ.)

1. *Beyrichia Buchiana*, nov. sp. Pl. V. figs. 1–3.

Surface of valve impressed with three transverse furrows; the anterior and central ones reaching across the valve, and separated by a narrow ridge; the posterior furrow extending about two-thirds of the width across, and bounded by a semicircular ridge. In other words, the exterior of the valve presents three transverse ridges; the anterior is isolated, narrow, and slightly curved; the other two, occupying the posterior half of the valve, are united towards the ventral border, and form a compressed semicircular or horse-shoe ridge, with its convexity downwards. The posterior arm of this horse-shoe-shaped ridge is larger than the other arm (or median ridge), and is sometimes indented by a slight, short, oblique furrow on its outer ridge (fig. 2); and sometimes it is tuberculated (fig. 3). The anterior and posterior margins of the valve are also roughened with spinose tubercles in old specimens.

This form presents a well-marked and simple pattern of the surface, to which we can conveniently refer for comparison in describing others. Only one of our limestone fragments affords this species, and in this it occurs in great profusion, together with *B. Wilckensiana*, *Tentaculites*, and *Leptæna lata*.

A very similar limestone appears to have furnished the specimens figured in the 'Recueil des Pétrif. Remarq.," and which indeed are possibly referable to this species:—a coincidence which has led me to dedicate this well-characterized *Beyrichia* to the memory of M. von Buch.

2. *Beyrichia tuberculata*, Klöden, sp. Pl. V. figs. 4–9.

Surface of valve embossed with three lobes or ridges. The anterior ridge is usually divided more or less decidedly by a transverse furrow into two oval bosses of unequal size, the lower or ventral one being the largest and often becoming in the adult a protuberance of great (relative) size, and so prominent as to render the anterior part of the valve broader than the posterior (figs. 7 & 8). The central ridge is usually reduced to an oval boss, isolated and placed rather obliquely. The posterior or largest ridge is well developed, strongly curved, thick above and tapering downwards and forwards, until it terminates nearly opposite and near to the lower end of the central boss, with which it sometimes shows an inclination to unite at a sharp angle. At its thickest part, the posterior ridge is divided obliquely and transversely, by two, slight, narrow, sinuous furrows, into three parts, which vary in their distinctness in nearly every individual: sometimes a third similar furrow again divides this ridge in its ventral portion (fig. 8).

The surface of the valves is coarsely granulated, except in the very young state.

This species differs from *B. Buchiana* in its larger bulk, its coarser aspect, its granulations, and especially in the disposition of the surface-ridges. The same general arrangement of these exists in both species, but in *B. tuberculata* they have a greater development and are more subdivided; the horse-shoe ridge especially of the one is broken up in the other species.

This is evidently the species illustrated by Klöden's figures 20–23; and it is therefore the typical *Beyrichia tuberculata*. The other figures (16–19) referred by this author to the young state of the same species, belong to our new species *B. Wilckensiana*, to be presently described.

B. tuberculata, var. *nuda*. Pl. V. figs 10, 11.

A smaller-sized variety of this species occurs plentifully in another block of limestone. The surface is destitute of tubercles; and the ventral anterior lobe does not appear to attain the excessive growth that is seen in old specimens of the typical form.

B. tuberculata, var. *antiquata*. Pl. V. fig. 12.

A large and unique left carapace-valve, from No. 5 limestone, exhibiting the usual arrangement of the surface-lobes of this species, except that the posterior ridge is not quite so largely developed, has a perfectly smooth surface, and a trenchant margin well armed with spines on the front, hind, and lower borders of the valve. This spiny or denticulated condition of the margin I have not met with in other varieties of this species; but it occurs in two figures (20, 21) of M. Klöden's typical form.

3. *Beyrichia Dalmaniana*, nov. sp. Pl. V. fig. 13.

Anterior extremity of valve contracted, so as to give an almost triangular outline. Surface bearing five smooth rounded unequal protuberances or lobes; two obliquely placed anteriorly, two posteriorly, and one in the middle towards the dorsal border; the infero-posterior lobe is the largest. In the arrangement of these five lobes some reference to that of the ridges in the preceding species can be recognized, the two anterior lobes being the equivalents of the divided cephalic ridge in *B. tuberculata*; the posterior lobes representing the great caudal ridge, and the central lobe being isolated and similarly placed in both species. The narrow depressed border of the valve is slight but distinct. The surface is smooth, with traces of very fine linear punctations.

Only a right and a left valve were found (in No. 3. limestone).

I have distinguished this rare and curious little Scandinavian *Beyrichia* by the well-known name of one of the illustrious palæontologists of Sweden.

4. *Beyrichia Maccoyiana*, nov. sp. Pl. V. fig. 14.

Carapace-valve nearly semicircular; bearing three almost symmetrical rounded ridges. The anterior ridge broad, tapering downwards and backwards, and disunited at its termination from the others by a very slight depression. The middle ridge oval, united below with the posterior ridge, but constricted at the junction; the two forming a compressed horse-shoe ridge. Surface of valve punctate. The marginal depressed rim is broad, prominent, and trenchant, especially on the ventral margin, where it is marked by regularly placed, transverse, depressed lines or striæ equally on its upper and its under surface. This breadth of the ventral rim gives rise to the peculiar semicircular form of the valve.

The surface-lobes of this species have the arrangement of those in *B. Buchiana*; but, the furrows not being so deeply excavated, the ridges are fuller and less distinctly separate. The punctation of the surface and especially the well-developed and striated rim are the peculiar characteristics of this species.

B. Maccoyiana approaches some of Prof. Hall's* figures of *B. lata* (Vanuxem sp.), a *Beyrichia* from the Clinton rocks of the U.S.; but differences in the relative proportions of the ridges, and especially the broad rim, sufficiently separate the two forms.

Three specimens of left valves are all that I have found (one

* Palæontology of New York, vol. ii. pl. A. 66. fig. 10.

in No. 2. limestone, and two in No. 3.); and from their friable condition the carapace appears to have been of an unusually delicate structure.

This rare and interesting species is named after Prof. M'Coy, who founded the genus and devoted much labour to the elucidation of the species of this and other allied forms of palæozoic Entomostraca.

5. *Beyrichia Salteriana*, nov. sp. Pl. V. figs. 15, 16.

Valves narrow oblong; caudal portion wider than the cephalic; marginal rim of the anterior, inferior, and posterior borders uniform, well developed, and impressed with a series of shallow pits along the ventral portion. Surface finely punctate; divided into three unequal subtriangular convexities or lobes, separated by a very narrow forked or Y-shaped furrow. The posterior lobe is the largest; and the middle one, which is slightly in advance of the centre of the valve and is pushed up to the dorsal border, is the smallest.

This species offers a strong contrast to *B. Buchiana* in the width of the surface-lobes and the narrowness of the furrows; and it could scarcely answer to the name of "*jugosa*" or *ridged*, were it not that its system of furrows is equivalent to that of *B. tuberculata*, which is at the opposite extremity of this group.

This small, but elegant and well-characterized species is numerous in No. 5. limestone; and I dedicate it with much pleasure to my friend Mr. Salter, Palæontologist of the Geological Survey, to whom we are indebted for much information on the history of the Entomostraca of the Silurian rocks.

(Corrugatæ.)

6. *Beyrichia Wilckensiana*, nov. sp. Pl. V. figs. 17, 18.

Carapace-valves contracted anteriorly, almost reniform. Surface of valve smooth, highly convex, divided into three unequal lobes by two short furrows, the anterior of which is near the centre of the valve. The middle lobe, lying between the furrows, is rounded, prominent, projecting over the dorsal edge, and passes, by a narrow and sometimes constricted neck, into the convex body of the valve with which the front and hind lobes are continuous. The middle lobe, though prominent, is the smallest, and the anterior lobe is the widest, but depressed. The ventral part of the convex surface, where the lobes unite, hangs over the narrow flat rim of the inferior margin of the valve, and is separated from it by a deep wrinkle, which dies out on the flattened margins of the anterior and posterior dorsal angles of the valve.

This form abounds in two of the limestones, and is evidently referred to in Klöden's figures 16–18; but it is still better figured by Wilckens, after whom I have named this peculiar species.

Beyrichia Wilckensiana, var. *plicata*. Pl. V. figs. 19–21.

In this variety the anterior dorsal angle is more acute, and the central lobe more compressed, than in the typical form; and the dorsal portions of the anterior and posterior lobes are marked by short faint vertical furrows, so as to appear pinched up into two or three small projecting angular ridges or plaits. The wrinkle or sulcus bounding the convex part of the valve is rather more strongly marked also.

This variety does not occur with the foregoing, but is plentiful in No. 1. limestone; and the specimens are usually smaller, though some individuals attain the full size of the type.

Possibly Klöden's figure 19. was taken from a specimen of this variety.

7. *Beyrichia siliqua*, nov. sp. Pl. V. fig. 22.

Carapace-valve elongate, contracted anteriorly; smooth; convex; divided into three unequal lobes by two shallow, rather oblique furrows crossing the convexity of the valve. Posterior lobe the largest. Marginal rim well developed on the ventral border.

Two dextral valves only in one of the limestones represent this well-marked species.

(Simplices.)

8. *Beyrichia mundula*, nov. sp. Pl. V. fig. 23.

Carapace-valves varying from oblong to nearly oval, convex, smooth, punctated, and marked by a short distinct furrow near the middle of the upper part; the marginal depressed rim narrow and sometimes obscured on the ventral border by the convexity of that part of the valve.

This occurs in three of the limestones, and from its small size and general appearance is liable to be confounded with the numerous Cythere-like forms so common in these Scandinavian limestones. The specimens from No. 1. limestone are more oval and convex than the others; those from No. 5. are well preserved, and interesting from their oblong shape, depressed margins, slight sulcus, and trace of central "lucid spot;" in which characters we have a near approach to *Leperditia.*

B. mundula differs from *B. simplex,* Jones (Quart. Journ. Geol. Soc. vol. ix. p. 161. pl. 7. fig. 7), chiefly in its having a proportionally longer hinge-line, or dorsal border, and a narrower posterior extremity, and in frequently presenting a depressed Leperditia-like aspect of the valves, which we do not find in *B. simplex.*

The specimen here figured (fig. 23) is from the No. 1. limestone, and is very convex and broadly oval in shape. The dorsal border is, however, usually straight, two-thirds the length of the valves, and from each of its extremities the margin has an oblique direction downwards and outwards to about half the width of the valve, where it meets the semicircular ventral border, and so forms the more or less angular anterior and posterior extremities of the valve, the former of which is somewhat narrower and sharper than the latter. This outline, or an approximation to it, is traceable in very many of the *Beyrichiæ,* but it is best developed in the specimens of *B. mundula* above referred to, from No. 5. limestone, in which the obliquity of the antero-dorsal and the postero-dorsal angles of the carapace is as well marked as in *Leperditia,* and is combined with a general depression of the carapace-valves and other characteristics above-noticed, which indicate a close relationship to the last-named genus:—to this point we shall again refer in further descriptions of the species of these genera.

Of the three groups of the genus, that of the *Jugosæ* is well represented in the Scandinavian limestones under examination. To this group also belong—

Beyrichia Klœdeni, M'Coy.
—— *complicata,* Salter.
—— *symmetrica,* Hall.
—— *lata,* Vanuxem, sp.
—— *Busacensis,* Jones.
—— *Bohemica,* Barrande, MS.

The *Corrugatæ* have here only two representatives (*B. Wilckensiana* and *B. siliqua*). Possibly Hall's *Cytherina spinosa* may be a *Beyrichia* of this type. An undescribed species from Busaco belongs to this group, and, taken together with *B. Bohemica,* affords a passage into *B. complicata* of the *Jugosæ* group.

The little *B. mundula* above described has many larger congeners among the *Simplices,* such as—

Beyrichia simplex, Jones,
—— *Logani,* Jones, MS.
—— *strangulata,* Salter,

and several Bohemian forms collected by M. Barrande.

EXPLANATION OF PLATE V.

[The figures represent the specimens magnified 4 diameters, with the exception of 16 *b.*]

Fig. 1 *a. Beyrichia Buchiana,* Jones: right valve. 1 *b.* Ventral aspect of the same valve. 2. Left valve. 3. Left valve of old specimen.

Fig. 4. *Beyrichia tuberculata,* Klöden, sp.: right valve (young individual). 5 *a.* Right valve. 5 *b.* Ventral aspect of the same valve. 6. Left valve. 7 *a.* Left valve (old individual). 7 *b.* Ventral aspect of the same valve. 8 *a.* Right valve. 8 *b.* Transverse section of the right valve. 9 *a.* Left valve. 9 *b.* Ventral aspect of the same valve.

Fig. 10 *a. B. tuberculata,* var. *nuda,* Jones: right valve. 10 *b.* Ventral aspect of the same valve. 11. Left valve.

Fig. 12. *B. tuberculata,* var. *antiquata,* Jones: left valve.

Fig. 13 *a. Beyrichia Dalmaniana,* Jones: right valve. 13 *b.* Ventral aspect of the same valve.

Fig. 14. *Beyrichia Maccoyiana,* Jones: right valve.

Fig. 15 *a. Beyrichia Salteriana,* Jones: right valve. 15 *b.* Ventral aspect of the same valve. 16 *a.* Left valve. 16 *b.* Highly magnified view of part of the border.

Fig. 17. *Beyrichia Wilckensiana,* Jones: Left valve. 18 *a.* Right valve. 18 *b.* Ventral aspect of the same valve.

Fig. 19. *B. Wilckensiana,* var. *plicata,* Jones: right valve of large individual. 20 *a.* Right valve. 20 *b.* Ventral aspect of the same valve. 21. Left valve.

Fig. 22. *Beyrichia siliqua,* Jones: right valve.

Fig. 23. *Beyrichia mundula,* Jones: left valve.

VII.—*On the Conjugation of the* Diatomaceæ. By J. W. Griffith, M.D., F.L.S.

[With a Plate.]

The interest attached to the conjugation and the relation of the forms to the species of Diatomaceæ, will, I trust, render the following remarks of interest to the botanist.

At the end of May of the present year, I was fortunate enough to find the bodies delineated in Pl. II. B. figs. 1–5, in a ditch near Blackwall.

The first which attracted my notice was that represented by fig. 3, and which could not be referred to any known Diatomacean; it was composed of silex, *i. e.* indestructible by heat and nitric acid. Upon further search, other of these bodies were found (fig. 2) containing a frustule of a *Navicula,* some also with the valves of another *Navicula* (figs. 1 & 2) adherent to the former. It was then evident that these bodies represented a *Navicula* in a state of conjugation, and that the larger *Navicula* was the sporangial frustule of the smaller, enclosed in a siliceous sporangial sheath.

The siliceous sheath (fig. 3) is colourless, elongate, rounded at the ends, and furnished with coarse transverse striæ or depressions, through which the line of fracture runs when the object is crushed (figs. 1 & 2). Its length its variable, apparently according to the stage of growth. The smallest was $\frac{1}{500}$ of an inch, the parent frustules being very slightly separated from each other, the form of the sheath more rounded, and the transverse striæ very few. The larger forms were from $\frac{1}{130}$ to $\frac{1}{170}''$ in length.

The parent frustules (fig. 4, side view; fig. 1 (below), front view), of which there were two, were brownish when dry; linear in front view; almost linear in the side view, sometimes more or less lanceolate, but always suddenly constricted near the ends, which are produced. The valves have a medial line and central and terminal nodules. The length of the parent frustules was $\frac{1}{370}$ to $\frac{1}{300}''$.

The sporangial frustules (fig. 5, side view; fig. 2, front view) were also brownish when dry, and in side view of a linear form, slightly narrowed towards the obtuse ends; in front view, linear and narrowed towards the obtuse or slightly truncate ends, and slightly constricted in the middle; the medial line, with central and terminal nodules distinct. The dimensions of the sporangial frustules are those of the sporangial sheath.

The determination of the species I shall leave to those who believe that the numerous hair-splittings of forms belonging to *Navicula* constitute distinct species. But it is very clear that the forms of the parent and sporangial frustules belong respectively even to different sections of the genus *Navicula* as subdivided by Kützing* and Smith†.

It would be well perhaps for those who specially study the Diatomaceæ to attend more to the relations of the forms and structure of frustules to species than to the making out of the minute markings existing upon the valves, which at present receive almost the whole attention. The observations made in the former direction are exceedingly few, yet most important to the point. Those of Thwaites‡ and Focke§ have shown that great differences of size and shape may exist in forms of one and the same species; the subject of the present communication confirms this result. Variation in the number of markings, as rays, dots,

* Kützing, Species Algarum, 1849.

† Rev. W. Smith, Synopsis of the British Diatomaceæ, i.

‡ Thwaites, Ann. Nat. Hist. 1847, xx., and pls. 4 & 22.

§ Focke, Physiologische Studien, 1853, Heft ii.

and surface-elevations, or even their absence or presence, is not sufficient to distinguish species, as shown by Thwaites*, &c. and Shadbolt†. The observations of Ralfs‡ upon *Himantidium* are very interesting in this respect, although unfortunately very incomplete.

It may be remarked, that the surface of the valves of the *Navicula* described above were covered with minute depressions, invisible by ordinary illumination, but visible by oblique light with the use of stops; while the sporangial sheath was free from markings, save the transverse striæ.

The manner in which the unyielding siliceous sporangial sheath enlarges in accordance with the growth of the sporangial frustule is obscure, unless it ensue by the occasional ecdysis, as it might be called, of the old sheath and the formation of a new. In the earliest conjugating specimen observed of the above *Navicula*, the sporangial sheath was of a rounded-oblong form, about two-thirds of the size of the parent frustules, and situated midway between them, both in regard to length and breadth, whilst the full-grown sporangial frustule and sheath were twice the length of the parent frustule (figs. 2 & 3), both the former being of about the same size, and the latter situated near one end of the sporangial sheath. It was noticed also, that all the sporangial frustules were undergoing division, although contained within their sheaths.

VIII.—*On a New Genus of Fossil* Cidaridæ, *with a Synopsis of the Species included therein.* By Thomas Wright, M.D., F.R.S.E.

Notwithstanding the many new generic sections introduced into the classification of Echinoderms, by MM. Agassiz and Desor, and the important light thrown by these savans on our knowledge of the numerous species of this class contained in European collections, still the progress of discovery renders it imperative on palæontologists to modify from time to time many of the opinions put forward by these authors in their 'Catalogue raisonné.' When the amount of real work done by them is taken into account, in a field which was then comparatively unknown, the wonder is, not that mistakes or oversights should have been committed, but that so much good work

* Annals, *loc. cit.*

† Shadbolt, Microsc. Journal, vol. iii.

‡ Ralfs, Annals, 1843, xii. on *Fragilaria pectinalis*, R. (*Himantidium pectinale*, Kütz.) var. *β*.

under the circumstances should have been attained, which will bear the most severe criticism, and remain as it was left, a monument of the genius and industry of the authors.

In our memoirs on the Cidaridæ of the Oolites, we have figured and described three species, *Goniopygus perforatus*, *Pedina Etheridgii* and *Pedina Bakeri*; the true generic position of these forms seemed to us uncertain at the time our papers were passing through the press, as they exhibited characters which did not assimilate with either of the generic divisions of the 'Catalogue raisonné.' Our materials did not then justify us in proposing a separate genus for their reception; the discovery, however, of an interesting series of new congeneric forms has now enabled us to rectify our determination, and propose the genus *Hemipedina* for the group, to which we have added a synopsis of the species included therein.

Hemipedina, Wright, 1855.

This new genus is composed of small, neat, and highly ornamented Urchins, much depressed on their upper surface, and with a flat or slightly concave base. The ambulacral areas are narrow and straight; the pores in the poriferous zones are arranged in single pairs; the interambulacral areas are in general more than double the width of the ambulacral, with two, four, or six rows of tubercles in general arranged abreast on the same tubercular plate. The tubercles are perforated, and set on mammillary eminences with smooth uncrenulated summits; one row of tubercles in general only extends from the peristome to the disc; the other rows, when there are four and six rows in the area, stop short at the equator, or between the equator and the disc; the intertubercular space on the upper surface of the test is therefore in general wide, and covered with a small miliary granulation. The apical disc is large; the genital and ocular plates are expanded and foliated. The mouth-opening is of moderate dimensions, and the peristome is divided into ten nearly equal-sized lobes. The spines are long, slender, and needle-shaped; those that are known, equal at least the diameter of the test, and their surface is sculptured with delicate longitudinal lines.

Hemipedina is related to *Diadema* in having the pores arranged in the zones in single pairs and the tubercles perforated; but it is distinguished from *Diadema* by the absence of crenulations on the summits of the mammillary eminences. It is related to *Pedina* in possessing perforated and uncrenulated tubercles; but it is distinguished from that genus in having the pores in the zones in single pairs (*Pedina* having the pores in triple oblique pairs like *Echinus*), in having the elements of the apical disc more largely developed, and in the species being nearly all small and depressed forms. *Hemipedina* is related to *Echinopsis* in possessing uncrenulated and perforated tubercles, with the pores in pairs; but it is distinguished from the latter by the narrowness of the ambulacral areas, the depressed form of the test (*Echinopsis* being high and inflated), the form of the mouth-opening, and the deep decagonal lobes of the peristome (that of *Echinopsis* being almost deprived of these incisions), together with the greater size and development of the elements of the apical disc.

Hemipedina, as far as we at present know, is composed of Jurassic species, which commence in the lower Lias and extend into the Coral Rag, each stage possessing its own specific forms. The following synopsis of the British species now before us will be figured and described in detail in our Monograph on the British Oolitic Cidaridæ.

A. *Species from the Lias.*

Hemipedina Bechei, Wright.

Cidaris Bechei, Broderip, Geol. Proc. ii. 202.
Diadema Bechei, Agassiz, Morris's Catalogue of British Fossils, 1st ed. p. 51.

Test small, much crushed, and covered over with spines; ambulacra with two rows of tubercles; interambulacra with four or six rows of tubercles; spines long, slender and needle-shaped, $\frac{8}{10}$ths of an inch in length, with longitudinal lines on the surface. This appears to be identical with the type-specimen in the Museum of the Geological Society.

Locality.—Lower Lias, Lyme Regis.
Coll. J. S. Bowerbank, Esq.

Hemipedina Bowerbankii, Wright, nov. sp.

Test crushed, $1\frac{1}{20}$th of an inch in diameter; ambulacral areas narrow, with two rows of marginal tubercles rather smaller than those in the interambulacra, a tubercle on every alternate plate; interambulacral areas wide, with six rows of tubercles abreast, surrounded by a delicate scrobicular circle; spines shorter and thicker ($\frac{15}{20}$ths of an inch in length) than those of *H. Bechei*, although the test is much larger, deeply sculptured with longitudinal lines.

Locality.—Lower Lias, Lyme Regis.
Coll. J. S. Bowerbank, Esq.

Hemipedina Jardinii, Wright, nov. sp.

Test small, much depressed; ambulacral areas wide, with two rows of marginal tubercles which extend from the peristome to the disc; interambulacral areas with two rows of tubercles set near the poriferous zones, from eleven to twelve tubercles in each row, a delicate scrobicular circle of granules around each, and a naked intertubercular space in the centre; mouth-opening small, situated in a depression; peristome decagonal; base finely radiated in consequence of the size and regularity of the interambulacral tubercles.

Locality.—Marlstone near Ilminster, Somersetshire, and Bredon Hill, Gloucestershire.
Coll. of the late H. Strickland Esq., and Dr. Wright.

Hemipedina Etheridgii, Wright.

Pedina Etheridgii, Wright, Annals of Nat. Hist. S. 2. vol. xiii. p. 315. pl. 1. fig. 5 *a–d*.

Test small, circular, depressed; ambulacral areas narrow, with six small perforate tubercles below, and a double row of marginal granules above; interambulacral areas with two rows of tubercles, seven in each row; apical disc large and petaloidal; mouth-opening small; peristome decagonal; lobes nearly equal.

Locality.—Upper Lias, Ilminster.
Coll. Dr. Wright.

B. *Species from the Inferior Oolite.*

Hemipedina Bakeri, Wright.

Pedina Bakeri, Wright, Annals of Nat. Hist. S. 2. vol. xiii. p. 312. pl. 1. fig. 4 *a–c*.

Test circular, depressed; ambulacral areas very narrow, with two rows of small tubercles set so far apart that they form a zigzag row; interambulacral areas with two rows of rather large prominent tubercles, five in a row; apical disc with a prominent anal rim; mouth-opening large; peristome deeply decagonal.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.
Coll. Dr. Wright: a single specimen.

Hemipedina perforata, Wright.

Goniopygus ? perforatus, Wright, Annals of Nat. Hist. S. 2. vol. viii. p. 267. pl. 6. fig. 5 *a–b*.

Test small, circular and depressed; ambulacral areas with two rows of small tubercles which extend from the peristome to the disc; interambulacral areas with two rows of tubercles, seven to eight in each row, three or four secondary tubercles between the primary rows at the base; surface of the plates covered with numerous coarse miliary granules; mouth-opening large; peristome rather deeply decagonal; lobes nearly equal in size; apical disc large and foliated.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.
Coll. Dr. Wright.

Hemipedina tetragramma, Wright, nov. sp.

Test circular, $\frac{9}{10}$ths of an inch in diameter; ambulacral areas narrow, with two marginal rows of small nearly equal-sized tubercles extending from the peristome to the disk; interambulacral areas with two rows of primary tubercles, about fourteen in each row, and two rows of secondary tubercles, ten in each row, extending from the peristome to nearly the upper surface; mouth-opening small, situated in a depression; peristome decagonal, unequally lobed.

Locality.—Pea-grit, Crickley Hill.
Coll. Dr. Wright.

Hemipedina Waterhousei, Wright, nov. sp.

Test small, pentagonal, rather inflated at the sides; ambulacral areas with two rows of small tubercles extending from the peristome to the disc; interambulacral areas with two rows of tubercles, eight in a row; scrobicular circles neatly defined; mouth-opening small; apical disc narrow and prominent.

Locality.—Pea-grit, Inferior Oolite, Crickley Hill.
Coll. Dr. Wright.

Hemipedina Bonei, Wright, nov. sp.

Test small, pentagonal, depressed; ambulacral areas with two marginal rows of close-set tubercles; interambulacral areas with one entire row and four short rows of tubercles, which extend only as far as the equator; tubercles of both areas about the same size; base flat; mouth moderate in dimensions; peristome unequally decagonal; apical disc absent.

Locality.—Pea-grit, Crickley Hill.
Coll. Dr. Wright.

C. *Species from the Great Oolite and Cornbrash.*

Hemipedina Davidsoni, nov. sp.

Test much depressed, 1 inch in diameter; ambulacral areas with two rows of marginal tubercles very regular in their arrangement throughout; interambulacral areas wide, with two rows of primary tubercles, fourteen in a row, and two rows of secondary tubercles which extend beyond the equator, between the former, and two rows of smaller tubercles between the main rows and the poriferous zones, so that at the equator there are six rows of tubercles abreast, whilst on the upper surface there are only two rows; mouth-opening small, in a concave depression; peristome decagonal and nearly equally lobed; apical disc absent.

Locality.—The sandy beds of the Great Oolite, Minchinnampton.

Coll. Dr. Wright: only one specimen known.

Hemipedina Woodwardii, Wright, nov. sp.

Test circular, much depressed; ambulacral areas narrow, with two rows of small tubercles below and extending as far as the equator, diminishing to granules on the upper part of the areas; interambulacral areas with two rows of rather large primary tubercles, eight in a row, and two rows of secondary tubercles, three to four in each row, which scarcely reach the equator, the upper part of the intertubercular space being filled with a small, abundant miliary granulation; apical disc large, anal rim prominent; mouth-opening small; peristome decagonal, nearly equal-lobed.

Locality.—Cornbrash, Wiltshire.

Coll. British Museum, from Dr. Smith's collection; Dr. Wright.

Hemipedina tuberculosa, Wright, nov. sp.

Test elevated, subconoidal ?, the precise form unknown; ambulacral areas with two rows of basal semitubercles raised on very prominent bosses diminishing rapidly in size into coarse granules above; interambulacral areas with two rows of large tubercles set on very prominent bosses, with scrobicular circles of coarse granules surrounding the areolas; two rows of small secondary tubercles close to the poriferous zones from the peristome to the equator, and three or four at the base of the intertubercular space; upper surface enveloped in the matrix; apical aperture large.

Locality.—Coral Rag, Wiltshire.

Coll. British Museum.

Foreign Species of the genus Hemipedina.

Hemipedina seriale, Wright.

Diadema seriale, Agassiz; Leymerie, Mém. de la Société Géologique de France, tome ii. p. 330. pl. 24. fig. 1, 1839; Agassiz and Desor's Cat. raisonné des Echinides, 3 sér. tome vi. p. 348.

Test hemispherical, subglobose above, flat below; ambulacral areas with two rows of tubercles nearly as large as those of the interambulacra; interambulacral areas with six rows of tubercles abreast at the equator, diminishing to four and two rows above; a few secondary tubercles unequally distributed; mouth-opening small; peristome slightly decagonal.

Locality.—Inferior Lias, France.
Coll. M. Michelin.

Hemipedina Woodwardii, Wright.

This species occurs in the Cornbrash of the Marquise, near Boulogne-sur-Mer. In one of the specimens before us the spines are preserved; the primary spines are not very long, scarcely the length of the diameter of the test; the secondary spines are short and needle-shaped; the surface of both kinds is covered with fine longitudinal lines.

Locality.—The Cornbrash near Boulogne-sur-Mer.
Coll. British Museum.

Hemipedina Nattheimense, Wright.

Echinopsis Nattheimense, Quenstedt, Handbuch der Petrefactenkunde, p. 582. pl. 49. fig. 37.

Locality.—White Jura, Nattheim.
Coll. British Museum. At this moment the specimen is not at our disposal. We shall give a diagnosis of this species in our Monograph.

Hemipedina Sæmanni, Wright, nov. sp.

Test small, hemispherical; ambulacra with two rows of tubercles; interambulacral areas with one row of primary and two rows of secondary tubercles, the primary tubercles alternating with the secondary tubercles, not placed abreast as in most of the species; tubercles of both areas nearly the same size.

Locality.—Coral Rag, Commercy, Meuse.
Coll. Dr. Wright: sent by M. Louis Sœmann of Paris.

IX.—*Brief Notices of several new or little-known species of Mammalia, lately discovered and collected in Nepal, by* Brian Houghton Hodgson, Esq. By T. Horsfield, M.D.

Early in the year 1853, B. H. Hodgson, Esq., late of the Bengal Civil Service, presented to the Museum of the East India Company, a large collection of prepared skins of Mammalia, chiefly from the higher regions of India, with duplicates of most species. Many of these have already been communicated to the public in a detailed catalogue prepared by Dr. John Edward Gray, chief Zoologist of the British Museum, with the title of "Specimens and Drawings of Mammalia of Nepal and Tibet, presented by B. H. Hodgson, Esq., to the British Museum, December 10th, 1845."

Since Mr. Hodgson's return to India in 1847, various new and interesting species of Mammalia have been discovered by him in Nepal, Darjeling, Tibet, and other parts of India near the Himalayan range, which are not contained in the catalogue above mentioned; of these a concise description is now given, with remarks on several other species hitherto imperfectly known.

Of the numerous duplicates liberal distribution has been made, under the orders of the Hon. Court of Directors of the India Company, agreeably to the recommendation of Mr. Hodgson, to the British Museum, the Derby Museum at Liverpool, to several other English museums of natural history, and also to the museums at Leyden, Frankfort and Heidelberg, on the continent of Europe.

Of the family of Vespertilionidæ the collection contains the following species:—

1. Megaderma schistacea, Hodgs. J. A. S. xvi. 589, with a figure.

Megaderma Lyra, Geoff. apud Kelaart, Prodr. Faunæ Zeylanicæ, Mammalia, p. 11.

This species was discovered by B. H. Hodgson, Esq., in 1847, in Sikim Tarai, and a very copious description of its form and habits is given in vol. xvi. of the Journ. As. Soc. Beng. It appears to be the representative of the *M. Lyra* in the higher regions of Bengal, and though very like that species, Mr. Hodgson considers it clearly distinct, on account of its slaty colour in the living state, and his figure represents it of that tint. When dry it can scarcely be distinguished from *M. Lyra*: this appears from the specimens set up in the Company's museum. Dr. Kelaart, who found it in Ceylon, introduces it in his catalogue as a synonym of that species, while he remarks, that "none of the specimens examined by us were of the dimensions given by Mr. Hodgson."

Mr. Hodgson describes the colour of the fur for the most part of a clear, deep slaty-blue above, and sordid buff below, and that of the eye very dark. Females resemble males. The expanse of the wings is 1 ft. 6 in. The dimensions are given in detail at page 894.

2. Rhinolophus perniger, Hodgs. J. A. S. xii. 414, xvi. 896.

Rhinolophus perniger, Hodgs. apud Blyth, J. A. S. xiii. 484.

Discovered by Mr. Hodgson in the central regions of the Sub-Himalaya, and described in vol. xii. of the Journ. As. Soc. Beng.; also briefly noticed by Mr. Blyth. As yet a rare species in collections. According to comparisons made at the British Museum, it resembles the *Rh. trifoliatus*.

3. Rhinolophus tragatus, Hodgson.

First described in Journ. As. Soc. Beng. iv. 699; Gray, Cat. Mamm. Br. Mus. p. 22; Cat. Hodgs. Coll. p. 2; Blyth, Journ. As. Soc. Beng. xiii. 484. A new subject in the Company's museum.

4. Hipposideros armiger, Hodgs. J. A. S. iv. 699; Gray, Cat. Mamm. Br. Mus. p. 24; Cat. Hodgs. Coll. p. 3; Blyth, J. A. S. xiii. 488.

Although nearly allied to *Rh.* (*Hipposideros*) *nobilis* of Horsfield, it deserves the rank of a distinct species. It is larger than the Javanese species, and its peculiarities are pointed out by Hodgson and Blyth.

5. Vespertilio siligorensis, Hodgson.

Muzzle pointed, with a moustache on the upper lip. Ears oval, slightly emarginate and somewhat pointed; tragus elongate, acute. Wing-membranes arising from the base of the toes. Fur above uniform dark brown, below dark brown tipped with pale brown. Membranes brown. Fore-arm 1 in. 3 lines. Tibia $6\frac{1}{2}$ lines. Longest finger 2 in. 4 lines.

Obs.—Very nearly allied to, if not identical with, the *V. mystacinus* of Europe.

6. Vespertilio darjelingensis, Hodgson.

Very nearly allied to the former, but differing in having the ears more emarginate, with a distinct lobe at their base; in having the tibia somewhat shorter, with the fur of the upper parts darker and tipped with chestnut, with a gloss somewhat as in *V. mystacinus,* but lighter*.

7. Scotophilus coromandelicus, F. Cuv. sp.

Vespertilio coromandelicus, Lesch. & Cuv. Nouv. Ann. de la Mus. Schinz. Syst. Mamm. p. 171.

Examined by R. F. Tomes, Esq.

8. Murina suillus, Temm. sp.

Vespertilio suillus, Temm. Monogr. ii. 224. t. 56. f. 456.
Murina suillus, Gray, Ann. and Mag. Nat. Hist. 1842, 259.

Identified by R. F. Tomes, Esq.

9. Barbastellus Daubentonii, Mém. Acad. Par. 1759, t. ii. p. 8; Bell, Brit. Quad.

Barbastellus communis, Gray, Mag. Zool. and Bot. ii. 13.

Examined by R. F. Tomes, Esq., who considers it identical with the European species, although somewhat darker in colour from its preservation in spirits.

10. Plecotus homochrous, Hodgs. J. A. S. xvi. 894.

Mr. Hodgson, after giving a very copious description of this new species of *Plecotus,* which he discovered in the central regions of Sub-Himalaya, remarks: "Nearly allied to *auritus,* but differs therefrom by disunited ears, fewer molars, a flat inner ear, shorter fur and nude ears, besides its more uniform colour. The joints of the digits also differ, showing how little dependence can be placed upon this mark, which yet Cuvier, Geoffroy and Hamilton Smith make the corner-stone of the general classification of the family."

11. Plecotus darjelingensis, Hodgson.

Nearly allied to the former, but considered distinct by Mr. Hodgson. The dimensions are the same in all points; the colour is deeper, inclining to blackish. The lobes of the ear are spreading, with a small appendicule at the bases. The tragus is narrow. The specimens of this and of the former are few and not well preserved, and more materials are required for a satisfactory discrimination.

12. Lasiurus Pearsonii, Horsfield, Cat. Mamm. E. I. C. Museum, p. 36; Blyth, J. A. S. xx. 524.

Noctulinia lasiura, Hodgs. J. A. S. xvi. 896; fide Blyth, J. A. S. xxi. 343.

The specimen sent by Mr. Hodgson is not quite adult; in

* This and the preceding were examined and described at my request by R. F. Tomes, Esq.—T. H.

other respects it agrees with Mr. Pearson's specimen from Darjeling, from which the original description was made.

13. Nycticejus nivicolus, Hodgson.

Colour of the head and body above uniform light brown, with a slight yellowish shade; underneath, from the throat to the vent, dark grey with a brownish tint, lighter on the sides of the throat. Ears long, attenuated to an obtuse point, exceeding half an inch in length.

The fur has the character of that of *Lasiurus Pearsonii*, being delicate, very soft and silky both above and underneath. Entire length 5 in., of which the tail measures 2; brachium $1\frac{3}{8}$ in.; cubitus $2\frac{1}{2}$ in.; longest digit $4\frac{1}{4}$ in.; tibia $1\frac{1}{2}$ in.; foot and claws $\frac{3}{4}$ in.; ears $\frac{5}{8}$ in.; expanse 1 ft. 7 in.

This species resembles the *Nycticejus ornatus* described by Mr. Blyth in vol. xx. of the Journ. As. Soc. Beng. pp. 517, 518, but it is of larger dimensions, more uniform in its colouring, and altogether destitute of the white spots and bands indicated in the description of the *N. ornatus*, and of the tawny-red colour on the membranes of that species. It has also some affinity to the *Nycticejus Tickelii*, Blyth, Journ. As. Soc. Beng. xx. 157, 158, but its dimensions and proportions are different, and the brighter maroon colour which spreads over the membranes, as in *Kerivoula picta*, is entirely wanting in the *Nycticejus nivicolus*.

More specimens of this species are desirable to illustrate its true character.

14. Pteropus Edwardsii, Geoffr. (Gray, Cat. Hodgs. Coll. p. 3), presents nothing peculiar.

Of the genus *Felis*, the collection contains, besides the more common species, the following:—*Felis Uncia*, Erxleb. Syst. Mamm. p. 508. *Leopardus Uncia*, Gray, Cat. Mamm. Br. Mus. p. 41; Cat. Hodgs. Coll. p. 5. *Uncia Irbis*, Ehrenb. sp. Gray, Ann. & Mag. Nat. Hist. N. S. xiv. 394*.

* Dr. J. E. Gray has recently proposed that the *Ounces*, or Tortoise-shell Tigers as they have been called, should form a particular group of Cats, to which the name of *Uncia* may be attached. They are easily characterized by the great length and thickness of their cylindrical or rather clavate tail, and the marbling of the colours on the fur. They are confined to Asia.

1. *Uncia Irbis*. *Felis Uncia*, Schreber. *F. Pardus*, Pallas. Tibet.
2. *Uncia macroscelis*, Temm. Sumatra.
3. *Uncia macrosceloides*, Hodgson. India.
4. *Uncia marmoratus*. *Felis marmorata*, Martin. *F. Diardii*, Jardine. Penang.
5. *Uncia Charltoni*. *F. Charltoni*, Gray. *F. Duvaucelli*, Hodgs. MSS. India, Himalaya.—*Dr. Gray, Ann. Nat. Hist.* 1854, xiv. p. 394.

15. Felis uncioides, Hodgs. List of Mamm. presented to E.I.C. Mus.

The specimens received from Mr. Hodgson agree in all points with those from Tibet presented to the Museum of the East India Company by Capt. R. Strachey.

16. Felis macrosceloides, Hodgs. Coll., Journ. N. H. iv. 286.

Felis macroscelis, Hodgs. J. A. S. xi. 275.
Felis, n. sp., Tickell, J. A. S. xii. with a figure.

Although nearly allied to *F. macroscelis*, Temm., of the Malayan Islands, Dr. J. E. Gray allows it the rank of a distinct species, on account of its smaller size and some difference in the markings. In a note on the specimen described by Mr. Hodgson in vol. xi. of the Journ. As. Soc. Beng. p. 276, Mr. Blyth remarks, "that this fine species originally discovered in Bengal should also inhabit Tibet is a remarkable circumstance."

Mr. Hodgson's specimen is from Tibet; that described by Lieut. Tickell is from the snowy range of Darjeling.

A figure of Mr. Hodgson's specimen will be found in the Illust. Proc. Zool. Soc. 1853.

17. Felis murmensis, Hodgs. Proc. Zool. Soc. 1832, p. 10, varietas nigra.

Mr. Hodgson has recently discovered a very beautiful variety, of a saturated brown or black colour, of which the collection contains several specimens. In size and external character it agrees exactly with the brown-red or bay species, first described in the 'Proceedings of the Zoological Society.' The lateral marks on the cheeks, forehead and thighs are the same, and also a slight whitish discoloration on the tip of the tail. It is a very beautiful variety.

18. Felis Charltoni, Gray, Br. Mus.

Uncia Charltoni, Gray, Ann. & Mag. Nat. Hist. xiv. p. 394 (1854).

This is as yet a very rare species in collections. Besides the original specimen discovered by Col. Charlton, and that forwarded by Mr. Hodgson, none is enumerated in Catalogues of Natural History. It is from the higher regions.

19. Paradoxurus strictus, Hodgson.

General colour grey, with a slight rusty shade; two prominent white spots on each side of the head, one beneath the eye oblong, tending forward, one behind the eye larger, triangular, tending backward; five continuous stripes, regularly defined and straight, of a deep black colour, commencing on the neck, extend over the whole length of the body, having on each side beneath an interrupted band of black spots. Abdomen grey. Tail exceeding the body in length; mixed grey and black at the base, the terminal portion black, the colour increasing in deepness towards the extremity. Legs black. Throat grey, with a medial black stripe. Ears developed.

Length from the snout to the root of the tail 23 inches, of the tail 25 inches.

This species appears nearly allied to *Par. Palassii*, described by Dr. Gray in Proc. Zool. Soc. 1832, p. 67, but it has no resemblance to the figure of that species given in Gray and Hardwicke's Illustrations of Indian Zoology, ii. fig. 8. Its distinctive character requires further examination.

Five well-defined and regular black lines on the back are the chief characteristic of this species; hence the specific name. Mr. Hodgson considers it to be new; and from the comparison made by Dr. Gray at the British Museum, it appears to be distinct from *Par. Palassii*.

20. Paradoxurus quadriscriptus, Hodgson.

General colour grey, with a slight rufous shade extending over the whole of the body, over one-half of the tail, over the forehead and the lower part of the ear. On the back and parts adjoining, four well-defined continuous black stripes pass from the neck to the rump, having a shorter interrupted band on each side; the bridge of the nose in the middle, a well-defined narrow streak from the canthus of the eye, the neck, the feet, and the terminal part of the tail are black; on the upper part of the neck the hairy covering is slightly variegated black and grey, the separate piles being grey at the base and black at the tip. The fur is soft, lengthened and straggling.

The entire length of this species is 50 inches; 26 of which are occupied by the head and body, and 24 by the tail.

This species resembles the *Paradoxurus Bondar* in habit and in the softness of its hairy covering, but differs essentially in colour and in the four strongly marked black lines on the back. The *Bondar*, according to the description of M. de Blainville (Desm. Mamm.), is of a yellowish colour, with one prominent black line on the back: the *Par. hirsutus* of Hodgson, which is identical with the *Bondar* of Dr. Buchanan Hamilton, described in vol. xix. of the 'Asiatic Researches,' is of a yellow colour, and without lines on the body. According to the notice of Dr. Gray, this species is not contained in the British Museum *.

* Dr. Gray states in Proc. Zool. Soc. 1853, p. 191:—"I cannot see any difference between these specimens and the *P. musanga*."

21. Hyæna striata, Zimm.

The collection contains two imperfect skins, marked by Mr. Hodgson "*Hyæna virgata,* List of specimens presented to the East India Company." In Mr. Ogilby's memoir on the Mammalogy of the Himalayas, in Royle's Illustrations, &c., is the following remark: "the Hyæna of India (*Hyæna virgata*), a native of the plains, sometimes ascends even to Simla." The skins have been compared with specimens of the striated species at the British Museum and at the East India House, but present no character to warrant a specific distinction. The multifarious specific names with which this species is enumerated in books on zoology have greatly perplexed its synonymy.

Besides the common Indian species of *Vulpes bengalensis, montanus* and *ferrilatus,* the collection contains a specimen commonly indicated as *Vulpes laniger,* which is, however, a true *Lupus.*

22. Lupus laniger, Hodgson.

The entire length of the specimen from the nose to the root of the tail is 4 feet 4 inches; of the tail only 11 inches remain, and its length cannot be determined accurately. The general colour above is fulvescent inclining to sordid, deeper on the back, which is slightly variegated by the admixture of black-tipped hairs; underneath pale grey. On the back the pelage is close and formed into small tufts, on the sides dense and shaggy, in accordance with the cold regions which it inhabits; on the head and nose it is greyish. The ears are large, pointed, and covered externally with a dense brownish fur. The form of the head is that of a common European wolf, rounded posteriorly and tapering to the nose.

This animal must be considered specifically distinct from the *Canis Lupus* of Elliot (Madr. Journ. Lit. x.), and from the *Canis pallipes* of Sykes (Proc. Zool. Soc. 1831), to which the name of Wolf is also assigned. It is a larger animal, and the hairy covering is of a different character, besides other distinctions which appear from the descriptions. The black lines on the front of the fore feet are observed in both species. Mr. Blyth's remarks in his Report for September 1847, afford a useful illustration of the Tibetan Wolf.

23. Mustela strigidorsa, Hodgson.

A new species discovered by Mr. Hodgson in the Sikim Hills of Tarai, and thus described by himself:—Snout to vent 12 inches; head $2\frac{3}{4}$ in.; tail only $5\frac{1}{2}$ in.; tail and hair $6\frac{1}{2}$ in. Palma $1\frac{3}{4}$ in., planta 2 in. Weight $7\frac{1}{2}$ to 8 ounces. Intense brown, with the lips, head and neck inferiorly, and a dorsal and ventral stripe, yellowish-white or pale aureous.

Remark.—Is a fourth larger than the *Kathia* or *auriventer*, and differs from it by the dorsal stripe and also by the ventral, the latter in the *Kathia* being much wider and its colour richer.

Hab. Sikim (Hodgson MS.).

The specimen sent to the Museum agrees generally with this description; the brown colour has a shade of chestnut, and the under part of the head, neck and breast are nearly white, with a slight isabelline discoloration *.

24. Meles leucurus, Hodgson.

Taxidea leucurus, Hodgs. J. A. S. xvi.
Túmphá of the Tibetans.
Tibetan Badger.

This interesting animal was first brought to the notice of Mr. Hodgson by the receipt of a specimen from the neighbourhood of Lassa, and a very copious description of it is given in vol. xvi. of the Journ. Asiat. Soc. Beng., with a figure of the animal, and details of its skull and feet comparative with the allied quadrupeds. A specimen in a tolerable state of preservation, with a separate skull quite perfect, has been presented to the Museum. The comparison of this skull with one of the European Badger has afforded the means of determining its true generic character. The result of the examination made by Dr. J. E. Gray, which illustrates this point, is given in a short notice published in vol. xii. of the Ann. & Mag. Nat. Hist. N. S. xii. 221 †.

The specimen sent agrees generally with Mr. Hodgson's

* See also description by Dr. Gray in Proc. Zool. Soc. 1853, p. 191.

† *The Tibetan Badger of Hodgson.*

"Mr. Hodgson having sent to the India House a specimen with its skull of his *Taxidea leucurus* (Journ. Asiat. Soc. xvi. 763, 1847), I have compared the skull with that of the various Badgers in the Brit. Mus. Collection. I find all the Old-World Badgers (*Meles*) have a moderate-sized triangular flesh-tooth, and a very large four-sided oblong tuberculous grinder in the upper jaw, which is rather longer than broad, and the skull is rounded behind. The nose of the Tibetan Badger or Tumpha, *Meles leucurus*, is rather more tapering and more compressed than that of the European Badger (*Meles Taxus*), which it most resembles. The Japanese Badger (*Meles Anakuma*) differs from both in having a much shorter skull and a short, rather broad nose.

"The American Badgers (*Taxidæ*, Waterh.) have a very large triangular flesh-tooth, and an equally triangular tubercular grinder in the upper jaw not exceeding the flesh-tooth in size. The skull is also much broader, more depressed and truncated behind. Of this genus I only know a single species, *T. Labradoria*."—J. E. Gray, Ann. Nat. Hist. N. S. xii. 221. See also Proc. Zool. Soc. 1853, p. 191.

original description. The upper parts are of a greyish-white colour, with a fulvescent shade which is deeper on the extremity of the tail. The chin, throat, breast and extremities are entirely black. In the hairy covering on the back, the separate piles are nearly 3 inches long, white at the base one-half of their length, with a black extremity, widely diffused and straggling, giving the animal a rough and shaggy appearance. It bears a great resemblance to the European Badger.

Mr. Hodgson has proposed that it should be formed into a genus under the name of *Pseudomeles*.

In the Report to the Bengal Society for September (1854), Mr. Blyth communicates some remarks on Indian Badgers. He mentions the Tibetan Badger with reference to Mr. Hodgson's description and figure in vol. xvi. of the Journ. Asiat. Soc.; while he indicates what he considers to be a distinct species, with the name of *Meles albogularis*: comparatively with the European Badger "it has smaller and much less tufted ears, a shorter and much less bushy tail, and the fur shorter and coarser."

The subject of Indian Badgers requires further examination. An Indian Badger resembling the *Meles leucurus* is described by Pennant in vol. ii. of Hist. of Quad. p. 16 (*Ursus indicus*): "Badger with a small head and pointed nose; scarcely any external ears; only a small prominent rim round the orifice, which was oval; colour of the nose and face, a little beyond the eyes, black; crown, upper part of the neck, the back, and upper part of the tail, white inclining to grey; legs, thighs, breast, belly, sides, and under part of the tail black. Five toes on each foot, the inner small; claws very long and straight. Length from nose to tail about 2 feet; tail 4 inches long; hair short and smooth."

Dr. Shaw in his 'General Zoology' adds the following remark: "Mr. Pennant is the first and only describer of this species, which was brought from India, and was in the possession of the late Mr. John Hunter. (It remains to be determined whether all the Badgers hitherto indicated do not constitute local varieties of the same species?—T. H.)

Of the genera *Lutra* and *Aönyx*, the collection contains the following representatives:—

25. Lutra chinensis, Gray, Mag. Nat. Hist. 1836; Cat. Mamm. B.M. 71?

Lutra tarayensis, Hodgs. J. A. S. viii. 819; Gray, Cat. H. C. p. 14.

26. Aönyx sikimensis, Hodgson.

This Mr. Hodgson considers to be a new species. It differs chiefly from the common *Aönyx* of India, which is found in Bootan and Afghanistan, by a more clear brown colour, inclining to chestnut, but the specimen is not sufficiently perfect to afford the means of an accurate description.

In the "Summary Description of four new species of Otter," Journ. Asiat. Soc. viii. 319, Mr. Hodgson remarks: "One of the most remarkable features of the mammalogy of Nepal is the great number of distinct species of Otter characterizing it. There are at least seven species, I believe, though not one of them is numerous in individuals,—at least not in comparison of the common Otter of commerce, which is produced in the neighbourhood of Dacca and Sylhet."

In the "Summary" Mr. Hodgson describes four species; most of these are rare in collections. In the Catalogue of Hodgson's collection, Dr. Gray enumerates four species from Nepal: *Lutra aurobrunnea, Lutra chinensis, Lutra monticola,* and *Aönyx indigitatus.*

27. Sorex murinus, Zimmerman.

Sorex myosurus, Pallas.

The Museum contains specimens of this species from Nepal, Bootan, and other Indian localities; among these are several very perfect specimens presented by Capt. R. C. Tytler. One of these, as well as a single specimen of Mr. Hodgson's last collection, are of comparatively larger dimensions, of a cærulescent greyish colour, agreeing with the description of *Sorex cærulescens* of authors; while two specimens of a former collection, received from Mr. Hodgson in 1845, are of a darker colour, brown, and not cærulescent, resembling the *S. murinus* described by authors. Much uncertainty still exists in the discrimination of the species of *Sorex,* and the real character of many species enumerated by authors remains doubtful, until, for instance, *cærulescens, murinus, myosurus, serpentarius, nemorivagus, soccatus,* &c., be subjected to a careful examination of specimens in a perfect state.

28. Sorex saturatior, Hodgson.

Colour uniform deep brown, inclining to blackish, with a very slight rufescent shade. Fur short, with an admixture of a few lengthened piles; when adpressed to the body smooth, but reversed somewhat rough and harsh. Tail cylindrical, long, and gradually tapering to the point. Snout elongate, regularly attenuated. Ears moderate, rounded.

Very nearly allied in habit and dimensions to *Sorex Griffithii,* Horsf. Cat. Mamm. E. I. C. Mus. p. 134, the more lengthened and cylindrical tail forming the chief distinction. The character of the fur is the same in both species.

Length from the tip of the snout to the root of the tail 5½ inches, of the tail 3 in.

29. Sorex caudatus, Hodgs. Ann. & Mag. Nat. Hist. N. S. iii. p. 203; Cat. Mamm. E. I. C. Mus. p. 135.

Corsira? caudata, Blyth, Mem. on Indian Shrews, J. A. S. 1855, p. 37.

A true *Sorex*, as appears from the examination of the skull. Judging from the number of specimens sent to the Museum, this species appears to be common on the hills.

30. Sorex? nemorivagus, Hodgs. Ann. & Mag. Nat. Hist. xv. 269; Coll. J. N. H. iv. 288; Gray, Cat. H. Coll. p. 10.

Sorex nemorivagus, ap. Blyth, Mem. on Ind. Shrews, J. A. S. 1855, p. 31.

A species by no means clearly determined. The specimens sent defective.

31. Sorex pygmæus, Hodgs. Ann. & Mag. Nat. Hist. xv. 269; Gray, Cat. H. Coll. p. 16.

"Structure typical, save that no odorous glands were detected, nor had the animal any musky smell."—Hodgs. *loc. cit.*

32. Sorex leucops, Hodgson.

In Mr. Hodgson's list, accompanying his present, this is marked as a new species.

Colour uniform blackish-brown; tail very slender and tapering, exceeding in length the body and head together, terminating with a whitish tip of half an inch long. It is named White-lipped, but this character does not appear in the specimen sent. It appears to be a distinct species, but further specimens and examinations are required to determine its rank.

Length of the body and head 3 inches, of the tail 3¼ in.

The distinguishing character is the comparative length of the tail and its white tip. It resembles the *caudatus*, but the colour is darker, and the single specimen examined is not furnished with the delicate hairs on the sides of the snout which exist in the *S. caudatus*.

Note.—The *Sorex sikimensis*, Hodgs. Ann. & Mag. Nat. Hist., N.S., vol. iii. p. 203; Cat. Mamm. Mus. E. I. C. p. 136, has, on a more accurate examination of its skull and other characters, been determined to be identical with *Corsira nigrescens*, Gray, Ann. & Mag. Nat. Hist. x. 261. In the Catalogue of Hodgson's Coll. p. 17, Dr. Gray gives the following synonyms of this species:—*Sorex? soccatus*, Hodgs. Ann. & Mag. Nat. Hist. xv. 270, and

Cat. Journ. Nat. Hist. iv. 288; and *Sorex aterrimus*, Blyth, Journ. As. Soc. Beng. vol. xii. 1843, p. 928? The latter species is not enumerated in Blyth's Memoir on Indian Shrews, J. A. S. B. 1855; but the *Corsira nigrescens* is defined here as *Soriculus nigrescens*, Blyth, with the synonym of *Corsira nigrescens* and *Sorex sikimensis*. The *Sorex soccatus* of Hodgson, Ann. & Mag. Nat. Hist., is enumerated by Mr. Blyth as a distinct species.

33. Mus tarayensis, Hodgson.

Nearly allied to *Mus brunnusculus*, Hodgs., Ann. & Mag. Nat. Hist. xv. 267.

Colour of the body and head above dark brown, delicately variegated with blackish and rufous hairs; a very slight gloss on the surface. Outer sides of the extremities rather darker. Under parts from the chin to the vent, and inner parts of the extremities greyish-brown, with a rusty shade. Tail shorter than the body, tapering to an abrupt tip. Head lengthened and compressed; muzzle gradually tapering to an abrupt tip.

Distinguishing character.—A dark brown surface with a slight gloss. Head lengthened. Tail shorter than the body. Underneath rusty-grey.

Mr. Hodgson's collection contains only a single specimen, and further observations are required to confirm the distinctness of this species.

34. Mus plurimammis, Hodgson.

Colour above brown, with a rufescent shade; fur soft, consisting of brown and rufous hairs intermixed in equal proportions, forming a uniform upper surface; a rather obscure band extending from the gape over the cheek, terminating under the ears, and the abdomen and adjoining parts rufous-grey. Head proportionately short, muzzle abrupt; ears moderate. Tail equal in length to the body, tapering to a sharp point, and minutely annulated.

Length of the head $2\frac{1}{2}$ inches, of the body from the neck to the vent $5\frac{1}{2}$ in.; of the tail the same.

The distinguishing character, according to Mr. Hodgson, rests on the number of teats, exceeding that of other species.

35. Mus morungensis, Hodgson.

Hairy covering of the body above minutely striated with black and rufous hairs, nearly equally mixed, giving the animal a blackish rufous aspect; abdomen and extremities paler, rufescent-grey. Body proportionately robust and stout; head large and thick; muzzle short and abrupt; ears large and rounded; tail cylindrical, gradually tapering to the point and delicately annulated, equal in length to the body and head together. Fur above soft; hairs more lengthened than in *Mus plurimammis*, rufous and brown intermixed, the former predominant.

Dimensions.—Head 1½ inch; body 3 inches; tail 4½ in.

Distinguishing character.—A large truncated head, robust body, long, tapering and minutely annulated tail. General colour rufescent-black.

36. Arctomys tibetanus, Hodgs. J. A. S. xii. 409.

In presenting this animal to the Museum, Mr. Hodgson gave us personally the following remark respecting the two species of this genus described by him, and their respective specific names and localities:—"The *Bobac, Arctomys himalayanus*, Hodgs., *A. Bobac*, Schreb., is found only in the higher regions of Tibet, while the *A. tibetanus*, Hodgs., inhabits exclusively the lower regions of Himalaya; but inadvertently the respective locality of the two species has been alternated in my descriptions."

Among the Squirrels sent by Mr. Hodgson there are several specimens of the *Sciurus M'Clellandii*, Horsfield, Proc. Zool. Soc. 1839, p. 152, which was discovered by J. M'Clelland, Esq., in his visitation to Assam as a member of the deputation on the Tea-plant, and described in the Report of his contributions of Mammalia and Birds to the Company's Museum. It is thus described:—

Sciurus M'Clellandii, Horsfield. Supra fuscus fulvo tenuissime irroratus notæo saturatiore; subtus ex sordido fulvo-canescens; dorso summo linea recta atra; linea insuper utrinque laterali fusca læto fulvo marginata, antice saturatiore, ad oculos extensa, postice obsoleta in uropygio utrinsecus approximata; cauda mediori subcylindrico-attenuata nigro fulvoque variegata; auriculis atris barba nivea lanuginosa insigni circumscriptis; vibrissis longis nigris.

In the specimens contained in Mr. Hodgson's collection, the colour on the upper parts is brownish-grey, with a slight rufescent shade, rather deeper on the back, minutely grizzled with brown and blackish hairs; all the under-parts are fulvescent-yellow: on the middle of the back from the neck to the rump is a deep black stripe, and somewhat lower a brownish-black stripe of the same extent, adjoining which, on each side, is a yellowish-white stripe, commencing at the tip of the nose and extending along the sides to the rump, gradually narrower towards its termination. Ears large, black exteriorly, delicately fringed with white on the posterior border. Tail tapering, variegated with black and rufescent hairs. Whiskers long and black.

Dimensions.—Head $1\frac{1}{2}$ inch; body 3 inches; tail 3 in.

This species, although provisionally arranged in the genus *Sciurus*, resembles in its external habit, markings, attenuated tail, and minutely fringed ears, the American genus *Tamias*, and it remains for naturalists in the higher regions of India, who may examine living specimens, to determine whether it has cheek-pouches, by which *Tamias* is distinguished from *Sciurus*.

Mr. Hodgson's collection contains a large supply of most of the Indian UNGULATA: many of these have been discovered, and first described by himself, and are known to naturalists chiefly by the copious details given in the Journal of the Asiatic Society of Bengal, and by Dr. J. E. Gray's Catalogue of the collection presented to the British Museum. Among the subjects as yet rare in collections may be mentioned *Poëphagus grunniens*, Linn., adult and one calf., *Porcula salvania*, Hodgs., and *Budorcas taxicolor*, Hodgs.* Of the latter, Mr. Hodgson has some three specimens, on the whole in good preservation; one of these is exhibited in the Museum of the East India Company, one has been presented to the British Museum, and one to the Museum at Leyden. A very perfect specimen of the *Cervus affinis* of Hodgson has also been sent, and is mounted in the Museum. Whether this be really a distinct species from *Cervus Wallichii* of Cuvier remains still to be determined; the horns of both agree in structure and subdivisions. Dr. Gray has given most copious details regarding the various, multifarious synonyms with which they are enumerated by authors (Cat. Mamm. Brit. Mus. Part iii. Ungulata furcipeda, pp. 197 & 199).

X.—*On the* Assiminia Grayana *and* Rissoa anatina. By WILLIAM CLARK, Esq.

To the Editors of the Annals of Natural History.

GENTLEMEN, Exmouth, 26th June 1855.

I BEG to present descriptions of two testaceous Gasteropoda, which could not be obtained during the passage through the press of my volume on the British Marine Testaceous Mollusca. One of them, the *Assiminia Grayana*, is of peculiar interest, and has caused much discussion and difference of opinion

* These three interesting animals have been figured in the Illustrations of the Proc. Zool. Soc. for 1853.

respecting the structure of the tentacula and eyes, and its natural position. The other, the *Rissoa anatina*, is a Rissoidean of the group which is represented by *R. ulvæ*. Authors have mentioned both these animals, and the Rev. M. J. Berkeley has published a valuable memoir and figure of *A. Grayana*, in vol. v. p. 429 of the 'Zoological Journal;' but I have thought that the addition of later notes on several unobserved points of this last species, and in comparison with those of the genus *Truncatella*, would be acceptable to some of your readers.

In vol. xii. p. 4 of the 'Annals' for July 1853, and in my work above mentioned, pp. 380–6, I have expressed an opinion that the genus *Assiminia* is superfluous, and that its only species would be handed over to the genus *Truncatella*. I have been so impressed with this view, that I invited malacologists residing in the neighbourhood of Greenwich to send me live specimens of the *A. Grayana*; this request was inserted in the 'Annals,' but the appeal remained unsuccessful until this date, when I had the good fortune to obtain the long-sought-for desideratum, with an unexpected addition of the *Rissoa anatina*, both in a living state, through the kindness of my friend John Gwyn Jeffreys, Esq., of Swansea, who omits no opportunity nor spares any personal exertion to add to his valuable contributions to the molluscan branch of British natural history.

Truncatella Grayana, nobis.

Assiminia Grayana, auctorum; Brit. Moll. vol. iii. p. 70. pl. 71. figs. 3, 4; (animal) pl. H.H. f. 6.

Shell, a short strong cone of $6\frac{1}{2}$ tumid volutions, increasing rapidly in bulk from the apex to the base, which are distinctly but not deeply divided; each whorl is marked with a somewhat irregular and confused rufous-brown and a yellow spiral band, the former being the broadest, and situate at its base; the latter winds round the upper part, but in many examples the bands become so blended as to diffuse throughout the entire area the mixed hues of the two fasciæ. The transverse striæ of increment are well marked, and also obsolete rather coarse spiral lines may be detected. Aperture suboval or pear-shaped; peristome disunited; outer lip sharp; no umbilical fissure; the apex is pointed. Axis $\frac{2}{10}$ths, diameter $\frac{1}{10}$th of an inch.

Animal.—The mantle at the aperture of the shell is simple. The muzzle is very short and broad, flat, expanded, and curved at the end on each side, forming minute auricles with a central emargination or well-impressed sinuation, and furnished with raised elastic annular lines that enable the animal to effect a great protrusion of the neck and rostrum; the latter organ in every position is always borne much in advance of the foot; it is vertically cloven, and at the under part, in the centre, slightly so, in a crosial direction, from whence the jaws or subcircular arches of the lingual riband, supported by the buccal plates, are almost momentarily exserted; the œsophagean portion of the riband springing from the stomach is short and of rissoid stamp. The posterior part of the muzzle next the neck is suffused in different individuals with all the phases of dark colour approaching to almost black, and with all the variations of the most delicate cinereous hues; the flattened or expanded anterior curved terminal portion abruptly becomes white, and is shot with the minutest points or flakes of a still intenser white. A not very deep longitudinal groove, or two contiguous parallel lines, are visible on the neck when moderately protruded, but these, when greatly so, are lost; they are generally supposed to act as a conduit to the branchial water.

The dark tentacula spring from a minute mammilla, and are very short, massive, and columnar at the base, becoming, though still thick, somewhat spatulate and rounded at their whitish terminations; in the centre of this minute plateau, at some little distance from the extremities, the large eyes are immersed, and from the intensity of the black colour are almost equally visible on the upper and lower surface; this is their natural position when the animal is on the undisturbed march, but the instant it is disquieted, both the tentacula and eyes assume various modifications of figure: for instance, when the neck is greatly exserted, or the animal is in comparative repose, in either of these opposite conditions they become much contracted, especially at the tips, which are folded or withdrawn into a minute hollow, out of which the eyes peep, and thus appear fixed at the extremities; but, as we have shown, this is not their true site, which here, and in all the *Truncatellæ*, is at some little, but distinct, distance from their final points.

Some authors have thought that the eyes are mounted on pedicles, connate, and of the same length as the true tentacula: this idea is wrong: we repeat their true position is an absolute immersion in the tissue; the tentacula are therefore strict vibracula, and in nowise sustentacula. The white pupil mentioned in my first account of *Truncatella* was not detected in this species. The animal on the march carries the tentacula nearly at a rectangular divergence: this position is a marked characteristic of the genus *Truncatella*.

Foot rather short, broad and fleshy, not auricled, but subquadrate in front, with a tendency to roundness at the external angles, without a central sinuation, and deeply and conspicuously labiated; when not in action rounded posteally, but in full progression it assumes a broad lancet-shape, suddenly sloping on each side to an obtuse termination; there is no longitudinal depressed line on the sole, and only a slight transverse crease is visible when the posterior portion is drawn up to the advanced one; it carries on a distinct upper fuscous lobe, which is only narrowly alated on each side, a light corneous pear-shaped operculum, with a rather indistinct submarginal nucleus, the spiral continuations of which show the fine oblique lines of increment, as in the *Littorinæ* and *Rissoæ*. The animal is slow and deliberate in progression; its action is between that of *Littorina* and *Rissoa*, not having the lateral oscillatory march of the former, nor the perfectly steady advance of the latter. The foot on the upper surface is of all the hues of lead-colour; the sole is pale bluish-white, aspersed thickly with minute flakes of an intenser white.

From the non-transparency of the shell, the character of the branchiæ could not be well made out, and when examined after extraction their delicate and minute structure suffered from collapse. The neck has no appendages except the guide lines for the branchial water, and the muzzle is altogether without them. Verge long, slender, and falcate at the end.

It inhabits the Greenwich marshes in company with the *Rissoa anatina*, and seems, like many of the littoral species, to enjoy a kind of amphibious existence; it is also nearly equally at home in fresh water, or in a mixture of salt, half of each. It feeds on a common *Ulva* of the pools. I received the animals by post, deposited in a small tin box in moderately moistened weed; they remained alive for some time, but they are constitutionally sluggish.

The above minutes of this curious creature do not differ in any essential character from my recorded descriptions of the *Truncatellæ*, and will justify the surmises I have expressed in the earlier part of this account, that *Assiminia* is only a generic synonym of the established genus *Truncatella*.

Rissoa anatina, auctorum.

Rissoa anatina, Brit. Moll. vol. iii. p. 134. pl. 87. f. 3, 4.

Shell—of a light horn-colour, of 4–5 rounded tumid volutions, with well-marked wrinkled striæ of increment, as in *Bithynia ventricosa* (*Leachii*, nonnull.), to which, in these respects, it bears much resemblance, as well as in the entire peristome; the two are also occasionally found in the same locality, with the colour of their shells obscured by a similar black earthy deposit. This circumstance is singular, as the *Truncatella Grayana* living with or near them is perfectly clean: perhaps the other two have some difference of habitat. Axis $\frac{3}{20}$ths, diameter $\frac{2}{20}$ths of an inch.

Animal.—The mantle is simple, and the linear process seen at that part which lines the upper angle of the aperture in *Rissoa ulvæ*, and often in other *Rissoæ*, is wanting. The muzzle is long, subcylindrical, and armed with very contractile, dark, annulated ridges, which allow of a great protrusion of the neck. The buccal orifice is cloven vertically, and from it, almost without cessation, the animal shows a pair of corneous jaws, to which the short lingual riband proceeding from the stomach is united, and both portions of the tongue are supported by a pair of red fleshy plates, which are visible through the tenuity of the enveloping tissue.

The tentacula are long, not much flattened, slender and moderately pointed, of a very light ashy hue, quite smooth, divergent, with rather large black eyes at the external bases, fixed on minute semicircular expansions; at their lower half they are sparingly studded with white, flaky, minute irregular blotches, and sometimes a very fine cinereous line coasts their margins.

The foot is scarcely so proportionately long, slender, and constricted below the auricles as in the usual run of the *Rissoæ*; it is perfectly rounded postcally, but parts of the margin are sometimes notched; anteally furnished with moderately large lateral auricular expansions. The opercular lobe is distinct, and shows at the junction of the foot with the body a whitish alated process on each side, and carries a rissoidean suboval operculum of laxly spiral rather indistinct turns, with an eccentric nucleus; the curved lines of each volution are coarser, fewer, and less oblique than in the generality of the *Littorinæ* and *Rissoæ*. The upper part of the main foot is of a darkish lead-colour, disposed in close-set fine irregular lines; the sole is either white, yellow or palely cinereous, without a longitudinal depressed central line, and aspersed thickly with minute pale-gray-coloured points or flakes. The opercular lobe is without a caudal process, but it may be observed, this is not an invariable adjunct of all *Rissoæ*.

The character of the branchial plume in a young, almost white horn-coloured shell was sufficiently apparent; it consists of a flat ordinary-shaped leaf deposited in the usual position in the branchial vault, of 12 to 16 or even more coarse white strands; the transverse measure of the anterior ones and those nearest to the pericardium being the shortest, whilst the central threads are gradually elongated. The intestine is rendered visible, by its contents, through the filmy shell,—at least that length of it which proceeds from the part of the animal enclosed in the second volution to its debouchure as rectum on the right side. Verge?

The animal continues lively for some days in a mixture of salt, as well as in the fresh, or scarcely brackish water. These creatures were received from Greenwich in company with the *Truncatella Grayana*; they are neither shy nor apathetic.

Though the shell of *R. anatina* resembles the *Bithynia ventricosa* (*Leachii*, nonnull.), and is found in company with it and the *Limneus palustris, L. truncatulus* and *B. impura*, all of freshwater habitat, I am of opinion that the *R. anatina, R. ulvæ* and *R. ventrosa* are essentially of marine organization, and inhabit the salt and brackish estuaries as their natural localities, and that the *Bithyniæ* and *Limnei* are mixed with them fortuitously,—perhaps impelled into their districts by floods, and agreeably to a well-known habit and law, live and even multiply and become acclimated in localities that are not strictly natural to them.

In other words, I believe that both these tribes are eminently distinct, the one being of marine, the other of freshwater habitat, and that there is no connexion between them beyond that of accident, chance acclimation, and the alliance which is consequent on the proximity of their genera in most malacological methods. It results from these views of ours, that the *R. anatina, R. ventrosa* and *R. ulvæ* are in their right places as the Ulvan group of the Rissoideans.

It has been proposed to remove the above species to *Littorina*, or *Hydrobia*, or *Paludinella*; the two latter of these genera would only be useless synonyms of *Rissoa*; for the variations of the malacology of the three species from the typical *Rissoæ* are not greater, perhaps not so great, as those of many of the animals that form part of that genus, and if such differences are to be held as of generic value, every admitted *Rissoa* must have its particular genus and be itself the only species.

I have merely mentioned casually the localities of *Truncatella Grayana* and *Rissoa anatina*, but the deficiency of the detail of the habitats will be well supplied by presenting, by way of conclusion, a valuable letter from Mr. Jeffreys, which contains many excellent remarks on these points.

"9 Montague Place, Bryanstone Square,
London, 25th June 1855.

"My dear Sir,—Our friend Mr. Barlee told me that he had not been successful in procuring for you specimens of the *Assiminia Grayana*, the animal of which you were desirous of examining. I went to Greenwich last Saturday, and have the pleasure of sending you some lively examples of this curious mollusk, as well as a few *Littorina* (?) *anatina*. The shell of the latter is closely allied to *Bithynia*, but the operculum is that of *Littorina*, and the animal resembles *Paludinella ulvæ*.

"2nd July.—I again visited the Greenwich marshes yesterday for the purpose of ascertaining the range of *Littorina* (?) *anatina* and *Assiminia Grayana*, and to inform you more particularly of their respective habitats. I found both of them more or less distributed along the banks of the Thames, from a little below Greenwich Hospital to the upper Pier at Woolwich, a distance of about three miles. I met with them occasionally in the same localities, but their habitats are somewhat different. The *Littorina* inhabits muddy ditches and their banks, and it is gregarious. The other mollusk inhabits muddy places, but seldom occurs under water. It is in countless profusion at and about the roots of the water-flag, and is more generally dispersed than *L.* (?) *anatina*. It is associated with *Limneus palustris* (our *tinctus*) and *L. truncatulus*. The *Littorina* lives in company with *Bithynia impura* and *Leachii*, as well as with the *Assiminia*. I have little doubt that both kinds are also to be found on the other side of the river in the Isle of Dogs, and perhaps below Woolwich. The *Assiminia* has the same habit as *Paludinella ulvæ*, and seems to take its place on the brackish estuary of the Thames.

"I remain, my dear Sir, yours sincerely,
"J. Gwyn Jeffreys."

"*Wm. Clark, Esq.*,
Exmouth, Devon."

I am, Gentlemen,
Your most obedient servant,
William Clark.

XI.—*Descriptions of two newly discovered species of* Araneidea. By John Blackwall, F.L.S.

Tribe OCTONOCULINA.

Family Ciniflonidæ.

Genus Ciniflo, Blackw.

Ciniflo humilis.

Length of the female $\frac{1}{10}$th of an inch; length of the cephalothorax $\frac{1}{24}$; breadth $\frac{1}{30}$; breadth of the abdomen $\frac{1}{18}$; length of an anterior leg $\frac{1}{8}$; length of a leg of the third pair $\frac{1}{11}$.

The four intermediate eyes describe a trapezoid, the two anterior ones, which form its shortest side, being much the smallest and darkest of the eight. The cephalo-thorax is convex, glossy, compressed before, rounded on the sides, and has an indentation in the medial line; it is of a brown colour, with longitudinal lines in the cephalic region, oblique streaks on the sides, and lateral margins of a brownish black hue. The falces are conical, vertical, armed with a few minute teeth on the inner surface, and, with the maxillæ, which are enlarged at the extremity and slightly inclined towards the lip, have a pale brown hue. The lip is dilated about the middle and truncated at the extremity; and the sternum is heart-shaped. These parts are of a dark brown colour, the former being paler at the extremity. The legs are moderately long, hairy, of a yellowish brown hue, with brownish black annuli, and the metatarsi of the posterior pair are provided with calamistra; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi resemble the legs in colour, but are without annuli. The abdomen is oviform, thinly clothed with hairs, convex above, and projects over the base of the cephalo-thorax: it is of a pale yellowish brown colour, with a series of angular lines of a brownish black hue, whose vertices are directed forwards, and whose extremities are enlarged, extending along the middle of the upper part; this series of angles is bisected by a brownish black, longitudinal line, which is enlarged and somewhat triangular at its anterior extremity; the sides are closely reticulated with brown lines; two brown bands extend along the under part to a transverse bar of the same hue, near the spinners; and the sexual organs are of a red-brown colour.

This small species of *Ciniflo* was captured by Mr. R. H. Meade in Buckinghamshire in August 1854.

Family Linyphiidæ.

Genus Neriëne, Blackw.

Neriëne affinis.

Length of the male $\frac{1}{7}$th of an inch; length of the cephalo-thorax $\frac{1}{12}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{16}$; length of a posterior leg $\frac{11}{48}$; length of a leg of the third pair $\frac{3}{16}$.

The legs are provided with hairs, and have a bright yellowish red tint; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and slightly pectinated, and the inferior one is inflected near its base. The palpi are long and resemble the legs in colour, but are somewhat paler; the humeral joint is slightly curved towards the cephalo-thorax, and the cubital and radial joints are clavate, the former having a conical, pointed process projecting at right angles from its extremity, on the under side, and the latter a very minute, bifid, black apophysis at its extremity, in front; the digital joint is small, oval, convex and hairy externally, concave within, comprising the palpal organs, which are moderately developed, not very complicated in structure, and of a pale red-brown colour. The cephalo-thorax is oval, convex, glossy, with slight furrows on the sides converging towards an indentation in the medial line; the falces are powerful, subconical, vertical, convex at the base, in front, divergent at the extremity, armed with teeth on the inner surface, and have a conical tooth-like process near the middle, towards the inner side, and numerous minute, pointed prominences in front; the maxillæ are convex at the base, enlarged where the palpi are inserted, and at the extremity, which has a pointed process on the outer side, and incline towards the lip, which is semicircular and prominent at the apex; and the sternum is broad, glossy, and heart-shaped. These parts have a reddish-brown colour, the lip and anterior part of the cephalo-thorax being much the darkest. The four intermediate eyes form a trapezoid, the two anterior ones, which constitute its shortest side, being the smallest and darkest of the eight; and those of each lateral pair are seated obliquely on a small tubercle, and are almost in contact. The abdomen is oviform, thinly clothed with hairs, convex above, projecting over the base of the cephalo-thorax; it has a dark olive hue, the under part being the palest, and the colour of the branchial opercula is yellow; along the middle of the upper part there extends a series of obscure, curved, grayish lines whose convexity is directed forwards; and two indentations occur on each side of the medial line, the posterior pair being rather the wider apart.

Two adult males of this species were received from Mr. R. H. Meade in June 1855, one of which had been taken in the vicinity of Burton-on-Trent, and the other at Hornsea, near the east coast of Yorkshire, in the preceding year.

XII.—*Note on the Descent of Glaciers.*

By J. Gwyn Jeffreys, Esq., F.R.S.

The different theories, propounded from time to time by so many able observers of this singular phænomenon, have been so earnestly and plausibly argued, that it may be worth while to inquire if they cannot be reconciled with each other; and, although my knowledge of the subject does not enable me to do so, I trust I shall not be considered presumptuous in offering a suggestion which may be improved by some abler pen. My attention has been somewhat directed to the question in consequence of my having resided during a considerable part of last year in Switzerland, the land of glaciers, where I had the good fortune of making the acquaintance of that veteran geologist, M. de Charpentier.

These theories appear to be five in number.

1st. That of De Saussure, who supposed that glaciers descended solely by their own weight; and this has been called the "Gravitation" theory. His observations have justly had the credit of being most accurate; and they extended over a great number of years, and were conducted with much labour and at considerable expense. They will be found in his 'Voyage dans les Alpes,' published in 1779.

2nd. That of De Charpentier, and adopted by Agassiz, which supposed that the phænomenon was caused by the surface of the glacier being thawed during the day; that the water thus produced percolated the porous material; and that upon congelation taking place at night the whole structure expanded in every direction, naturally occasioning or accelerating a downward movement in the direction of the slope. This is called the "Dilatation" theory. It was first propounded by Charpentier at a Meeting of the Helvetic Society held at Lucerne in 1834; and it appeared in the 8th volume of the 'Annales des Mines.' It was afterwards (in 1841) published by him in a more elaborate form under the title of 'Essai sur les Glaciers.' Agassiz' memoir was read at a Meeting of the same Society held at Neuchatel in 1837; and it was, I believe, published in their Transactions. In his work entitled 'Etudes sur les Glaciers,' and published in 1840, this theory is further developed.

3rd. That of Professor James Forbes, which attributed the phænomenon to the viscous or plastic nature of the glacier, causing the descent *suis viribus.* This has been called in Germany the "Pech" theory, and was published in 1843 by our distinguished countryman in his work on Glaciers.

4th. That of Mr. Hopkins of Cambridge (mentioned by Professor Forbes), who referred the motion of a glacier to the dissolution of the ice in contact with the rock; although Charpentier had previously instanced some striking facts to prove that the glacier bed never thaws.

And 5th. The theory lately offered by the Rev. Henry Moseley and published in the 7th volume of the Royal Society's Proceedings, which (assimilating a glacier to a sheet of lead) supposed that the phænomenon was owing to the heat of the sun, and consequently to an alternate expansion and contraction of the material.

Now the suggestion I would venture to make is, that the phænomenon may be attributed to all and each of the forces above mentioned; and that the discrepancy of opinion between so many experienced and trustworthy observers may arise from their researches having been conducted at different seasons of the year, in different states of temperature, on different soils or kinds of rock (some of which retain or impart more heat than others), at different heights above the sea-level, after the fall of a greater or less quantity of glacier snow, at different degrees of solar heat or radiation, or under many other different conditions. Some of the theories are self-evident, and have been admitted to a certain extent by their opponents. Perhaps the structure of the material in various climates and at different heights may be better known when the science of photography has been further applied to it, as I cannot help thinking that the interesting and kaleidoscopic forms of snow (taken by Mrs. Glaisher), which were exhibited at the last *soirée* given by the Assistant Secretary of the Royal Society, may throw some light on this vexed and difficult question.

It seems to me that the *modi operandi* of nature for the same purpose are various, and that the inanimate and animated creation are governed by similar or analogous laws. An illustration of this occurs to me in the case of certain marine mollusks and annelids which perforate limestone and other rocks. This operation has been attributed by naturalists to many and different causes: viz. to mechanical action, to a solvent power, to continual maceration of the material, as well as to the action of siliceous bodies which are occasionally found in some of these mollusks. The modern and better opinion, however, seems to be, that all or more than one of these various methods are used by the same species, and perhaps by the same animal, in effecting its object, according to the nature of the material acted on, the age of the individual, and other circumstances.

London, 13th July 1855.

BIBLIOGRAPHICAL NOTICES.

Catalogue of British Hymenoptera in the Collection of the British Museum. Part I. *Apidæ*—Bees. By Frederick Smith, M.E.S. London: Printed by Order of the Trustees, 1855. 12mo.

Amongst the many anomalies presented by the state of Entomology in this country, the little attention paid to the interesting family of the Bees is certainly none of the least. It is indeed singular that the majority of our entomologists should confine themselves so religiously to the study of Coleoptera and Lepidoptera, the habits of which are generally obscure and often wholly uninteresting, whilst the insects of the large order of Hymenoptera, which present so many points of interest in the almost infinite variety of their œconomy, attract scarcely anybody's attention. In the case of the Bees this is the more remarkable, as we have for many years possessed a work upon the British species of those insects (the 'Monographia Apum Angliæ' of Kirby, published in 1802), which has generally been regarded as a model of an Entomological monograph, and which, notwithstanding the lapse of more than half a century since its publication, still holds its place as a standard work.

Nevertheless even in this neglected department of Entomology, this interval of fifty years has added considerably to the list of British species, and shown that the learned author of the work above mentioned, was, as might be expected, not unfrequently in error with regard to the species known to him, and especially that in some cases he has placed together as males and females of the same species insects which are truly distinct, whilst in others the two sexes of the same insect have been described as distinct species. Most of these errors are now corrected, mainly by the exertions of Mr. Smith, whose numerous and interesting papers on British Bees, published in the 'Zoologist,' have done much for the extension of our knowledge of this subject. The scattered nature of these notices, however, renders the appearance of the present little work particularly welcome, as in it Mr. Smith has given in a systematic form the entire results of his study of the British Bees, pursued assiduously for more than twenty years, and in many instances with the advantage of having corrected his previous notions by the more extended intercourse with continental entomologists, which his present position at the British Museum has opened up to him.

Although brought out as one of the series of Catalogues published by the Trustees of the British Museum, this little book is certainly far more deserving of the title of a *monograph* than a great majority of the things that commonly make their appearance under that name, many of which indeed are little more than catalogues;—Mr. Smith's Catalogue contains full descriptions of all the genera and species, accompanied by observations on their habits and œconomy, which are rendered particularly valuable by the author's long experience, and will be found very interesting even to the general reader. Of this the following account of the œconomy of the Bees of the genus *Osmia* may serve as an example, and the reader will find many other passages of equal interest in other parts of the book:—

"If I were asked," says Mr. Smith, "which genus of bees would afford the most abundant materials for an essay on the diversity of instinct, I should without hesitation point out the genus *Osmia*. I propose to notice in this place all that has occurred to me during an attentive observation of their œconomy for the last twenty years. The most abundant species is *Osmia bicornis*; its œconomy is varied by circumstances; in hilly country, or at the sea-side, it chooses the sunny side of cliffs or sandy banks, in which to form its burrows;

but in cultivated districts, particularly if the soil be clayey, it selects a decaying tree, preferring the stump of an old willow; it lays up a store of pollen and honey for the larvæ, which when full-grown spin a tough dark brown cocoon, in which they remain in the larva state until the autumn, when the majority change to pupæ, and soon arrive at their perfect condition; many however pass the winter in the larva state. In attempting to account for so remarkable a circumstance, all must be conjecture, but it is not of unfrequent occurrence; this species also frequently makes its burrows in the mortar of old walls. *Osmia leucomelana* may be observed availing itself of a most admirable, and almost ready, adaptation for a burrow; it selects the dead branches of the common bramble; with little labour the parent bee removes the pith, usually to the length of from five to six inches; at the end she deposits the requisite quantity of food, which she closes in with a substance resembling masticated leaves,—evidently vegetable matter; she usually forms five or six cells in one bramble-stick. The bee does not extract the whole of the pith, but alternately widens and contracts the diameter of the tube, each contraction marking the end of a cell; the egg is deposited on the food immediately before closing up the cell; it is white, oblong, and about the size and shape of a caraway-seed: the larva is hatched in about eight days, and feeds about ten or twelve, when it is full-grown; it then spins a thin silken covering, and remains in an inactive state until the following spring, when it undergoes its transformations, and appears usually in the month of June.

"*Osmia hirta* burrows in wood, seldom in any other material; the same habit will be observed in *Osmia ænea*; but I have observed this bee more than once constructing its burrow in the mortar of walls, and sometimes in hard sand-banks. *Osmia aurulenta* and *O. bicolor* are bees which commonly burrow in banks, the latter being very abundant in some situations, forming colonies; but although it appears to be the natural habit of these species to construct tunnels in hard banks, with great labour and untiring perseverance, still we find them at times exhibiting an amount of sagacity, and a degree of knowledge, that at once dispels the idea of their actions being the result of a mere blind instinct, impelling them in one undeviating course. A moment's consideration will suffice to call to mind many tunnels and tubes ready-formed, which would appear to be admirably adapted for the purposes of the bee—for instance, the straws of a thatch, and many reeds; and what could be more admirably adapted to their requirements than the tubes of many shells? So thinks the bee! *O. aurulenta* and *O. bicolor* both select the shells of *Helix hortensis* and *H. nemoralis*: the shells of these snails are of course very abundant, and lie half hidden beneath grass, mosses, and plants; the bees finding them in such situations, dispense with their accustomed labour and take possession of the deserted shells. The number of cells varies according to the length of the whorl of the shell selected, the usual number being four, but in some instances they construct five or six, commencing at the end of the whorl; a suitable supply of pollen and honey is collected, an egg deposited, and a partition formed of abraded vegetable matter; the process is repeated until the requisite number is formed, when the whole is most carefully protected by closing up the entrance with small pellets of clay, sticks and pebbles; these are firmly cemented together with some glutinous matter, and the bee has finished her task.

"We will now observe the intelligence of the bee under different circumstances: she has selected the adult shell of *Helix aspersa*; the whorl of this species is much larger in diameter than that of *H. nemoralis* or *H. hortensis*—too wide, in fact, for a single cell; our little architect, never at a loss, readily adapts it to her purpose by forming two cells side by side, and as she advances towards the entrance of the whorl, it becomes too wide even for this contrivance; here let us admire the ingenuity of the little creature; she constructs a couple of cells transversely! And this is the little animal which has been so blindly slandered as being a mere machine!

"There is still another species of this genus whose habits are so different to the rest, that our admiration of the ingenuity of these bees is greatly increased when we consider its curious details and reflect upon the degree of care and foresight exhibited by the provident parent,—this is the *Osmia parietina*, a bee only found in the northern parts of this country. This species selects the underside of a slate or stone lying on the ground, and having a hollow space beneath; to the stone the bee attaches the little balls of pollen. A stone of this kind was found at Glen Almond, Perthshire, on the Grampians, 800 feet above the level of the sea, by Mr. J. Robertson, who, on turning it up, observed a mass of cocoons; although he was not much acquainted with entomology, still he knew them to be the production of some insect; he presented the stone to the British Museum, and it was placed in my hands for observation. The size of the stone was 10 inches by 6; the number of cocoons attached to it two hundred and thirty: when first discovered, about one-third of them were empty; this was in the month of November. In the beginning of the following March, a few males made their appearance, and shortly afterwards some females; they continued to come forth occasionally until the end of June; at this time there remained thirty-five undeveloped cocoons; on opening one or two of them, they proved to contain active larvæ; these I carefully closed, and left the whole undisturbed until the following April, at which time, on examination, they proved to be still in the larva state; but at the end of May they changed to pupæ, and about the end of June began to come forth perfect insects. This, then, was the result—a portion of a deposit of eggs made in 1849 had been three years in arriving at maturity: when found, one-third were developed; the following year a second brood came forth, and whilst in my possession a third. In the first instance, the whole deposit was subject to the same influences, and had produced larvæ; what was the cause of the retarded development of the rest, it were vain to attempt to determine."

There can be no doubt that this is one of the most valuable contributions to entomological literature that has been brought out by the Trustees of the British Museum. It is illustrated with several excellent plates engraved on copper by the author himself, containing figures of all the genera, accompanied by carefully executed details. If we might suggest any improvement it would be, that Mr. Smith would have rendered his work more generally acceptable, had he given characters to the families and subfamilies into which he divides the Bees; for as it now stands, a beginner will perhaps be somewhat at a loss to determine which of the principal groups will receive a bee of which he may have taken specimens. This however is but a passing objection, and we trust that the present work, which is published at an exceedingly low price, may lead some of our young entomologists to turn their attention to the interesting subject of which it treats.

Proceedings of the Yorkshire Philosophical Society. Vol. I. York, 1855.

We have recently received this interesting volume, containing "A selection from the papers relating to the Antiquities and Natural History of Yorkshire, read at the monthly Meetings of the Society, from 1847 to 1854," and recommend it strongly to the attention of our readers. By far the greater number of the papers here published relates to Antiquities, and are of such a character as doubtless to attract the attention of our Archæological brethren. Amongst those more especially interesting to the naturalist we may particularize the observations on *Zamia gigas*, by Messrs. Yates and Williamson; on the Zoophytes of the Flamborough Chalk, by Mr. Charlesworth; on the Sclerotic ring of the Eyes of Birds and Reptiles, by Mr. Allis; as well deserving of perusal.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

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

NOTICE OF THE SPECIES OF THE GENUS ORTHOTOMUS OF HORSFIELD, WITH DESCRIPTIONS OF A NEW SPECIES, AND OF THOSE HITHERTO KNOWN. BY FREDERIC MOORE, ASSIST. MUS. EAST INDIA COMPANY.

Fam. SYLVIADÆ, Vigors.

Subfam. SYLVIANA, Vigors.

Genus ORTHOTOMUS, Horsfield.

Syn. *Edela*, Lesson.—*Sutoria*, Nicholson.

1. ORTHOTOMUS SEPIUM, Horsfield.

Syn. *Orthotomus sepium*, Horsf. Trans. Linn. Soc. xiii. p. 166 (1820). Lath. Hist. iv. p. 265. Temm. Pl. Col. 599. f. 1. G. R.

Gray, Gen. of Birds, i. p. 162. Blyth, Catal. B. Mus. A. S. Beng. p. 145. Bonap. C. G. Av. p. 282.

The Chiglet Creeper, Lath.

Chiglet of the Javanese, Horsf.

Hab. Java.

O. sepium.—The forehead, lores, over the eyes and ear-coverts, ear-coverts themselves, base of lower mandible and chin ferruginous, palest on the sides and chin; top of head, back and tail brownish olive, having a greenish tinge; wings dusky, broadly margined with brownish olive; throat and breast ashy black, the rest of the under parts yellowish; tail with a terminal dusky band, tipped with yellowish; thighs ferruginous; bill brownish, paler below; legs pale.

Length, $4\frac{1}{2}$ inches; of wing, $1\frac{8}{10}$; tail, $1\frac{3}{4}$; bill to gape, $\frac{7}{10}$; tarsus, $\frac{3}{4}$.

The above description is taken from Dr. Horsfield's typical specimens, contained in the Mus. East India Company.

2. Orthotomus atrogularis, Temminck.

Syn. *Orthotomus atrogularis*, Temm. Pl. Col. Texte, 599 (1836). G. R. Gray, Gen. of Birds, i. p. 162. Bonap. C. G. Av. p. 282.

Hab. Malacca; Borneo.

O. atrogularis.—"The forehead, top of the head and occiput bright brownish red; the neck, the back and the wings of a grassy green; the tail of a yellowish green, marked near the end and on the inner web with a narrow yellowish band; the chin, throat, breast and upper parts of flanks pure black, the sides of the abdomen yellowish; middle of the belly and abdomen white; bill and feet brown. No difference in the sexes.

"Length, $3\frac{1}{2}$ inches."—*Temm.*

3. Orthotomus flavoviridis, nobis.

The forehead, crown, round the eyes, and occiput ferruginous; back and rump yellowish green; tail more dusky green; wings brown, broadly margined exteriorly throughout with yellowish green; chin, base of lower mandible, ear-coverts, centre of some of the feathers of the throat and breast white; lower part of the breast ash and white; centre of abdomen white; throat and fore part of the breast black, centred as above; flanks yellowish; extreme edge of shoulder of wing yellow; under part of tail yellowish, with a terminal dusky band, tipped with yellowish; thighs greenish ferruginous. Specimens labelled "male."

Length, 4 inches; of wing, $1\frac{3}{4}$; tail, $1\frac{1}{2}$; bill to gape, $\frac{7}{10}$; tarsus, $\frac{7}{10}$.

Hab. Malacca. In Mus. East India Company.

4. Orthotomus edela, Temminck.

Syn. *Orthotomus edela*, Temm. Pl. Col. 599. f. 2 (1836). G. R. Gray, Gen. of Birds, i. p. 162. Blyth, Catal. B. Mus. A. S. Beng. p. 144. Bonap. C. G. Av. p. 282.

Motacilla sepium, Raffles, Trans. Linn. Soc. xiii. p. 313. Lath. Hist. vii. p. 218 (nec Horsf. v. Lafres.).

Edela ruficeps, Less. Cent. Zool. p. 212. t. 71 (1834) (nec Less. Tr. d'Orn.).

Kachichi of the Malays of Sumatra, Raffles.

Hab. Malayan peninsula; Sumatra. In Mus. East India Company.

O. edela.—"The forehead, lores and crown ferruginous; the entire lower parts whitish, but the sides of the neck slightly variegated with clear ashy; back of neck, back, wing-coverts and tail greenish; the wings ashy, but bordered with greenish ferruginous; the tail is regularly of one colour; the bill and feet brownish."—*Temm*.

Length, $4\frac{1}{4}$ inches; of wing, $1\frac{3}{4}$; tail, $1\frac{1}{2}$; bill to gape, $\frac{3}{4}$; tarsus, $\frac{5\frac{1}{2}}{8}$.

5. Orthotomus ruficeps, Lesson.

Syn. *Edela ruficeps*, Less. Tr. d'Ornith. p. 309 (1831) (nec Less. Cent. Zool.).

Orthotomus sericeus, Temm. Pl. Col. Texte, 599 (1836). G. R. Gray, Gen. of Birds, i. p. 162. Bonap. C. G. Av. p. 282.

Hab. Malacca; Borneo.

O. ruficeps.—The forehead, crown, occiput, lores and upper part of ear-coverts bright ferruginous; the chin, base of lower mandible, lower part of ear-coverts and the rest of the under parts silky white; back, rump and wings deep ash; tail bright ferruginous, at base ashy, and with no terminal band; thighs ferruginous; bill yellowish brown, pale below; legs pale.

Length, $4\frac{1}{2}$ inches; wing, 2; tail, $1\frac{3}{4}$; bill to gape, $\frac{7}{8}$; tarsus, $\frac{8}{10}$.

The above description is from a specimen in the East India Company's Museum. This species may readily be distinguished by the bright ferruginous colour of the head, the tail also being of the same colour, and by the bill being considerably longer and stouter (though strictly typical) than in any of the other known species.

6. Orthotomus cineraceus, Blyth.

Syn. *Orthotomus cineraceus*, Blyth, Journ. A. S. Beng. xiv. p. 589 (1845); Catal. B. Mus. A. S. Beng. p. 144. Bonap. C. G. Av. p. 282.

Orthotomus sepium, Lafres. Mag. de Zool. 1836, t. 51 (nec Horsf. v. Raffles).

Hab. Malacca.

O. cineraceus.—"Upper parts pure ash-grey, without any tinge of green; forehead and sides of the head light ferruginous, palest on the cheeks, and there is a slight tinge of the same upon the chin; crown tinged with olive-brown; lower parts white, passing to light ashy on the sides of the breast; tail somewhat brownish, with terminal dusky band, and whitish extreme tips to its outer feathers; tibial plumes rust-coloured; the tarsi and toes red-brown; bill dusky above, pale beneath.

"Length about $4\frac{1}{2}$ inches; of wing, $1\frac{8}{10}$; tail, $1\frac{5}{8}$; bill to gape, $\frac{3}{4}$; tarse, $\frac{5}{8}$."—*Blyth*.

A specimen in the East India Company's Museum, from Malacca, has the centre of the throat and the whole of the breast and flanks lightish ash, paling to silky white on the centre of the belly; the under tail-coverts are also white; wings brown, the primaries margined exteriorly with pale dusky ferruginous, the secondaries with ashy olive; extreme edge of wing, under spurious wing-coverts and exterior margin of the latter ferruginous white, contrasting with the ash on the breast; under wing-coverts white. The wing and tarsus are both an eighth of an inch longer. Other characters as in the description above.

7. Orthotomus longirostris, Swainson.

Syn. *Orthotomus longirostris*, Swains. $2\frac{1}{4}$ Cent. p. 343 (1837); Classif. Birds, ii. p. 62. f. 135. G. R. Gray, Gen. of Birds, i. p. 162. Bonap. C. G. Av. p. 282.

Hab. S.W. Australia (*Swains.*). Malacca?

O. longirostris.—"Cinereous; sides of the body beneath cinereous, the middle white; head, chin and thighs ferruginous; throat black; tail brownish, graduated, the latter with dusky black ends, tipped with whitish; bill and legs pale.

"Length, $4\frac{1}{2}$ inches; wing, $2\frac{1}{10}$; tail, beyond 1; base, $1\frac{4}{10}$; bill to gape, $\frac{8}{10}$; tarsus, $\frac{9}{10}$."—*Swains.*

This species differs from *O. cineraceus* in having a black throat, and in the wing being three-tenths of an inch longer, the tarsus also being longer by a quarter of an inch. Mr. Swainson has given S.W. Australia as the habitat of this species, which must evidently be an error.

8. Orthotomus cucullatus, Temminck.

Syn. *Orthotomus cucullatus*, Temm. Pl. Col. 599. f. 3 (1836). G. R. Gray, Gen. of Birds, i. p. 162. Bonap. C. G. Av. p. 282.

Hab. Java; Sumatra.

O. cucullatus.—"Top of the head bright ferruginous; neck, cheeks, and the sides of the breast of a pure ash; the neck in front, the breast, and the middle of the belly are pure white; the sides, the thighs and the abdomen of a citron-yellow; back and wings of a greenish tint, the quills and tail margined with greenish; upper mandible brown, the lower as well as the feet yellowish."—*Temminck.*

9. Orthotomus longicauda, Gmelin.

Motacilla longicauda et *sutoria*, Gmel. S. N. L. i. pp. 954, 997.

Orthotomus longicauda, Strickl. Ann. N. H. xiii. p. 35. Blyth, J. A. S. Beng. xiii. p. 377; Catal. B. Mus. A. S. Beng. p. 144. G. R. Gray, Gen. of Birds, i. p. 162. Tickell, J. A. S. Beng. xvii. pt. i. p. 298. Hutton, J. A. S. Beng. xvii. pt. ii. p. 691. Bonap. C. G. Av. p. 281. Layard, Ann. N. H. 1853, p. 262.

Sylvia longicauda et *sutoria*, Lath. Ind. Orn. ii. pp. 545, 551; Gen. Hist. vii. pp. 79, 119. Vieill. Enc. Méth. p. 456.

Malurus longicaudus, Pearson, J. A. S. Beng. x. p. 644.

Sylvia guzuratta, Lath. Ind. Orn. ii. p. 554; Gen. Hist. vii. p. 129.

Orthotomus Bennettii et *O. lingoo,* Sykes, P. Z. S. (1832) p. 90. Lafres. Mag. de Zool. (1836) t. 52, 53. Jerdon, Madr. Journ. xi. p. 1. Hodgs. Cat. B. Nep. p. 63.

Orthotomus ruficapilla, Hutton, J. A. S. Beng. ii. p. 504 (1833).

Orthotomus sphenurus, Swains. $2\frac{1}{4}$ Cent. p. 343 (1838).

Orthotomus sutorius, v. *ruficapillus,* v. *sphenurus,* Hodgs. Gray's Zool. Misc. (1844) p. 82.

Orthotomus sutoria et *O. patia,* Hodgs. P. Z. S. (1845) p. 29.

Sutoria agilis, Nicholson, P. Z. S. (1851) p. 194.

The Indian Tailor Bird.

Phutki, of the Hindoos, Jerdon.

Tuntuni, of the Bengalese, Hamilton, Blyth.

Patia, or "*Leaf Bird,*" Nepal, Hodgson.

Hab. India generally; Ceylon; Burmese countries; Malayan peninsula?

This species is too well known to require further description.

"*The Tailor Bird* is tolerably common in most wooded districts, and universally spread, frequenting cultivated ground, especially gardens, groves of trees, aud is also found in high jungle, in the more open spaces. It lives in pairs or in small flocks, incessantly hopping about the branches of trees and shrubs, peas and other vegetables, with a loud reiterated note, and picking various insects (chiefly ants and small larvæ) off the bark and leaves, and not unfrequently seeking them on the ground. It has the habit of frequently jerking up its tail while feeding or hopping about, and at times (especially when calling) it has the power of raising the feathers on the lower part of the throat, and displaying on either side a small black stripe. This has been noted by no one except Lieut. Hutton, who states, 'it is only seen when the bird is in motion, and wholly disappears when in a state of rest.' It has various notes, one of which sounds like *twee, twee, twee,* as mentioned by Col. Sykes, and another which is generally used when alarmed or angry, aud sounds like *chick, chick, chick, chicky, chick.* It is a familiar bird, and ventures close to houses, but when observed becomes wary."—*Jerdon.*

Dr. Nicholson says, "It has a loud, short, and not unmelodious song; its general cry being '*wheet, wheet, wheet,*' often repeated; but its alarm cry is like '*cheertah, cheertah, cheertah.*'"

The following are a few observations on the structure of two specimens of the nest of the Tailor Bird, found in the garden belonging to Capt. Hearsey, by Lieut. Hutton: "The first was neatly formed of raw cotton and bits of cotton threads, woven strongly together, thickly lined with horse-hair, and supported between two leaves on a twig of the Amaltás tree (*Cassia fistula*). These two leaves were first placed longitudinally upon each other, and stitched in that position from the points to rather more than halfway up the sides with a strong thread spun from the raw cotton by the bird, leaving the entrance to the nest at the point where they join the branch of the tree. Both of these leaves were of course green and living. Subsequently, however, they were blown down by a high wind, and being now withered, the nest appears enclosed between two dead leaves.

The second specimen was at the end of a branch of the Bhela (*Semecarpus anacardium*), about two feet from the ground, and constructed of the same materials as the above, viz. raw cotton, cotton threads, also a little flax, and lined with horse-hair alone; the leaves were stitched together partly with thread prepared by the bird, and partly with spun thread; and so well concealed was it, that even after Capt. Hearsey had discovered it (by accident) he could scarcely find it again to show to me. In it were found an egg and two young birds nearly fledged. These I placed, with the nest, in a trap-cage, and thus succeeded in capturing both of the old birds. The young birds are similar in colours to the adults, except that they are paler and the top of the head cinereous with a faint rufous tinge; bill yellowish. The eggs are white, spotted, chiefly at the larger end, with tawny spots."

Further notices of the habits and nest of this curious bird are given by the following authors, at the places above referred to, viz. Hodgson, Sykes, Blyth, Layard, Nicholson, &c.

March 14.—Dr. Gray, Vice-President, in the Chair.

1. Observations on the Genus Paludomus of Swainson, with Descriptions of several New Species, and the Description of a New Species of Anculotus. By Edgar L. Layard, F.Z.S., C.M.E.S. etc. etc.

A cursory survey of the genus *Paludomus*, which Swainson many years ago separated from *Melania*, at once satisfied me that several genera or subgenera, differing in structure and habits, were united together under one name by Mr. Reeve, in his monograph on the genus in the 'Conchologia Iconica,' where he describes the characters of the genus as follows:—"Animal fluviatile, with a horny subtriangularly-ovate concentrically-striated operculum."

Had Mr. Reeve been furnished with the operculum and a correct account of the habits of each species, he never would have left the genus as it now stands. I was not aware that Dr. Gray had separated one division from it, until so informed by him when I introduced the subject to the notice of the Zoological Society on a former evening; and I rejoice to find that my observations on the Mollusca in their natural state confirm the views to which that learned zoologist has arrived, from the structure of the opercula.

This induced me carefully to examine the whole group; and the ample collection of Mr. Cuming, ever open to the investigator, my own cabinet, particularly rich in this family, and my memoranda taken in Ceylon, have furnished the results here presented to the Society.

I propose to separate the genus into four divisions, founded upon the structure of the operculum.

The first I shall designate Paludomus, as, with the addition of the position of the nucleus in the operculum, the characters, as given by Reeve, sufficiently describe that organ, and from its partiality to sluggish waters (two species being found in the marshy borders of tanks or artificial lakes), it better suits the name than any of the other divisions. A note of interrogation after a species implies that I have not seen the operculum, but from the form I consider it to belong to the division in which it is placed.

Genus 1. Paludomus, Swains.

Animal inhabiting gently-running or still water. Operculum horny, subtriangularly ovate, with the apex superior and slightly inclined; concentrically striate; nucleus subcentral, sinistral.

P. læris, Layard.
P. palustris, Layard.
P. chilinoides, Reeve.
P. phasianinus, Reeve.
P. acutus, Reeve.
P. bicinctus, Reeve.
P. constrictus, Reeve.
P. nigricans, Reeve.
P. paludinoides, Reeve.
P. punctatus, Reeve.
P. globulosus, Reeve?
P. decussatus, Reeve?
P. Stephanus, Benson?
P. conicus, Gray.
P. bifasciatus, Reeve.
P. spiralis, Reeve.
P. pictus, Reeve?
P. bacula, Reeve?
P. abbreviatus, Reeve?
P. clavatus, Reeve?
P. Maurus, Reeve?
P. rudis, Reeve?

Genus 2. Ganga*, Layard.

Animal inhabiting gently-running water. Operculum horny, subtriangularly ovate; apex superior, slightly inclined, concentrically striate; nucleus subcentral, dextral.

G. dilatata, Reeve. *G. neritoides*, Reeve? *G. olivacea*, Reeve?

Genus 3. Tanalia, Gray.

Animal fluviatile, delighting in the most rapid mountain torrents. Operculum horny, subtriangularly ovate; apex lateral, lamellated; nucleus lateral, dextral.

T. loricata, Reeve.
T. crinascens, Reeve.
T. ærea, Reeve.
T. Layardi, Reeve.
T. undata, Reeve.
T. funiculata, Reeve.
T. Gardneri, Reeve.
T. Tennentii, Reeve.
T. Reevei, Layard.
T. similis, Layard.
T. violacea, Layard.

Genus 4. Philopotamis, Layard.

Animal fluviatile, amphibious, delighting in rocky torrents. Operculum horny, subtriangularly ovate; apex superior, paucispiral; nucleus sub-basal, dextral.

Ph. sulcatus, Reeve. *Ph. Thwaitesii*, Lay. *Ph. regalis*, Lay.

* Cingalese name for a river.

One characteristic habit, separating the whole of these species, as far as I can ascertain, from *Melania*, is that they are constantly found adhering to stones, or the submerged roots of trees and stems of aquatic plants, which the *Melaniæ* never are; neither do they burrow in sand, as do the *Melaniæ*, though they often resort to a sandy locality, perhaps for the purpose of breeding. The habit in *Ph. sulcatus* of crawling several feet out of the water on the damp grass is remarkable.

A few remarks on the various species in detail may prove not unacceptable.

PALUDOMUS CHILINOIDES, Reeve.

This is the commonest species of the whole tribe. It is found in gently-running water generally, but often in paddy fields and other marshy grounds to which these running waters have access.

The animal is blackish-mottled, forehead produced into an obtuse point, slightly indented in the centre and fringed with red dots; tentacula two, acuminate; eyes two, sessile, situated about one-fifth of the distance up the tentacles.

I have taken the operculum of this species as the type of the family; it therefore needs no description.

PALUDOMUS LÆVIS, Layard.

Shell oblong-ovate; axis 11 lines, diam. 7 lines; spire acute, exserted, moderately long; whorls rounded, not depressed round the upper part, smooth. Colour olive-yellow, the lower whorls seldom marked, but the upper always spotted with one or two rows of arrow-headed dots; apex bluish; aperture white.

Operculum as in *Pal. chilinoides*.

Hab. Ceylon, in slow-running streams on the northern side of the mountain zone extending into the flat country beyond Anarajahpoora. I also obtained a few in a paddy field in the south of the island, near the village of Heneratgodde. Mus. Cuming et Layard.

I think this may prove to be but a variety of *Pal. chilinoides*, although the experienced eye of Mr. Cuming at once separated it from that species. It is found in the same localities, and only differs from it in wanting the depression round the upper part of the whorls and in the colouring; the mollusk is similar.

PALUDOMUS PALUSTRIS, Layard.

Shell ovate, thin; axis 10 lines, diam. 6 lines; spire exserted, long; whorls rounded, rather flat, spirally closely grooved with minute granular striæ (visible under the lens). Colour of adult shell * a rich yellow spotted with dark brown, the markings frequently running into wavy lines; apex bluish; aperture white.

* In young shells the ground colour is almost hidden by the dark markings, and the aperture is found to be spirally marked with thin lines of the same colour.

Operculum nearly oval, the apex slightly inclined to the left; concentric nucleus subcentral, sinistral.

Hab. The grassy margins of a tank at Anarajahpoora. Mus. Cuming et Layard.

Paludomus nigricans, Reeve.

Operculum as in *Pal. chilinoides,* Reeve.

Hab. Balcaddua Pass, mountain torrent, affecting the little pools and not found in the rapids.

Paludomus constrictus, Reeve.

Operculum as in *Pal. chilinoides,* Reeve, but with the apex very much inclined to the left.

Hab. Kadaganava Pass, mountain streams. I have not taken it *in situ.* Mus. Cuming et Layard.

Paludomus bicinctus, Reeve.

Operculum as in *Pal. chilinoides,* Reeve.

Hab. Balcaddua Pass, in the Mahavillaganga, shallow quiet places on sand. Mus. Cuming et Layard.

Paludomus phasianinus, Reeve.

Operculum as in *Pal. chilinoides,* Reeve.

I cannot help thinking that this is but a geographical variety of *Pal. chilinoides,* of which the Ceylon race will be the connecting link. Seychelles type. Mus. Cuming. Ceylon var. Mus. Layard.

Paludomus paludinoides, Reeve.

Operculum as in *Pal. chilinoides,* Reeve.

Hab. Ganges. Mus. Cuming et Layard.

Paludomus decussatus, Reeve.

Operculum as in *Pal. chilinoides.*

Hab. Balcaddua Pass, mountain torrent, in company with *Pal. nigricans,* Reeve. Mus. Cuming et Layard.

Paludomus parvus, Layard.

Shell ovate; axis 6 lines, diam. 4 lines; spire exserted, moderately long; whorls slightly rounded, smooth. Colour dark olive-yello w more or less marked with fine spiral brown lines; aperture white.

Operculum as in *P. chilinoides,* Reeve.

Hab. Bombay. Mus. Cuming et Layard.

Paludomus globulosus, Reeve.

I am not quite satisfied that the opercula which I received with the specimens of this shell presented to me, are really the proper opercula of the species, but it probably belongs to this group.

I was told that the shells came from Rambodde Pass, between Newera Elia and Kandy, but never saw it *in situ,* as I did not visit that locality. Mus. Layard et Cuming.

Paludomus spiralis, Reeve.

I include in this group, from its resemblance to my *Pal. palustris.* The only specimens I ever saw are in Mr. Cuming's cabinet.

Paludomus dilatatus, Reeve.

Operculum concentric; nucleus subcentral, dextral.

Hab. Ceylon, Rambodde Pass, mountain torrent. This species was given to me along with *Pal. globulosus*; I therefore know nothing of its habits.

Genus Tanalia, Gray.

Tanalia loricata, Reeve.

This species grows to its largest size in the Calloo ganga, above Ratnapoora, where it is found in the most rapid foaming currents adhering to rocks. It resorts to deep sandy pools and reaches at some seasons, but apparently will not exist in a river devoid of rocks and rapids. Most of the streams of the southern provinces answering to this description contain it; but I never met with it to the northward, where the rivers become more sluggish.

The mollusk is almost black.

Tanalia crinascens, Reeve.

I doubt this being more than a geographical variety of the preceding species; and not being aware that it had been separated from it, did not pay attention to the operculum, though it evidently belongs to this group. I have only received the species from one locality, Kadaganava Pass, between Colombo and Kandy; but have intermediate varieties, on which half the spines are solid, as in *loricata*, half capped and hollow, as in *crinascens*.

T. ærea, Reeve. T. Layardi, R. T. undata, R.

I seek in vain for sufficient distinction in these species to separate them from *loricata*. Take a strongly-marked specimen of each, and the division appears an excellent one; place a hundred of each, and the gradations are imperceptible.

As far as my recollection serves me, there is nothing different in the animals; but as I was not aware of the separation of *ærea* and *Layardi*, I did not closely scrutinize them; however, of *undata* dozens passed in review with careful survey.

They are found with *loricata* and the pseudo-variety *crinascens* before mentioned; and the opercula are undistinguishable, save that those of *ærea* having a wider aperture to fill, are larger and not quite so angular. I look upon them as varieties of *loricata*.

Tanalia Gardneri, Reeve.

Operculum not distinguishable, except in size, from that of *loricata*. In very large specimens the angle is often very great, and is bent outward on the exterior side.

Hab. I found this species in a waterfall pool at Tambillichna, below Ratnapoora; also in the Calloo ganga, but only in the most rapid current, mixed with *loricata* and the next species.

Tanalia Tennentii, Reeve.

Operculum the same as in the preceding species, but, if anything, always more angular.

Hab. as in *T. Gardneri.*

Tanalia Reevei, Layard.

Shell oblong ovate; axis $1\frac{1}{2}$ inch, diam. 1 in. 2 lines. Spire exserted, short. Whorls rounded, spirally corded with rather distant obtuse ridges, longitudinally striated with well-marked close-set striæ, the great characteristic mark of the species. Aperture: outer lip edged with deep purple-brown, columellar lip white. Colour a dark yellow-brown, thickly marked with longitudinal, slanting, jet-brown wavy bands.

Hab. The Calloo ganga, Ratnapoora.

I have much pleasure in dedicating this beautiful species to the gentleman who has so extensively investigated this peculiar family.

Tanalia violacea, Layard.

Shell globose; axis 6 lines, diam. 5 lines. Spire very short, slightly exserted. Whorls rounded, ventricose, spirally grooved with close-set, fine, minutely decussated striæ (in one variety the striæ become ridges). Colour a dark bluish-brown, almost amounting to black, with darkish brown patches appearing in some specimens. Aperture deep violet inside; columella white, stained on the outside edge with dark brown.

Hab. A small mountain torrent in a dense forest between Gillymalle and Pallabaddoola, towards Adam's Peak, Ceylon.

Tanalia similis, Layard.

Shell rather globose; axis 8 lines, diam. 6 lines. Spire short, exserted. Whorls rounded, ventricose, spirally grooved with close-set, fine, minutely decussated striæ. Colour rich olive-yellow, profusely marked with longitudinal, wavy, dark lines, interrupted by four or five fine transverse bands of the same colour. Aperture: the dark markings of the shell show through, and are dimmed by a bluish haze; columellar lip white, stained on the outside edge with dark brown, which runs round the outer lip in a thin band.

Hab. A mountain torrent at Kandangamoa, near Ratnapoora.

Tanalia funiculata, Reeve.

I never could find any species which answered to Mr. Reeve's description of this shell, until Mr. Cuming kindly lent me the type specimen, when an hour's immersion in soap and water showed that the "jet-brown" was merely the accumulation of the freshwater algæ (which always cover this sluggish family) and the red cabooky dust of "India's utmost isle." This cleaning revealed a bright yellow epidermis, variegated with dark brown wavy lines, and the very minutely striated structure of the shell; and the specimen immediately ranged itself with a series of a very variable shell, which I had in vain endeavoured to reconcile with any published description.

A more lengthened description of this species, which I shall still call *T. funiculata*, Reeve, may prove acceptable, and prevent others from experiencing the same difficulty which I have felt.

Shell oblong ovate; axis 13 lines, diam. 10. Spire exserted. Whorls rather depressed round the upper part, spirally corded with rather distant obtuse ridges placed at unequal distances, sometimes with a thread-like ridge between two larger ones, the whole minutely longitudinally striated. Colour a bright rich yellow, variegated with closely set, dark brown, broadish, zigzag lines. Interior whitish; exterior lip faintly marked all round with purplish-brown, with frequent dark brown spots; columellar lip white, with the exterior margin stained with a bright pale brown. This description is taken from the original type shell; in some examples the ridges are almost, if not quite, obsolete; the spire is hardly exserted, the zigzag lines lost, and the aperture almost pure white; one of these specimens measures, axis 9½ lines, diam. 8 lines. In another, measuring, axis 17 lines, diam. 14 lines, the striæ are much coarser, and some of the upper ridges present a decided indication of nodules! The outer lip is pretty deeply edged with dark brown, and the bright brown of the columellar lip, though still present, is soon changed into a deep rich hue.

The species is abundant in a mountain stream not far from Ratnapoora, probably the very stream whence my lamented friend Dr. Gardner procured the type specimen, as it is crossed by the high road leading thither from Colombo; and, as I have had opportunity of witnessing, Dr. Gardner never failed to examine every stream he passed.

Philopotamis sulcatus, Reeve.

Operculum ovoid; apex slightly inclined, sinistral, paucispiral. Nucleus sub-basal, dextral. Mollusk black; forehead produced, as in *Paludomus chilinoides*; tentacles and eyes also the same.

Hab. Weyweldenia, a rocky rivulet. I found this species *loc. cit.*, and I then remarked that vast numbers of them were crawling on the wet grass on the banks of the stream. I subsequently found it at Kandangamoa and in the Calloo ganga.

Philopotamis regalis, Layard.

Shell oblong ovate; axis 1 inch, diam. 9 lines. Spire exserted, short. Whorls rounded, depressed at the upper part, spirally corded with close-set slight ridges, longitudinally minutely striated, and crowned with a single row of short, sharp, hollow, angular spines, closely set. Colour yellowish-olive, painted with wavy, dark brown longitudinal lines. Aperture pure white.

Operculum unknown, but most probably as in *P. sulcatus*.

Hab. Stream in the Cnia Corle, Western province, Ceylon.

Philopotamis Thwaitesii, Layard.

Shell oblong ovate; axis 13 lines, diam. 9 lines. Spire exserted, short. Whorls almost carinated round the upper part, spirally corded with unequal-sized, close, but irregularly set ridges, granulated or minutely striated. Colour yellowish-olive, painted more or less with wavy, dark brown longitudinal lines. Aperture pinkish-white, occasionally having the outer lip dotted with dark pink-brown marks.

Hab. Same as *P. sulcatus.*

This is a rare shell, if really distinct from *sulcatus*, from which and from *regalis* it may at once be distinguished by the shallowness and irregularity of the ridges.

Anculotus carinatus, Layard.

Shell somewhat globose; axis 5 lines, diam. 4 lines. Spire exserted, short. Whorls inflated, rather square, sharply keeled round the inferior angle, minutely longitudinally striated. Colour dull olive, marked faintly with two or three broad bands of dark rufous-brown, which are very apparent in the aperture; columellar lip white, stained with a light dash of the same rufous-brown on the exterior margin.

Hab. Streams in the Mahakeshwar Hills, Bombay Presidency. Mus. Cuming.

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

Mr. Gould exhibited male and female specimens of a very rare English Duck, described in 1847 by Mr. Bartlett, under the name of *Fuligula ferinoïdes.* The specimens exhibited were lent to Mr. Gould by M. Van den Bergh, of Rotterdam. Mr. Gould mentioned, that only three instances of the occurrence of the bird in England are on record; one of the specimens is in the collection of J. H. Gurney, another in that of Mr. Doubleday, of Epping, and the third in the museum of the late Earl of Derby, at Liverpool.

Characters of some New or imperfectly-described Species of Tanagers.

By Philip Lutley Sclater, M.A., F.Z.S.

I have been collecting Tanagers for some time, with the view of ultimately attempting a monograph of the family. But the forms in many of the genera are so closely allied, and the limits of the family itself at present so unsettled, that a larger collection of species, and a much greater familiarity with the subject-matter than I have yet had time to acquire, are requisite before such a monograph can be satisfactorily completed. Puzzling indeed to ornithologists would seem the question, "What is a Tanager?" as puzzling perhaps as to political economists Sir Robert Peel's celebrated poser, "What is a pound?" My ideas on this point, that is, I mean, as to the position and extent of the family or subfamily of Tanagers, coincide, I believe, nearly with those of Mr. G. R. Gray.

A Tanager I consider to be a *dentirostral* Finch—to be distinguished from other more typical *Fringillidæ* by the presence of one or more teeth or notches in the upper mandible (sometimes further developing themselves into serrations, as in certain species of *Euphonia* and *Tachyphonus*), and the culmen being always more or less inflexed, never straight. The colours of the group are generally very brilliant. They feed on ripe fruit, some on insects, and perhaps in habits rather resemble *Sylviadæ* than true *Fringillidæ*.

With these views, *I* keep among the Tanagers the *Pityli* and *Saltatores*, excluded therefrom by certain modern systematists, and retained among the *Fringillidæ*, while the whole of what may be termed the more typical portion of the group is removed far away to the neighbourhood of the *Sylvicolinæ*.

Now I think it will be impossible to settle these, and other families belonging to the South American Fauna, in a really satisfactory way, until we know much more than we do at present of the habits and customs of the animals of that vast continent. Unfortunately those who have hitherto written upon the ornithology of that country have in general had too little previous *scientific* knowledge of the subject. Not, of course, that this makes them less accurate observers of facts, but only less likely to hit upon the right facts to be observed. A person previously well acquainted with the varied forms of South American ornithology by study of the European collections, so as to know what points required looking up, would, I have little doubt, be in a much more favourable condition for observing these animals in their native haunts, and thereby solving many of those doubts which at present so perplex the student of natural history. As, however, we may perhaps have to wait some time before a determination of the question "What is a Tanager?" can be arrived at in this manner, I propose adopting as provisional limits for the family or subfamily, nearly those given by Mr. G. R. Gray in his 'Genera of Birds,' excluding only the genera *Pipilo, Embernagra*, and *Emberizoides*, which appear to me to go better with *Zonotrichia* and its allied forms. To show the arrangement I contemplate, I have formed a list* of the genera and species, which may perhaps be useful for collectors to mark off their duplicates or desiderata ; though, as a mere catalogue of names, it is, of course, of no scientific value. Some of the many lately-formed genera now used, I may hereafter find occasion to consolidate, the principle of subdivision having been carried to great lengths in this as in other families.

My present list contains the names of 222 species, though I have no doubt that many more remain to be discovered. These are all believed to be *real*, not *nominal* species ; indeed I have myself seen specimens of nearly the whole of them, and the ten or twelve I have not personally examined I believe rest on good authority. The names used are many of them taken from Bonaparte's 'Conspectus,' his "Note sur les Tanagras" in the 'Rev. et Mag. de Zool.' for 1851, the 'Museum Heineanum' of Cabanis, and my own papers in Sir William Jardine's 'Contributions.'

The Tanagers are essentially a South American family. Out of the whole 222 species, 193 are from the continent south of the Isthmus of Panama, and the rest mostly either from Central America or Southern Mexico. Three or four only are peculiar to certain of the West Indian islands, and three only, well-known members of the genus *Pyranga*, extend as summer migrants into the United States of

* Tanagrarum Catalogus Specificus. Auctore Philippi Lutley Sclater. Basingstoke, 1854. 8vo. 16 pp.

North America. Through South America they range down to the Rio de la Plata, but on the western coast I am not aware that they have been observed nearly so far south. M. d'Orbigny met with but one species* at all on the occidental slope of the Andes; Tschudi mentions but three or four as occurring in the vicinity of Lima, on the coast-region of Peru.

Subjoined are the specific characters of five species occurring in my list, of which accurate descriptions have not yet been published.

1. ARREMON AXILLARIS, Sclater. *A. supra olivaceo-viridis; capite atro; superciliis productis albis; vitta verticali et cervice postica cinereis: subtus niveus, lateribus cinerascentibus; macula utrinque cervicali vittam quasi imperfectam formante, mentoque summo atris; remigibus rectricibusque nigricantibus: tectricibus alarum majoribus flavo-olivaceis, minoribus et axillis læte flavis: mandibula superiore nigra, inferiore flava: pedibus clare brunneis.*

Long. tota 5·2, alæ 3·0, caudæ 2·0 poll. Angl.

Avis junior. Semitorque collari vix conspicuo.

Hab. In Nova Grenada.

Obs. Species *Arremoni semitorquato* maxime affinis, sed hujus axillis olivaceis, illius lætissime flavis.

2. RAMPHOCELUS DORSALIS, Bp. MS. ♂ *Coccineus: dorso medio obscurius coccineo: alis caudaque nigris: rostro nigro, mandibula inferiore basi læte alba.*

♀ *Fusco-brunnea: alis caudaque nigricantibus: uropygio et ventre toto erubescentibus: rostro brunneo.*

Long. tota 7·0, alæ 3·2, caudæ 3·2.

Hab. In imp. Brasiliensi.

Obs. R. brazilio maxime affinis at dorso medio obscurius coccineo.

I should hardly have ventured to have separated this species from *R. brazilius*, from which it only differs, so far as I can make out, in the patch of darker colouring in the middle of the back; but as the Prince Charles Bonaparte has done so, and his MS. name has attained wide circulation on the MM. Verreaux's labels, I think it best to give a published description of the grounds of the alleged specific difference. However, M. Jules Verreaux,—a good authority,—considers the two species truly distinct, and has assured me, if I recollect right, that he has seen and shot them both frequently at Rio and Pernambuco.

3. BUTHRAUPIS CHLORONOTA, Sclater. *B. supra viridis; pileo cæruleo: alis caudaque nigris, illarum tectricibus minoribus cæruleis; majoribus et secondariis viridi limbatis: subtus flavus, crisso saturatiore: gutture toto atro: rostro pedibusque nigris.*

* The *Tanagra striata*, Gm., in the ravines of Palca in Peru, 18° S.L. M. d'Orbigny attributes a wide range to this species, which he says occurs besides in the Banda Oriental, near Monte Video, at Buenos Ayres, near La Paz, and in the provinces of Yungas, Sicasica, Cochambamba, Valle Grande, and Chiquisaca in Bolivia. (Voy. p. 272.) But, *quære*, does he not confound with *T. striata*, Tschudi's *T. frugilegus*?

Long. tota 8·8, alæ 4·6, caudæ 3·8.

Hab. In republ. Equatoriana.

Obs. Affinis *B. eximiæ,* sed major, dorso toto viridi nec uropygio cæruleo.

I have seen only one specimen of this species, which was received by the Frères Verreaux of Paris from Ecuador. It is closely allied to *B. eximia,* but is larger in all its dimensions, nearly equalling in size *B. cucullata.* Its distinguishing character is the uniform green back, whence I have named it *chloronota.* I have examined multitudes of *B. eximia,* and invariably found the uropygium blue.

4. Euphonia concinna, Sclater.

E. hirundinacea, Bp. Rev. et Mag. de Zool. 1851, p. 156?—*E. affinis,* Less. Rev. Zool. 1842, p. 175?

E. supra nigro-violacea valde purpurascens; pileo summo flavo: infra gutture nigro-violaceo; abdomine aurantio-flavo: cauda subtus immaculate nigra.

Long. tota 3·8, alæ 2·2, caudæ 1·4.

Hab. In Nova Grenada.

Obs. E. chloroticæ similis, sed cauda subtus immaculata, fronte latius nigro, dignoscenda.

This bird is one of the group so closely affine to *E. chlorotica,* but may be distinguished from all of them (as *E. melanura* from *E. violacea* and its affines) by the absence of white markings on the exterior rectrices. The middle of the belly is also of a brighter orange tint, and the black front is broader than in *E. chlorotica.* A skin of this species, received from the MM. Verreaux, is labelled *E. hirundinacea,* Bp., and it is probably the species referred to by that name in the "Note sur les Tanagras," Rev. et Mag. de Zool. 1851, p. 156. It is not however the true *E. hirundinacea,* Bp. Proc. Zool. Soc. 1837, p. 117; for on examination of the type of that species, which is now in the Derby Museum at Liverpool (labelled *E. hirundinirostris!*), I found it coequal with the bird described by me (Cont. to Orn. 1851, p. 86) as *E. laniirostris,* which again is not the true *laniirostris* of MM. de Lafresnaye and d'Orbigny, but a closely allied species, called in the Baron de Lafresnaye's museum *E. fortirostris.* This must, of course, for the future bear the first proposed specific appellation *hirundinacea,* and will stand as follows:—

5. Euphonia hirundinacea, Bp.

Euphonia hirundinacea, Bp. Proc. Zool. Soc. 1837, p. 117.—*E. laniirostris,* Sclater, Cont. to Orn. 1851, p. 86.—*E. hirundinirostris,* Bp. in Mus. Derb.—*E. fortirostris,* Lafr. in mus. suo.

E. æneo-nigra: capite summo antico et corpore toto subtus flavis: rectricibus 2 utrinque extimis late albo intus notatis: rostro et pedibus nigris.

Long. tota 4·5, alæ 2·5, caudæ 1·5.

Hab. In Guatimala (*Bp.*); Chiriqué in Veragua (*Kellett* in Mus. Brit.); Nova Grenada?

Obs. E. violaceæ similis, sed æneo-nigra nec purpurascens: rostro robustiore.

BOTANICAL SOCIETY OF EDINBURGH.

June 14, 1855.—Professor Balfour, President, in the Chair.

Professor Balfour stated that *Pontederia elongata* had been cultivated in the Botanic Garden of Edinburgh, and distributed under that name. It seems to be only a variety of *P. crassipes*, produced by being grown in soil in place of water, The effect of this treatment is to cause the inflated petioles to elongate and lose their globular form. When the plants are put into deep water so as to float, the roots being unable to reach the soil, they assume the proper form of *P. crassipes*.

The following papers were read:—

1. "Remarks on the *Calamites* and *Sternbergia* of the Carboniferous Epoch," by Dr. Fleming.

Dr. Fleming arrived at the following conclusions:—1. That many species have the original matter, now forming a thin film of coal, smooth on the outside, or not exhibiting externally any traces of joints or longitudinal ribs. 2. From the inside of their woody cylinders, now converted into coal, diaphragms proceeded at regular, but occasionally at irregular, intervals, dividing the inside of the hollow stem into a series of chambers.

These partitions appear to have possessed a very loose texture towards the centre, but become more dense in substance towards their junction with the stem, and usually leave traces of coaly matter at the sides. The jointed character of the casts of the inside, in general all that is noticed by the geologist, is thus referable to the dissepiments, and cannot be regarded as resembling the jointing of a *Calamus*. 3. The inside of the woody cylinder, although smooth on the outside, was grooved longitudinally in the spaces between the partitions or on the walls of the chambers, and hence the rubbed surfaces of the casts. 4. The stem, unlike *Stigmaria* and *Lepidodendron*, had no woody axis, nor dense medullary sheath.

The author next exhibited specimens of *Sternbergia*, displaying, like the Calamite, the external cylinder of coal with a smooth surface, and giving no indication of the internal arrangements. The inside exhibited diaphragms having the same origin as in the Calamite, but less regularly disposed, frequently wanting, and giving to the surface of the cast, not a distinctly jointed, but a transversely crumpled appearance. He concluded, by stating that, from the smooth surface, and thickness of the coaly matter into which the plant had been converted, joined to its independent or detached condition in the rocks, it could not be regarded as the remains of a discoid pith, but, like the Calamite, as a plant which had a hollow stalk, the cavity divided into chambers by transverse partitions, the remains of which give to the casts their characteristic appearance.

2. "On the Dyeing Properties of Lichens," by Dr. W. Lauder Lindsay.

In this paper the author endeavours to direct public attention specially to the two following facts, viz. First—that, in our own country, many native Lichens, which grow more or less abundantly, might, with advantage and œconomy, be substituted for the somewhat expensive and scarce foreign Roccellas and other dye-Lichens usually employed in the manufacture of orchil, cudbear and litmus; and, secondly—that, in our colonies, and foreign countries to which we have access, species valuable as dye-Lichens probably grow in abundance—might be collected and transported easily and cheaply—and thus become important and lucrative articles of commerce.

3. "On *Diatomaceæ* found in a Sub-fossil state in Dumfriesshire," by Robert Harkness, Professor of Geology, Queen's College, Cork.

In this paper, the author remarked:—"While examining the boulder deposits which occur on the northern shore of the Solway Frith last summer, my attention was directed to a locality about a mile west of the mouth of the river Annan, where there is an interesting association of indurated gravel beds, hill deposits, and peat-bog, overlaid by the vegetable soil of the district. The boulder gravel, which here is the lowest deposit exposed, consists of the ordinary Silurian sandstone, mixed with the carboniferous grits, and a few fragments of the Bunter sandstone of the neighbourhood. It had a hardened nature, and in this respect bore considerable affinity to many conglomerates. Above this bed of indurated boulder gravel there is seen a silty deposit, which consists of beds of fine drab-coloured sandy clay, having vegetable remains scattered through the mass. These vegetable remains, when in such a condition that they can be recognised, are, for the most part, fragments of *Equiseta*. The contents of this silty deposit are, however, not confined to such organisms as ordinary swampy vegetation. On submitting portions of the silt to microscopic examination this substance is found to afford many species of Diatomaceæ, associated together in an interesting manner. Professor Gregory states that the following forms of Diatoms occur:—

Epithemia Hyndmanni.
Cymbella Scotica.
—— maculata.
Coscinodiscus radiatus.
Cyclotella operculata.
—— Kutzingiana.
Campylodiscus cribrosus (?).
Tryblionella acuminata.
—— punctata.
—— marginata.
Surirella minuta.
—— nobilis (or biseriata?).
Navicula didyma.
—— ovalis.
—— rhomboides var (*Gregory*).
—— varians (*Gregory*).
Pinnularia major.
—— viridis.
—— acuta.
—— tenuis (*Gregory*).
Gomphonema tenellum.
Doryphora amphiceros (fine).
Synedra radians.
Nitzschia (sp.?).
Grammatophora marina.
Melosira sulcata.
—— distans.
Fragilaria virescens.
Odontidium mesodon.
Meridion circulare.
Achnanthidium lanceolatum.

This association of marine and freshwater forms indicates the occurrence of conditions of an estuary nature, and leads to the inference that the circumstance under which the silt was deposited approached such as now prevails at the mouths of rivers.

"The occurrence of marine forms of Diatoms in silt, puts us in possession of another element, by means of which we are enabled to ascertain the changes which have taken place in the physical geography of the earth. It furnishes us with a means applicable in many instances where other and more perfect organisms have disappeared, the siliceous skeletons of these minute bodies being capable of resisting that agent by means of which the solid coverings of molluscs are dissolved. Many of the raised sea-beaches, now affording no shells, will probably be found to contain Diatoms, which will tell of the conditions under which these raised sea-beaches were originally deposited, and provide us with information concerning the circumstances which operated in the production of strata of this nature."

Dr. Gregory alluded to the interesting fact that Diatoms had been found by Ehrenberg in all fossiliferous rocks as far down as the Silurian; and that while the higher organisms exhibited striking differences in the rocks of different epochs, there was, in the case of Diatoms, a striking similarity.

4. "Notice of the time of Flowering of certain Trees and Shrubs in the Royal Botanic Garden during the past month," by Mr. M'Nab.

5. "Notes on the Effects of last winter upon Plants in the Royal Botanic Garden, Belfast," by Dr. Dickie, Professor of Zoology and Botany, Queen's College, Belfast.

The lowest point to which the thermometer fell during the month of February 1855 was on the 15th, viz. 13° F. In 1845, on March 5th, the thermometer in the Botanic Garden indicated 10° F., lower, than in 1855. The injury to the plants, however, in 1855, was greater, because in February last a generally low temperature, with east and north-east winds, prevailed during two weeks.

6. "Account of the Origin and of some of the Contents of the Museum of Economic Botany attached to the Royal Botanic Garden of Edinburgh," by Professor Balfour.

MISCELLANEOUS.

On the Organization of the Pedicellate Glands of the Leaf of Drosera rotundifolia. By M. A. Trécul.

There are some plants certain organs of which are capable of executing very remarkable movements under the influence of a mechanical excitement. Amongst these are the leaves of *Mimosa pudica* and *sensitiva*, and of *Dionæa muscipula*, the stamens of *Berberis*, &c. The *Drosera* has been classed with the plants which possess this singular property. It is generally supposed that as soon as a fly or other insect, attracted by the viscous juice secreted by the glanduliferous hairs which cover the surface of the leaf, settles upon it, the hairs stiffen and curve towards those of the opposite side, so as to form a sort of net under which the little creature remains imprisoned. It is certain that we often find one or more insects struggling or dead under the hairs of this leaf, and this, I believe, is the best proof that we possess of the excitability and movements of the hairs in *Drosera*. I think however that these hairs are not excitable, and that they are incapable of performing the movements attributed to them. I have often endeavoured to irritate them, but have never succeeded in observing anything which would indicate the least degree of excitability, although I have been placed in circumstances very favourable for these experiments; for after a recent shifting of the Orchideous plants at the Museum, a great many specimens of *Drosera* grew up amongst the *Sphagnum* employed in this operation, and there were for a long period leaves of all ages in the conservatory, so that I was enabled to experiment upon organs at different degrees of development. Nevertheless, I never perceived the least inflexion which was not occasioned by the pressure which I employed.

It appears to me that the following is the cause of the capture of insects by the leaves of *Drosera*. During their development these leaves are rolled in upon themselves, the margins of the limb are curved towards the centre, and the hairs have the same direction. In growing, the limb spreads by degrees and the hairs also stiffen successively from the circumference to the centre. If, before the whole of the hairs have become stiff, some insect comes to suck the viscous juice which exudes from their glands, it presses into the space which they leave between them at the centre of the leaf, and becomes entangled in the mucosity. The growth of the leaf continues nevertheless, the incurved hairs are straightened one after the other, but the unfortunate insect dies before they become quite straight.

The glands which secrete the viscous matter above mentioned are deserving of the attention of botanists from their interesting structure, which has not yet been sufficiently studied. Meyen gives the most detailed description of them in his memoir 'Ueber die Secretions-Organe der Pflanzen;' but this description, although apparently minute, is notwithstanding very incomplete. It may be resumed as follows:—"The glands of *Drosera* are elliptical and pedicellate; a spiral vessel runs up the pedicel and penetrates into the gland." Meyen adds in his 'Physiology' (p. 478), that the gland, like the pedicel, consists of a very compact cellular tissue. Let us now see whether this is the structure of the secreting organs. We shall soon see that the form of the glands of the margin of the leaf of *Drosera rotundifolia* has not even been indicated. In fact Meyen has only described the elliptical pedicellated glands, and yet he speaks of marginal and central glands; but he only distinguishes their inequality of size: he has seen only that they are longer than the others, but has not noticed that their organization is different.

The marginal glands which form the fringes of the leaf have a very different form from those of the surface. In the marginal glands, the substance of the pedicel seems to expand at the apex into an elegant oblong cup, at the bottom of which the carmine-coloured glandular tissue is spread. The central glands on the contrary are simple papillæ of a more or less rounded, ovoid or elliptical form, the outer ones being of a more or less red tint, whilst those nearest to the middle of the limb are colourless.

The structure both of the central and marginal glands is very remarkable, for it is not merely a single spiral vessel that exists in the gland, but a voluminous group of large reticulated cells occupies the centre of the organ. These reticulated cells have expanded meshes in the colourless central glands of the leaf, but the meshes of those nearest the margin are narrow. The middle of the marginal glands is also occupied by a considerable group of similar cells.

The pedicels of the marginal glands are dilated at the base and of a green colour; they become insensibly narrower, their green colour becomes paler and passes to rose in the upper part which supports the gland, which is elongated and attenuated at the base. These pedicels are composed of an epidermis, a coloured parenchyma, and a vascular system. 1. The epidermis is formed of long cells, which become shorter from the base of the pedicel to its apex; they are colourless at the base of the organ, tinged with rose colour at its upper part. In many cases the epidermic, or rather superficial utricles, were furnished with grains of chlorophyll on the wall contiguous to the green parenchyma: this is a fact to which I would call the attention of anatomists. Some small stomata are most frequently scattered between the epidermic cells towards the dilated base of the pedicel, and some may even be found at a considerable height upon it. There are also some small eminences, or short, simple or bifurcated hairs, scattered on its surface. 2. The green parenchyma is also composed of elongated cells, which contain a proportion of chlorophyll equal to that of the tissue of the leaf itself. This parenchyma goes on diminishing with the diameter of the pedicel, so that towards the top it only consists of one or two series of cells surrounding the vascular axis; the green matter also diminishes in the interior of the cells, and at last is even sometimes replaced by the rose colour. 3. The vascular system is usually composed of single central bundles, but towards the base of the pedicel there are sometimes two bundles distant from each other which unite higher up. Each bundle is composed of two or three tracheæ of great delicacy, often having two spiral fibres at a little distance and turning in the same direction.

This is the structure of the pedicels of the marginal glands. If we examine that of the glands themselves, from their posterior to their anterior face, that is to say, from the surface corresponding with the lower surface of the leaf to that which corresponds with the upper, we find the elements arranged in the following manner. First, there is an epidermis of colourless or rose-coloured cells, then a layer of cells containing chlorophyll of a pale green or nearly yellow colour;—these two parts form the oblong and slightly concave cup already referred to, at the bottom of which the vascular system, considerably increased, is placed. Lastly, these vessels or reticulated cells are covered by utricles of a carmine red colour. They form on the surface of the cup, with the vascular cells which they enclose, a prominent oblong gland, which is very elegantly bordered by the periphery of the cup.

The order in which these elements are presented, is not without analogy with that which rules the arrangement of those of the stem of a Dicotyledonous plant. Thus, in this respect, we may compare these marginal glands (as has been done with leaves) to a segment of the stem of a plant with two cotyledons. Thus at the exterior of the gland there is an epidermis as in the segment of stem, and then a layer of cells with green matter, representing the herbaceous envelope; then the vessels as in a stem; and lastly, the rose-coloured cellular tissue of the gland represents the pith. This comparison is the more just, as the glands which fringe the leaf are, so to speak, only the termination of the delicate teeth of the latter represented by the pedicels, just as the marginal glands of the stipules of roses terminate their much shorter teeth and even their nervures.—*Comptes Rendus*, 25th June 1855, p. 1355.

On a new Organ observed in Callitriche (C. platycarpa, *&c.*). By M. A. Chatin.

The organs for which I propose the name of cystiæ give a whitish appearance to the lower surface of the leaves in *Callitriche*, where they exist in immense number. Under the lens they appear like brilliant points, but the microscope shows that each cystia is a small utricular apparatus presenting a closer esemblance to a doctor's cap*.

The cystiæ are usually formed of eight cells, enlarged at their apical or free portion, and united in a common, narrow circular base, inserted into the larger, irregular cells of the epidermis. Towards the middle and upper parts the cystia is adorned with ribs, like some Cucurbitaceous and Euphorbiaceous fruits (especially that of *Hura crepitans*).

These organs are at first filled with a liquid, which is often replaced by gases (oxygen, nitrogen, and carbonic acid) towards the period of flowering. The liquid usually contained in these organs contains floating granules, which sometimes attach themselves to the walls, and which are, for the most part, rendered brown by iodine. The cystiæ when filled with gas serve as floats; their presence coincides with the absence of pneumatophora in the tissue of the leaves.

The organogeny of the cystiæ is peculiar. Each of them, like the stomata, arises from a cell which is distinguished by its small size and its rounded form from the large twisted cells which constitute the epidermis. Like that of the stomata, the original cell of the

* The peculiar structure in question was described by Dr. Lankester in 1850; see *Ann. Nat. Hist.* vol. vii. S. 2. p. 123.—Ed.

cystiæ is soon divided by a septum, and if at this moment it did not rise above the epidermis, it would be impossible to say decidedly whether it was a cystia or a spiracle in course of development. But afterwards the two cells of the cystia each divide into two others, forming four cells, which by a further subdivision are converted into the eight elements composing the perfect organ.

All the stomata of the lower surface of the leaves, and those of the stalk, give place in this manner to cystiæ, whilst the transformation only takes place in the minority of those placed on the upper surface of the leaves. Thus nature makes use of an organ already existing to form a new apparatus.—*Comptes Rendus*, 18th June 1855, p. 1291.

Description of a new Tanager of the Genus Calliste. By Philip Lutley Sclater, M.A.

Calliste venusta, Sclater. *C. læte cæruleo-viridis : interscapulio alis caudaque nigris, eodem viridi limbatis : fronte, loris, gula summa et auchenio nigris : pileo lateribusque capitis flavis : ventre medio crissoque pallide ochraceis : rostro nigro : pedibus pallidis.*

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

Hab. In Nova Grenada et in rep. Equatoriana provincia Quixos.

I have been acquainted with this pretty *Calliste* for some time, but have always considered it as the *xanthocephala* of Tschudi, and have described it as such in my "Synopsis of the genus *Calliste*" in the Contributions to Ornithology. But having lately had the opportunity of examining Tschudi's type specimens in the Neuchâtel Museum, I find that his *Callospiza xanthocephala* is not this bird, but the same as my *Calliste lamprotis* (Cont. to Orn. 1851, p. 65). That species closely resembles the present, but may be distinguished by its orange cap and brilliant golden-yellow ear-coverts.

The extreme inaccuracy of Dr. Tschudi's figure, which looks more like this species than the other, must be my excuse for committing this error, in which however I am not alone, as even in the Berlin Museum (where Tschudi's types ought to be known) I have observed the present bird called *xanthocephala*.

Mr. Gould's collection from Quixos contained examples of this species. My own specimens are from Santa Fe di Bogota.—*Proc. Zool. Soc.*, Nov. 14, 1854.

On the Spermatophora of the Crickets. By C. Lespés.

In the Crickets the ejaculatory canal does not turn back as in nearly all insects to form the penis. During copulation, which is accompanied by some singular manœuvres, the male introduces into the vulva of the female the extremity of a small apparatus which contains a drop of the seminal fluid. This spermatophore consists of a small horny vesicle, and of a slender, flattened appendage; the latter is the only part that penetrates into the vulva. In the course of a few hours the female drops the whole apparatus.

As soon as the male has lost one of these spermatophora, a new one takes its place. It may easily be seen at the extremity of the abdomen by raising the dorsal plate which terminates it, and this reproduction may be observed repeatedly upon the same male.

The spermatophore is produced by an appendage of the genital segment,—the ventral plate of this segment being flattened posteriorly and converted into a twisted glandular plate. When the spermatophore is formed, the vesicle is expelled from the secreting apparatus, and takes its place between two fleshy palettes, by which it is supported at the moment of copulation. It remains in this position for a longer or shorter time, but if the male is prevented from copulating he will after a time allow it to drop.—*Comptes Rendus*, 2nd July 1855, p. 28.

METEOROLOGICAL OBSERVATIONS FOR JUNE 1855.

Chiswick.—June 1. Overcast. 2. Cloudy and fine: very clear. 3. Fine: cloudy: overcast. 4. Heavy clouds: very fine. 5. Cloudy: fine. 6. Hot and dry: rain. 7. Very fine. 8. Cloudy: very fine. 9. Showery. 10, 11. Very fine. 12. Very fine: clear at night. 13. Slight haze. 14. Overcast: rain. 15. Cloudy: fine: rain. 16. Fine: showery: overcast: heavy rain. 17. Cloudy: slight showers. 18. Clear: cloudy: rain. 19. Overcast and fine. 20. Light clouds: fine: clear: *frosty at night.* 21. Clear and fine. 22. Fine: very dry air. 23. Overcast. 24. Very fine. 25. Cloudy and fine. 26. Overcast: very fine. 27. Dry haze: very fine. 28—30. Very fine.

Mean temperature of the month	57°·98
Mean temperature of June 1854	56 ·93
Mean temperature of June for the last twenty-nine years	60 ·39
Average amount of rain in June	1·89 inch.

Boston.—June 1. Cloudy: rain A.M. 2. Cloudy. 3, 4. Fine. 5. Cloudy. 6. Fine. 7. Cloudy: rain A.M. 8. Cloudy. 9. Fine: rain P.M. 10. Fine: rain with thunder P.M. 11. Fine. 12, 13. Cloudy. 14. Rain A.M. and P.M. 15. Cloudy: rain A.M. and P.M. 16. Fine. 17, 18. Cloudy: rain P.M. 19, 20. Cloudy. 21, 22. Fine. 23—27. Cloudy. 28—30. Fine.

Sandwick Manse, Orkney.—June 1. Bright A.M.: rain P.M. 2. Damp A.M.: foggy P.M. 3. Hazy A.M.: cloudy P.M. 4. Hazy A.M.: clear P.M. 5. Bright A.M.: clear P.M. 6. Rain, thunder A.M.: drops P.M. 7. Foggy A.M.: cloudy P.M. 8. Bright, fine A.M.: foggy P.M. 9. Showers A.M.: showers, foggy P.M. 10. Cloudy A.M.: clear P.M. 11. Bright A.M.: cloudy P.M. 12. Rain A.M. and P.M. 13. Foggy A.M. and P.M. 14. Clear A.M. and P.M. 15. Cloudy A.M.: clear P.M. 16. Showers A.M.: drops P.M. 17. Drizzle, showers A.M. and P.M. 18. Bright A.M.: drizzle, showers P.M. 19. Clear A.M. and P.M. 20. Cloudy A.M.: small rain P.M. 21. Foggy A.M. and P.M. 22. Foggy A.M.: bright P.M. 23. Bright A.M. and P.M. 24. Bright A.M.: bright, rain P.M. 25. Rain A.M. and P.M. 26. Drops A.M.: rain P.M. 27. Bright A.M.: clear P.M. 28. Clear, fine A.M.: bright, fine P.M. 29, 30. Bright, fine A.M. and P.M.

Mean temperature of June for twenty-eight previous years	52°·78
Mean temperature of this month	52 ·23
Mean temperature of June 1854	52 ·86
Average quantity of rain in June for fifteen previous years	2 21 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.
1855. June.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·924	29·718	29·36	30·12	30·03	55	36	52	51½	46	sw.	s.	ne.	....	·75	....
2.	30·002	29·918	29·55	29·93	29·87	61	35	59	49	46	sw.	ssw.	se.	....	....	·08
3.	29·917	29·874	29·48	29·75	29·68	67	51	58	51	49	sw.	ssw.	sse.	·02	....	....
4.	29·870	29·859	29·38	29·62	29·55	69	50	62	52	49½	sw.	ssw.	se.	....	....	....
5.	29·893	29·876	29·38	29·55	29·64	76	54	60	58½	50½	sw.	s.	sse.	....	....	....
6.	29·809	29·693	29·36	29·72	29·81	86	53	66	53	52	s.	sse.	ese.	·16	....	·09
☾ 7.	29·881	29·826	29·34	29·70	29·79	71	47	60	55	53½	sw.	se.	......	....	·19	·09
8.	29·941	29·929	29·45	29·85	29·83	72	46	63	57	48½	sw.	ssw.	e.	....	....	....
9.	30·019	29·991	29·50	29·79	29·83	66	42	63	51½	49½	sw.	ssw.	nw.	·08	....	·05
10.	30·227	30·191	29·70	30·01	30·12	73	41	58	55½	51	ne.	sw.	wnw.	....	·04	·16
11.	30·195	30·189	29·78	30·16	30·09	72	46	60	55	52	e.	e.	wsw.	....	·20	....
12.	30·107	29·856	29·70	29·95	29·82	70	54	60	51½	50	ne.	e.	sw.	....	....	·30
13.	29·686	29·435	29·30	29·70	29·57	74	51	63	56	50	e.	e.	nw.	·27	....	·47
● 14.	29·517	29·420	28·98	29·40	29·32	65	51	51	53½	50½	sw.	nw.	ne.	·18	·46	·10
15.	29·346	29·280	28·80	29·26	29·39	65	42	61	51	47	sw.	w.	nne.	·11	·30	....
16.	29·434	29·328	28·40	29·52	29·69	65	46	60·5	50½	46½	s.	sw.	n.	·46	·30	....
17.	29·906	29·698	28·30	29·82	29·88	59	36	47	48½	44	nw.	n.	nw.	·02	·02	·02
18.	30·095	30·017	29·60	29·85	29·98	58	50	53	47½	42½	w.	w.	nw.	·18	·02	·06
19.	30·223	30·061	29·70	30·07	30·24	61	36	52	50	46	n.	nne.	se.	....	·06	....
20.	30·366	30·227	29·98	30·27	30·24	56	30	53	55½	55	n.	nne.	wsw.	....	....	....
21.	30·335	30·181	29·94	30·28	30·31	69	38	52	55	54	ne.	nne.	s.	....	....	·07
☽ 22.	30·252	30·104	29·83	30·20	30·17	74	58	58	59½	50	nw.	nw.	w.	....	....	....
23.	30·170	30·110	29·67	30·13	30·11	68	41	63	53	50½	nw.	n.	w.	....	....	....
24.	30·178	30·148	29·73	29·99	29·88	71	43	56	55	50½	nw.	nw.	ssw.	....	....	·07
25.	30·164	30·074	29·61	29·65	29·77	68	52	62	52	49	sw.	w.	e.	....	....	·59
26.	30·224	30·167	29·63	29·94	29·98	77	56	68	52	53½	nw.	w.	wsw.	....	....	·11
27.	30·357	30·297	29·84	30·10	30·29	81	45	70	57½	52	sw.	wnw.	w.	....	....	·38
28.	30·274	30·104	29·80	30·22	30·12	79	53	73	65	57	e.	sse.	e.	....	....	....
○ 29.	30·072	29·874	29·58	30·04	29·96	79	61	65	67½	56	se.	e.	sse.	....	....	....
30.	30·017	29·928	29·34	29·92	29·85	76	52	75	58½	55	sw.	ssw.	se.	....	....	....
Mean.	30·013	29·912	883·01	29·883	29·893	69·43	46·53	60·0	54·26	50·21				1·48	2·34	2·64

THE ANNALS

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XIII.—*Observations on the Genera* Pachybdella (*Diesing*) *and* Peltogaster (*Rathke*), *two animal forms parasitic upon the abdomen of Crabs.* By Professor STEENSTRUP*.

IN the most recent systematic work on the Worms, Intestinal Worms and the lower division of the great Articulated series in general, Diesing's 'Systema Helminthum' (1850, vol. i. p. 434–435), we find amongst the *Bdellidea*, in the suborder *Monocotylea*, subtribe *Cephalobdellida*, a new genus *Pachybdella*, established upon a parasitic animal discovered some years before by Rathke under the abdomen of the common Crab, *Carcinus Mænas*, and described by him under the name of *Peltogaster Carcini*†. Diesing himself appears to have had no specimens of the animal before him, but to have merely drawn up his generic and specific characters from Rathke's descriptions and figures, which again are founded upon two specimens of this remarkable parasite, one of which was obtained from the Norwegian coast, the other from the Black Sea. Neither Rathke's description nor his figures, however, furnish a sufficient notion of the structure of the animal to enable us to arrive at any definite conclusion as to its systematic position, or as to the group, whose characteristic marks it might have lost in consequence of its parasitic existence. It is only from the circumstance that Rathke refers the animal to the genus *Peltogaster*, which had been recently established by him, and of which he has more fully described another species‡ (*P. Paguri*, Rathke), from the abdomen of the Hermit Crab, that we learn that this author would

* From Wiegmann's Archiv. 1855, No. 1. p. 15.

† Nova Acta Acad. Cæs. Leop. Car. 1843, tom. xx. pt. 1. pp. 244–249.

‡ Partly in the same paper, p. 245–247, and partly in the Neuest. Schr. der Nat. Ges. in Danzig, 1842, Bd. ii. p. 105–111.

place the genus *Pachybdella* amongst the Vermes, accepting this class in its widest sense. In this class, however, Rathke has given his genus no determinate place; he only thinks that these animals are by no means to be arranged with the Bdellidæ or Trematode worms, of which we are at once reminded by the form of their bodies, the pits with which they attach themselves, and their parasitic mode of life; he would rather regard them as transition forms from the Worms to the *Actiniæ* and the Radiated animals most nearly allied to these. Thus, according to his view, the pit with which these sac-like parasites attach themselves to the abdomen of the crab, is only a sucker, from which no tube leads into the body of the animal; and the other opening, which exists at the free extremity of the body, is a mouth, which leads into a large cavity, serving at once as a digestive cavity and for the development of the ova,—a double office which he considers to be proved by the extended observations which he was enabled to make upon the *P. Paguri*, but which we must admit with the author is "something very peculiar and hitherto unheard of in the case of a worm."

Our knowledge of Diesing's so-called genus *Pachybdella* is however fortunately not confined to the scanty information, welcome as it may be in every respect, which Rathke has furnished upon the individuals found and examined by him; other statements are extant, which, although they have hitherto been overlooked, are deserving of every attention, as they throw a light upon the distribution and systematic position of this parasite.

With regard to the occurrence and diffusion of *Pachybdella*, I will refer to the sac-like parasite found by Bell under the abdomen of *Carcinus Mænas* and *Portunus marmoreus* from the British Channel, and which he has described in such a manner, that there can be no doubt he had a *Pachybdella* before him. On the first-mentioned crab he appears to have found the parasite only occasionally, but it occurred in considerable numbers on the other. This author, who only refers to the parasite *en passant*, regards the pit by which it attaches itself as the oral aperture, and the other orifice, which Rathke considers to be the mouth, as the anus. Bell consequently ascribes a complete digestive canal to the animal. The parasites which occurred upon *Carcinus Mænas* were so similar to those which Bell found in greater abundance upon *Portunus marmoreus*, that he does not appear to have felt any doubt as to the identity of the species.

I can prove the occurrence of *Pachybdella* not only in the Channel, but also in the Mediterranean, from several individuals in the Zoological Museum of this University (Copenhagen). In the year 1848 I received a few Crustacea from the former locality, from M. V. Prosch, a ship-surgeon, and amongst these was a *Portunus hirtellus*, under the abdomen of which there was a very large sac, which I took to be a Lernæid parasite, without however being able to refer it to any known form of the family of Lernæidæ. I have since, however, recognized in it a form approaching so closely to *Pachybdella Carcini*, that it could only be distinguished therefrom by a few immaterial points in the outline of the body, and the wrinkling of the hinder opening. From a specimen of *Carcinus Mænas*, taken by Captain Svenson on the "Black banks" in the North Sea, I obtained a very large individual of a form exactly agreeing with *P. Carcini*, Rathke; and I have since found three other individuals, resembling the first, in a bottle containing several specimens of *Portunus hirtellus* from the Mediterranean.

If the preceding statements would lead to the supposition that this form of parasite is by no means to be reckoned amongst the greatest rarities of these seas, this appears still more distinctly from some observations which I found in Cavolini's memoir upon the Development of Fishes and Crustacea, on reading it through last autumn with a very different object. From this I found that Cavolini had not only known and figured these animals, but that he had had them in quantity, and, as it appears from his figures, several species of them, found under the abdomen of two species of crabs, which are called *Cancer depressus*, Fabr., and *C. verrucosus*, Forsk., in his memoir. These sacs are found both upon the males and females; they are represented under the abdomen of the males of both species (tab. 2. figs. 1 & 14), and under that of the female of the former (fig. 13). They occur so commonly, that the fishermen are generally of opinion that the eggs of the crabs are contained in them. The form represented under the tail of the *C. verrucosus* in Cavolini's fig. 14, so closely resembles the *P. Carcini* figured by Rathke, that it might be taken for the same species; that represented in figs. 1 & 13 on *Cancer depressus* rather resembles the one above mentioned from *Pagurus hirtellus*, but Cavolini states that the opening at the narrow end has only four knots or teeth, whilst my specimens had at least twice that number (8–10). The comparison of the outline of the animal with that of the fruit of *Thlaspi Bursa-pastoris* is very characteristic, but shows that his specimens must have been somewhat longer in proportion than those which I obtained from *Pagurus hirtellus*.

From the above observations it is sufficiently evident, that these *Pachybdella*-like parasites are not only more abundant than has been supposed, but that several species of them occur, according to the various species of crabs upon which they live. But still more important consequences result from Cavolini's investigations. He has traced the development of the eggs which fill these sacs in such enormous quantities, and ascertained that the young proceeding from the sacs from both species of crabs are of the same kind, and that the young is a true *Crustaceous* animal. He finds a resemblance between these young animals and the *Cancer paludosus* of Müller (Zool. Danica, tab. 48), but at the same thinks that they must be approximated to the *Monoculus Telemus* of Linnæus*. On tab. 2. fig. 15, Cavolini figures a portion of the eggs taken from "the sac" that is the *Pachybdella*, under the abdomen of the crab which he calls *Cancer verrucosus*; they are still immature, and are united by mucous threads into chains. Fig. 16 *a*. represents the mature egg with the developed embryo within it, and fig. 16 *c*, the embryo just after its exclusion from the egg, with three distinct pairs of swimming feet, provided with bristles. It cannot be denied that this embryo is exceedingly like that of many Entomostraca, and we might therefore be induced at first to regard the *Pachybdella* as a kind of Lernæid animal. But as I must leave it to future observers, who may have the opportunity of collecting these animals in large quantities, to give a conclusive answer to this question, and only propose in the following pages to indicate some remarkable relations between the *Pachybdellæ* and other forms of Crustacea, I will only add here, that Cavolini, notwithstanding the experiments which he made with this view, did not succeed in tracing the further changes of this embryo, and that he, in accordance with the spirit of his time, did not suppose that the young animal itself might become converted into the sac in which the eggs were found, but rather that it was developed into a Crustacean, which afterwards fastened this ovisac under the abdomen of the crabs.

From Cavolini's observations, however, it appears that *Pachybdella* is undoubtedly a Crustacean, and one which is gradually brought into its sac-like form in consequence of its parasitic mode of life.

Even if we admit Diesing's separation of the original contents of Rathke's genus *Peltogaster*,—according to which the shorter and broader form with the sucking pit at one end of the body, which occurs under the abdomen of crabs, will form a peculiar genus under the name of *Pachybdella*, and this we may be so much the more inclined to do, as it appears from the preceding statements that there are several species exceedingly closely allied to it in external appearance,—we should certainly establish no

* The *Monoculus Telemus*, Linn., which Linnæus himself says is "generis etiamnum dubii," is very clearly from his diagnosis and description the *Hyalæa tridentata* of Forskäl.

more than a generic or subgeneric division, as the other half of the original contents of the genus appears to be so closely allied to this, and only to differ in the more elongated form of the body, in the position of the sucking pit further from the extremity, and almost under the middle of the body, and in the residence of the animal under the abdomen of a species belonging to another family of Crustacea (*Pagurus Bernhardus*). If therefore *Pachybdella* has proved to be a true Crustacean, analogy leads us to regard *Peltogaster* in the same light.

However, we need not perhaps rest entirely upon this conclusion, as there are certainly direct observations in existence that the young of the *Peltogaster*-like sacs found under the abdomen of the Macroura and Anomura (?) are Crustacean in form. Thus, Diesing has not noticed that Kröyer, in his Monograph of the Northern species of *Hippolyte*, has briefly mentioned the parasites by which they are infested, and especially certain sac-like creatures, which must undoubtedly be referred to the animals now under consideration*. In the fourth section of the Monograph, which bears the title of "Ein Paar Bemerkungen über Schmarotzerthiere auf Hippolyten," the author, after describing some other parasites, continues as follows (p. 56):—"Lastly, under the abdomen of *Hippolyte pusiola*, I discovered an enigmatical parasite (tab. 5. fig. 110 *a*) which it is difficult to refer to its right position,—nay, its structure *appears* so simple, so completely destitute of all organs, that one might perhaps easily be led to regard it, not as an independent animal, but as a mere pathological phænomenon, a swelling or excrescence on the *Hippolyte*†. It evidently forms a new genus, which on the one hand appears to have some analogy with the Lernæidæ, and on the other possesses an external affinity to some Hirudineæ and intestinal worms. Of this form I know several species: I found one of a whitish colour and of considerable size, in abundance on the abdomen of *Pagurus pubescens* near Spitzbergen; another, smaller and of an orange-red colour, occurred on *Pagurus Bernhardus* in the Kattegatt; the third, which occurs on *Hippolyte pusiola*, is nearly of a globular or oval form, of a white colour, and about 2 lines in diameter. Of 25 specimens of *H. pusiola*, eight bore these parasites under the abdomen; some specimens had two, and upon one I found no less than three of them. I propose to describe these more fully on some other opportunity."

* This is also noticed by Lovén in his annual Reports.

† "I should perhaps not have ventured to mention this creature decidedly as a distinct animal, if I had not seen the eggs rush out on opening a specimen; these, when examined under the microscope, exhibited fully developed young, consisting of an anterior body and an abdomen or tail, the atter provided with swimming feet or bristles," &c.—Kröyer.

I am not aware that Professor Kröyer has since published anything upon this subject; but from the preceding it is evident, that at least the two first-mentioned vermiform species are true *Peltogastri*, and that the third must also be placed very near this genus, notwithstanding the difference in the form of the body, appears from the fact that Kröyer places them all in one and the same genus. If the interesting observation upon the young given by Kröyer in the preceding note applies to all the three species, it becomes a positive observation of the Crustacean nature of the vermiform *Peltogastri*; but if it applies only to the third and last form—to which, as is evident from the text, the note in which the observation is given particularly belongs,—it is at any rate a new confirmation of the opinion that these sac-like structures, filled with eggs, which occur under the abdomen of the long-tailed crabs, are themselves to be regarded as Crustacea.

Even if it may remain doubtful to which of the smaller natural divisions of the Crustacea the genera in question are to be referred, the above-mentioned observations upon the form of the young show distinctly that they are Crustaceous animals; so that it is evident they cannot be represented in our systems as *hermaphroditic animal forms*. As long as it is not universally admitted that the separation of the sexes, or unisexuality, is a general rule (not to say, law) in nature, and that in our science it must not be admitted that any single animal possesses an opposite sexuality or hermaphroditism, without a scientific proof of this abnormal behaviour with regard to *this* particular animal, the opponent of hermaphroditism, which is still ascribed to a good many animals, must find himself in this position,—that the sexual relations of the less known and uninvestigated animal forms are adopted from the relations of those animals which are most nearly allied to them, and which have been submitted to a closer examination in this respect, although innumerable examples of the uncertainty of this procedure are sufficiently well known. Thus, as long as the two genera of parasites under consideration could be regarded as Hirudinoid animals, we were under the necessity of supposing them to be hermaphrodites, although this point was not only not proved, but had never even been investigated, but because *all* the Hirudineæ were regarded as hermaphrodites. But if we now know that these animals are Crustacea, and agree that all the Crustacea—with the exception of most of the forms belonging to the group of Cirripedia, to which they can scarcely be referred—are to be regarded as animals with separate sexes, these parasites must also be considered from analogy as unisexual animals. To show this, and to prove that it was far from right to seek in these *fixed parasitic forms* for representations of hermaphroditism, was the principal object of the preceding remarks, in which I have endeavoured to give a better view of our knowledge of these parasites.

As, however, we have been directing our attention to these shapeless and somewhat enigmatical Crustacea, I will not omit, in conclusion, touching upon the question as to the positive systematic position which they may possibly occupy, in order to remind the reader of one or two remarkable circumstances, which perhaps may not be without their value in the solution of this problem.

Thus, it is known that in his *Peltogaster Paguri*, Rathke found some (eight) small Crustacea, scarcely one line in length; they were in the large cavity which occupied the greater part of the body of the animal, and contained an extraordinary quantity of developed eggs, so that this observer regarded the cavity as a combined digestive and hatching organ. That this cavity, to which the opening at the free end of the body forms an entrance, certainly serves for the latter purpose, we know with certainty from Cavolini's observations; and these small Crustacea were, therefore, contained in an ovisac (Bruthöhle) together with ova in course of development. In the work above quoted, Rathke has described and figured these Crustacea under the new systematic name of *Liriope pygmæa*; but, remarkably enough, has regarded this new genus as a form of the *Amphipoda*,—I know not for what reason, for the characters given do not appear to me to indicate that relation, nor do the figures remind one of an Amphipode. We are rather struck with the great resemblance of the young of the Isopodous genus *Bopyrus* to these small *Liriopæ*, and at least one cannot doubt for a moment that the form in question is Isopodous. They appear to differ in no essential points from the larvæ of the *Bopyri* which are known to us, especially from the observations of Kröyer and Rathke; they are only more elongated than the previously described larvæ of the Bopyridæ. Now, as it is well known that the *Bopyri* are parasitic under the carapace or abdomen of other Crustacea, we might suppose the relation between the *Liriopæ* and the *Peltogaster* in which they were found, to be of this nature: that the former, instead of serving, as supposed by Rathke, for the nourishment of the *Peltogaster*, led a parasitic life like other Bopyridæ, in the ovisac of the latter, which, as we are now aware, is a Crustaceous animal. There are, however, other circumstances which sufficiently prove that the relation may be quite of another nature.

In the above-mentioned memoir of Cavolini, which is so rich in excellent observations, we find a representation of a very remarkable irregular mass (fig. 19), which was quite full of more or less developed ova. It was found in a crab, attached by one end to the inner wall of the stomach, and with the opposite extremity somewhat squeezed in between two of the partitions, which indicate the limits of the lateral parts of the original rings of which the carapace is composed. In fig. 18 *m n*, Cavolini has represented the ova contained in this mass in various degrees of development, and in fig. 18 *r r*, two embryos just after their exclusion from the egg. Cavolini compares these embryos with the *Onisci squilliformes* described by Pallas, and confers upon them this name. We cannot help seeing that the embryos thus described and figured, are so very closely allied to Rathke's *Liriope*, that they could not be distinguished without difficulty, and we are consequently led involuntarily to compare them with the larvæ of *Bopyrus*. The form of the young larvæ, therefore, shows, that this irregular, ovigerous mass is in all probability not only a transmuted parasitic Crustacean, but that it also belongs to the family of the Bopyridæ, only it is more shapeless, or, as we might say, more monstrous than any other developed form of that family, more even than the *Peltogastri* and *Pachybdellæ*, and consequently this parasite is something more than an *Epizoon*; for it was attached to an internal organ, like an *Entozoon*, or intestinal worm, and especially like the extraordinary mollusk *Entoconcha mirabilis*, discovered by J. Müller in *Synapta digitata**.

We have now got the following facts together:—The Bopyridæ are known only as parasites upon the higher Crustacea,—the less irregular species of the genus *Bopyrus* occurring under the carapace of the long-tailed Crustacea (*Macrura*), and the most irregular, with which Rathke has even formed a separate genus, under the abdomen of the same animals. The latter forms consequently agree essentially, both in their *residence* and *external conditions of life*, with *Peltogaster* and *Pachybdella*, which, as we have seen, live under the abdomen of *Paguri* and Crabs (*Brachyura*). Moreover, they approach these two parasites to a certain extent even in their form. Thus they differ from the more regular species of the genus in having the limbs, with the exception of the anterior pair, completely lost on one side of the animal; and the cavity for the reception of the eggs, which occurs so universally amongst the Isopoda, instead of being formed of several equally developed plates, is here composed principally of a single plate, which has been developed at the

* See Annals, 2nd Series, vol. ix. pp. 22 and 103, Jan. and Feb. 1852.

expense of the others, and forms by itself a spacious pouch with a large opening. From this we might say, that they form a sort of transition to *Peltogaster* and *Pachybdella,* whose ovisacs might perhaps be represented as resulting from a further development of the single large lamina of *Bopyrus,* and whose feet must then be considered as having disappeared at once from both sides of the body. To this may be added Rathke's observations, who found the *Liriopæ,* resembling the larvæ of *Bopyrus,* amongst the eggs in the ovisac of *Peltogaster Paguri,* and Cavolini's observation of the development of *Liriope*-like larvæ from the eggs contained in an irregular sac, which cannot properly be placed far from *Pachybdella* and *Peltogaster;* and the question then forces itself upon us, whether we must not suppose that there is an actual and close relationship between these two parasites and the Bopyridæ, and especially whether we must not admit the existence of a more intimate connexion between *Peltogaster Paguri* and its *Liriope,* than that the latter is parasitic in its ovisac.

Supposing *Peltogaster* and *Pachybdella* to be Bopyridæ, the *Liriopæ* might either be regarded as the more advanced larvæ of the *Peltogaster* in which they were found, or as the young state of the male parasite, for it is well known that the males of the Bopyridæ are very different from the females and live as parasites upon them. None of these suppositions can however be proved at this moment, unless we are in a position to recognize a remarkable resemblance between the larvæ of the Bopyridæ and the Crustacean embryos, which Cavolini and Kröyer have found in our parasites. Neither the short notices given by both these authors, nor the figures published by the first, are sufficiently perfect for this purpose; but on the other hand, they do not appear to stand in the way of such an opinion. The feet with swimming bristles, mentioned by both and represented in Cavolini's figures, may very well represent the abdominal feet of a *Bopyrus;* and even the circumstance that no mention is made of the thoracic feet which are so characteristic of the Bopyridæ, cannot be taken positively as a proof that they were not present, as they might have been so pressed under the belly, that they would only become visible on more careful examination. It even appears from Cavolini's statements about the projecting branchial laminæ, seen when the animal was observed from beneath, that he must have seen something, which might be regarded either as these feet, or perhaps as the branchial laminæ of the Bopyridæ; nay, we cannot exactly understand how Cavolini can have compared his young animals with O. F. Müller's figure of *Cancer paludosus,* unless they had possessed such feet, or presented quite different forms from the one in which he has figured them. From the similarity to the *Cancer paludosus* we might almost be induced to suppose, that his figure represents the animal contracted into the bowed form in which it lies in the egg, and which it may probably have retained for some moments after exclusion,—and the resemblance to the larva of a Cirripede or of some other Entomostracan, might have been produced in this manner.

All this however lies, as I have already said, beyond the object which I had proposed to myself in the present communication, and only furnishes indications which I recommend especially to the notice of those naturalists, who for the study of the lower animals have lately so often visited the coast of the Mediterranean, where these remarkable parasites must, according to the preceding observations, be not uncommon*.

Postscript.

Some time since I was informed, by a letter from Dr. Creplin of Greifswald, that Professor O. Schmidt had given a figure and short description of the larva of a *Pachybdella* in a periodical called 'Das Weltall' for 1854 (No. 3. p. 19), but I have only just (December 1854) been able to obtain this journal. From the figure given by Schmidt, which agrees closely with Cavolini's fig. 16 *c*. referred to by me, it certainly appears that the young animal is extremely like the larva of an Entomostracan ; and this renders still more remarkable the relation above referred to between the *Liriopæ* of the *Peltogastri*, which resemble the larvæ of *Bopyrus*, and the *Liriope*-like young of Cavolini's extraordinary parasite (figs. 17 & 18 *r r*). Moreover Schmidt's observations prove that *Pachybdella* is not only common but even abundant at Wangerooge, and it also appears that Schmidt has collected single specimens of *Pachybdella* = *Peltogaster* on the Dalmatian coast.

† The *Peltogastri* which I have been able to examine, for three of which I am indebted to the Zootomical Museum of this University, and for a fourth to Professor J. Müller of Berlin, have unfortunately furnished me with no explanation of the structure of the embryos, as none of them presented eggs with developed larvæ. This was also the case with the specimens of *Pachybdella*.

XIV.—*Notes on Palæozoic Bivalved Entomostraca.* No. II. *Some British and Foreign Species of* Beyrichia. By T. Rupert Jones, F.G.S.

[Continued from p. 92.]

[With a Plate.]

In my former notice of Palæozoic Bivalved Entomostraca ('Annals,' No. 92, p. 81, &c.) the *Beyrichiæ* of Sweden and Gothland only were treated of; and I now propose to illustrate the British species, as far as my materials will allow, as well as some foreign species which I have had the opportunity of studying. I owe much to Mr. Salter for his friendly advice and assistance in the examination of these little fossils, and I have much pleasure in acknowledging his kindness; Mr. Morris also has kindly aided me; the Portuguese specimens have been lent to me by Mr. D. Sharpe; and to Sir R. Murchison I am indebted for permission to use and to illustrate the specimens in the Museum of Practical Geology in Jermyn Street, which form the largest portion of the series. I ought here also to repeat my thanks to Prof. Beyrich and Sir C. Lyell for the Scandinavian specimens above mentioned; for without them I could not have entered upon the subject, and because a part of the materials of this notice also is derived from that source.

Like the Scandinavian species, the forms now described also represent the three groups into which I divide the genus according to the surface-divisions of the valves;—and they are described in the same order.

The figures in Pl. VI. represent the objects magnified 4 diameters, as in Plate V.

Referring to my former communication for the generic characters, I proceed to the description of the several species.

(Jugosæ.)

1. *Beyrichia complicata,* Salter. Pl. VI. figs. 1–5.

Mem. Geol. Survey, 1848, vol. ii. part 1. p. 352. pl. 8. fig. 16; Brit. Palæoz. Foss. Cambridge, 1851, part 2. fasc. 1. p. 136 (M'Coy's descript.) pl. 1 E. fig. 3; *ibid.* 1852, fasc. 2. Appendix A. p. ii. (Salter's descript.).

Surface of valve depressed, deeply furrowed, and bearing three sharply defined ridges, which are usually united by a connecting ridge along the ventral margin. Anterior ridge largest, pear-shaped; middle ridge narrow, club-shaped: these two ridges, somewhat curved and pointing obliquely downwards and backwards, are frequently less distantly separated than the middle and posterior ridges are. The hindermost ridge is variously modified by a transverse depression on its thickest part, usually forming an oblique indentation on its inner (anterior) side, and producing a bifurcation of the ridge. In the figures in pl. 18 of the 'Mem. Geol. Survey' (above referred to) the artist has inadvertently made the small inner branch of the posterior ridge uniformly continuous with the produced upper part of the ridge; a condition, however, almost arrived at sometimes by the indentation on the broad part of the ridge (compare fig. 3).

I have not seen the carapace-valve itself of this species; but, judging from the aspect of the casts and impressions it was probably smooth. All the figures are from casts. Figs. 1–4 are selected from a number of drawings illustrative of the variations of outline, and of the disposition of the ridges. Figs. 1 and 2 may be regarded as the typical form.

In a young specimen from Harnage (fig. 5) the anterior furrow (dividing the fore and middle ridges or lobes) is seen to be shorter than that between the middle and hinder lobe; and the indentation on the upper part of the last ridge is vertical and distinct. This specimen is very interesting, as it shows that in the young state this species (so strongly ridged in the adult state) is scarcely removed, except by its well-defined marginal rim, from the merely "crumpled" condition of the *Corrugatæ*. With this young individual several adult specimens occur, which retain the *vertical* bifurcation of the posterior lobe, as is also seen in Prof. M'Coy's figure, Cambridge Pal. Foss. pl. 1 E. fig. 3 (which is better matched by our fig. 5 than by the others); in other respects they resemble our fig. 1.

Figs. 1 and 2 are from artificial casts of impressions in dark siliceous micaceous Llandeilo flagstone, from Llan Mill (two miles east of Narberth, Haverfordwest district). Figs. 3 and 4 are from internal casts in a dark calcareous Llandeilo flagstone of the same locality. The specimens are very abundant in the shelly bands of the flagstone and scattered over its divisional planes, together with the remains of Trilobites, Leptæna, Encrinites, &c. (In the Museum of Practical Geology.)

Fig. 5 is from a soft greenish-yellow argillaceous and micaceous bed of the lower Bala rocks at Harnage, near Shrewsbury; and occurs with a few older individuals, several specimens of *B. bicornis*, and a vast number of minute specimens, described further on under the heads of *B. strangulata* and *B. simplex*;—together with palliobranchiate and other Bivalves*,—nearly all in the state of casts, on the surface of a divisional plane of the rock. (In the Museum of Practical Geology.)

* Harnage, from whence many of these specimens are described, is a rich locality in the Lower Llandeilo (or Bala) flags; Trilobites, including *Alenus*, are found there.—J. W. S.

The black Bala flagstone of Abermarchant (in the Museum of Practical Geology) contains specimens of *B. complicata* in which the furrows are not so deeply excavated as in the Llan Mill specimens. Hence the ridges are broader and less steep, the connecting ridge along the ventral border more distinct, and the aspect of the valves approaches that of some of our *Corrugatæ*; thus making the passage still less difficult between our *B. Ribeiriana*, Barrande's *B. Bohemica*, and the typical *B. complicata*. There is here and there on the Abermarchant specimens some slight evidence of a granulated surface.

B. complicata, var. *decorata*. Pl. VI. fig. 6.

Accompanying the broad-ridged form of *B. complicata* in the Abermarchant flagstone (Mus. Pract. Geology), is an impression of the valve of a variety of this species, which has a semicircular outline, a finely granulated surface, and a broad, depressed, sloping marginal rim, which was crested by a continuous series of fine projecting spines. The ridges are disposed in much the same manner as those in fig. 5 and in M'Coy's specimen above referred to, the bifurcation of the posterior ridge being vertical; the furrows are very strongly marked; the middle ridge is somewhat crenulate, and the anterior lobe is impressed by a slight indentation along its thickest part.

Beyrichia complicata is a characteristic Lower Silurian form; its localities above alluded to are—Llan Mill, near Narberth; Harnage, near Shrewsbury; and Abermarchant. Prof. M'Coy mentions as localities for this species—

Llanfwrog, near Ruthin. Cwm of the Cymmerig, E. of Bala. Hill N. of Moel Uchlas, Montgomeryshire. Tregib, S. of Llandeilo. Coed-y-Bedw, Bala. Selattyn Road, S. of Llangollen. Bryn Eithin, Penmachno. Mynydd Mawr, Caermarthenshire. Mathyrafal, S. of Meifod. Pen-y-Park, Llanfyllin.	Upper Bala.
Pont-y-Meibion, two miles S. of Llansantfraid, on the Ceiriog. Militir Cerrig, Llangynnog, Montgomeryshire.	Lower Bala.

2. *Beyrichia Klœdeni*, M'Coy. Pl. VI. figs. 7 & 9.

Synops. Sil. Foss. Ireland, 1846, p. 58 (woodcut figs.); Brit. Pal. Foss. Cambridge, 1851, part 2. fasc. 1. p. 135. pl. 1 E. fig. 2. *Agnostus tuberculatus*, Sil. Syst. 1839, p. 604. pl. 3. fig. 17 (non *Battus tuberculatus*, Klöden). *Beyrichia tuberculata*, Salter, Mem. Geol. Survey, 1848, vol. ii. part 1. p. 352. pl. 8. figs. 14, 15, and *B. gibba, ibid.* p. 352. pl. 8. figs. 17, 18. *B. tuberculata,* Siluria, 1854, p. 234 (woodcut 45, 4), pl. 34. fig. 21.

Surface of valve convex, divided into three lobes; the hind and front lobes both large, pyriform, but somewhat variable in their relative proportions; the ventral extremity of the anterior lobe extending below that of the posterior lobe; the middle lobe small, oval, and frequently united with the posterior lobe by a narrow depressed curved neck; marginal rim distinct.

The surface sometimes smooth (fig. 7), and sometimes granulated (fig. 9).

Messrs. Salter and M'Coy have given several figures of this species, most of which accord generally with the above description, except that for the most part the anterior and posterior lobes are made to appear continuous along the ventral part of the valve. M'Coy's figure 2, pl. 1 E. Brit. Pal. Foss. is an interesting exception to this condition; and it differs from our specimens in having the anterior lobe much reduced in width. Salter's figures 17 and 18. pl. 8. Mem. Geol. Surv. are exceptional also in the angular production of the ventral border; these are from the Middle or Upper Silurian series at the Slate Mill, S.W. of Haverfordwest.

M'Coy also mentions (*loc. cit.* p. 136) a well-marked variety, having a long central ridge continued to the ventral * border from the Bala schist at Dermydd Fawr, near Craig Bronbanog, N.W. of Corwen.

Fig. 6 is an artificial cast of an impression in calcareous flagstone (in the Museum of Practical Geology), which contains numerous specimens of this species, chiefly on the divisional planes, with remains of Trilobites, Leptæna, &c., and belongs to the Wenlock shale of Tynewydd, S. of Llandovery. Fig. 9 represents the exterior of a well-preserved specimen (in Mr. Morris's collection) from the Wenlock limestone of Lincoln Hill, near Dudley.

In addition to the above-mentioned localities for this species Sir R. Murchison † gives "Tilestone (Upper Ludlow), Lodge Bank, Downton;" Mr. Salter mentions Woolhope (Wenlock limestone); and Prof. M'Coy enumerates Underbarrow, Kendal, Westmoreland (Ludlow Rocks); Cowan Head, Kendal (Upper

* In the comparison of the species here described, with the descriptions by Prof. M'Coy, it should be observed that I regard as the *dorsal* border that which M'Coy describes as *ventral*, and *vice versâ*.

† This species "is very abundant from the base of the Wenlock shale to the highest Ludlow stratum, and is a good index of Upper Silurian rocks, though found sometimes in the upper division of the Caradoc."—Siluria, p. 236.

Ludlow); Llanfair Road, W. of Welchpool (Wenlock shale); [Gaer Fawr, Montgomeryshire (Upper Bala) ?]; and the sandstone of Boocaun and the slates of Cappacorcogne, Cong, County Galway.

B. Klœdeni, var. *antiquata.* Pl. VI. fig. 8.

Fig. 8 represents a very fine dextral valve, clearly referable to this species, but differing from the typical form in its greater proportional length and squareness,—the relative shortness of the anterior lobe,—the greater development of the marginal rim, which has its outer edge furnished with strong spines,—and especially in the finely punctated surface of the valve. I found this specimen in a calcareous nodule, containing *Graptolites* and *Orthoceras subgregarium*, from the Wenlock schists in the road-cutting about half a mile from Montgomery towards Garth Mill.

B. Klœdeni, var. *torosa.* Pl. VI. figs. 10, 11, 12.

Accompanying specimens of the typical form (fig. 9) in soft light brown micaceous shale of the Upper Ludlow series, from Frith quarry, Stapleton, near Presteign, are numerous individuals of *B. Klœdeni* in which the anterior and posterior lobes are each divided into two knobs, which with the central boss make the valve 5-lobed (figs. 10, 11). The infero-anterior lobe attains in the larger specimens a great (relative) size, and overhangs the ventral border. The valve is more quadrate, and the marginal rim is better developed, than in the usual smaller 3-lobed form.

The specimens occur as impressions on a divisional plane of the rock. (Mus. Pract. Geol.)

In greenish clayslate from the lowest beds at Wooltack, Pembroke (Mus. Pract. Geol.) occurs an imperfect impression of a very large individual of this variety. The anterior lobe is oblique and subdivided into three tubercles, the lower one large and overhanging the ventral border, the other two decreasing rapidly in size upwards. The central lobe is represented by two triangular knobs, and the posterior lobe appears to be pyriform and curved, but is not well preserved.

This variety may be the result of age, especially as the greater development of the isolated lobes appears to accompany increase of the size of the valve. Still there appears to be a want of an intermediate stage between the forms represented by figs. 9 and 10.

At first sight, fig. 12 appears to bear a close resemblance to Klöden's fig. 22 (pl. 1. Verstein. Mark Brandenburg, &c.); but

I think that the resemblance is not real. I can trace no exact counterparts in the two figures; our specimen is imperfect posteriorly, and it seems to me probable that Klöden's specimen also was not quite perfect. Under the circumstances, I prefer to consider the two specimens as very old individuals of their respective species.

3. *Beyrichia lata*, Vanuxem, sp. Pl. VI. fig. 13.

Agnostus latus, Vanuxem, Conrad's Report Geol. New York; and Vanuxem, Geol. New York, p. 80 *et seq.*

Beyrichia lata, Hall, Palæontology of New York, vol. ii. p. 301. pl. A 66. figs. 10 *a–e*.

Surface of valve divided into three unequal ridges or lobes; posterior lobe largest, broad, its ventral portion curved forwards to meet the constricted neck of the middle lobe; anterior lobe smallest, depressed, forming a narrow oblique ridge which is scarcely separated at its lower end from the advanced extremity of the hinder lobe. Marginal rim well developed, uniform.

The specimens here described, and referred to the *B. lata* figured by Prof. Hall, are dispersed in great numbers, together with fragments of Trilobites, in the ferruginous (weathered) portion of a compact sandstone or quartzite, from a locality three or four miles south of Utica, New York State, and marked "Hudson River Group *." All trace of the carapace itself has disappeared, and the casts and impressions afford no good evidence either of a smooth or an ornamented state of the surface of the carapace-valves. (In the Museum of Practical Geology.)

Prof. Hall † describes his specimens (which are from the ferruginous rocks of the Clinton group of the State of New York ‡) as having on one valve a subcentral ridge, and on the other a subcentral and corresponding depression. But, guided by Mr. Hall's figures and by the specimens before me, I think that this description cannot be applicable; and that it has arisen from the relatively great breadth of the subcentral furrow, between the middle and hinder ridges or lobes, and from the sometimes almost obsolete condition of the anterior ridge.

* Most probably incorrect.

† With regard to the *Beyrichiæ* of the New York State, Prof. Hall remarks (*loc. cit.* p. 301), that "we have three or four species of *Beyrichiæ* in our successive groups, beginning with the Clinton group."

‡ "In the ferruginous shale associated with the iron ore at Wadsworth's quarries, and in the ferruginous sandstones below, at New Hartford, Oneida County; in numerous localities in the same position farther west, and in the green shale of the group at Sodus and Rochester."—Hall, *op. cit.* p. 301.

4. *Beyrichia Bussacensis*, Jones. Pl. VI. fig. 14.

Quart. Journ. Geol. Soc. vol. ix. p. 160. pl. 7. figs. 5, 6.

Surface of the valve depressed, smooth, bearing three well-defined, transverse, slightly curved, narrow, separate ridges; posterior ridge close to the posterior margin, and curving downwards and forwards until it meets and runs into the marginal rim of the ventral and anterior borders. Marginal rim well developed, and raised into a narrow continuous ridge, which in old specimens is one and the same with the posterior ridge and its extension forward.

In the majority of adult specimens (for instance, fig. 5. pl. 7. Quart. Journ. Geol. Soc. vol. ix.), the posterior ridge is placed close to the posterior margin; but in the young state (fig. 6. *loc. cit.*) and in the specimen here figured (fig. 14) a shallow depression occurs behind this ridge.

In young individuals the marginal rim is not so strongly developed, and the valve is rather less quadrate in outline.

This characteristic species occurs in great numbers on the divisional planes of Lower Silurian schists from near Coimbra (Serra de Mucela, and Porto de Louza in the Serra de Bussaco), Portugal, which form part of the collection made by Senhor C. Ribeiro and described by Mr. D. Sharpe, Quart. Journ. Geol. Soc. vol. ix. pp. 135 *et seq.*

(Corrugatæ.)

5. *Beyrichia Ribeiriana*, nov. sp. Pl. VI. fig. 15.

Carapace-valves contracted anteriorly, convex, impressed towards the dorsal border by two short, broad furrows, the hinder of which is largest and subcentral. The convexity of the valve forms a broad curved posterior lobe, a narrow short, oblique middle lobe, and an oblique anterior lobe; the last two near together, and forming a short angle, with the apex pointing downwards and backwards; and all three lobes continuous with the convex ventral portion of the valve. The posterior lobe is frequently indented on its broad dorsal extremity. Marginal rim indistinct.

The younger specimens may be described as presenting a nearly semicircular convex lobe, parallel with the ventral border and bounding a subcentral pit or furrow; the extremities of the two arms of the lobe being each, but unequally, impressed by an obliquely vertical indentation.

This interesting form (which I have named after Senhor C.

Ribeiro, who brought these Portuguese fossils to light) occurs plentifully, as casts, with *B. Bussacensis* in the Porto de Louza schist. When examining these schists in 1853, I overlooked this species, regarding the casts as crumpled specimens of a large variety of *B. simplex.* The corrugations of the surface, however, are quite constant and peculiar, as well as the outline of the valves, which differs from that of *B. simplex.* I have already mentioned (*supra,* p. 91 & p. 165) that *B. Bohemica* (in which the lobes are much more pinched up and ridge-like) forms a passage from this species to *B. complicata.*

6. *Beyrichia affinis,* nov. sp. Pl. VI. fig. 16.

Carapace-valve depressed; nearly semicircular, but obliquely acute at one extremity (anterior). Surface of valve, if regarded as 2-lobed, may be described as being divided into two parts by a deep and broad central indentation; the anterior part of the valve forming a somewhat convex, pyriform, curved lobe, tapering downwards and backwards; the other portion of the surface subdivided by a short furrow on its dorsal part and forming a depressed, bifurcated, Y-shaped lobe, the anterior arm of which is more prominent than the other, and constitutes a middle lobe, if the valve be regarded as 3-lobed,—in which case, besides the pyriform, curved, anterior lobe, there are two less prominent lobes, which are near together, occupying the broad (posterior) half of the valve, and are separated from the anterior lobe by a broad central pit; the middle lobe small, but well defined; posterior lobe larger, but depressed, curved. Marginal rim distinct, especially on the posterior border.

This little *Beyrichia* is essentially different from any other that I have seen, although it is not without points of resemblance to some of the above-mentioned forms, such as *B. Klædeni* and *B. Ribeiriana*; and hence I propose to distinguish it by the name of *B. affinis.*

It is represented by the cast of a single valve in a Lower Silurian dark-coloured schist from Waterford, Tramore. (In the Museum of Practical Geology.)

7. *Beyrichia Barrandiana,* nov. sp. Pl. VI. fig. 17.

Carapace-valve nearly semicircular; surface divided by a subcentral furrow into two unequal lobes; the smaller lobe is pyriform, tapering downwards; the other triangular and subdivided by a faint vertical furrow, and its largest portion, occupying the middle of the valve, gradually rises towards the ventral border until it is elevated into a strong conical projection or spine. The marginal rim is well defined, and was furnished with a series of thin projecting spines.

This well-marked and peculiar species is established on a distinct impression (somewhat squeezed obliquely by the cleavage-structure of the rock), discovered by Mr. Salter in the Lower Llandeilo schist of Mynydd Garw, Beddgelert, N. Wales. (In the Museum of Practical Geology.)

I have dedicated this *Beyrichia*—the earliest, so far as yet known, of the genus, and one of the most peculiar—to M. Barrande, of Prague, whose indefatigable and extensive researches in the palæozoic rocks of Bohemia will have comprised the study of the *Beyrichiæ* and their allies, as well as the larger and more important groups of organic life, some of which M. Barrande has already so elaborately and lucidly illustrated.

(Simplices.)

8. *Beyrichia strangulata*, Salter. Pl. VI. fig. 18.

Brit. Pal. Foss. Cambridge, part 2. fasc. 1. p. 136 (M'Coy's descript.), pl. 1 E. figs. 1 *a*, 1 *b*; and fasc. 2. Appendix A. p. ii. (Salter's descript.).

Carapace-valves subquadrate, convex; impressed at or near the dorsal border, and towards the narrow (anterior) end of the valve, by a short, vertical, subcentral furrow; the anterior side of the furrow rising up in a low rounded knob or tubercle.

The marginal rim is very broad, convex, divided from the body of the valve by a deep narrow furrow, and is seldom well preserved. From Mr. Salter's observations (*loc. cit.*), the marginal rim would appear to be broader at the antero-inferior, than at the posterior border of the valve. Prof. M'Coy says that the marginal rim is often wanting, having been broken away.

B. strangulata is abundant in the Upper Bala calcareous schists at Coniston Waterhead, Lancashire.

The foregoing description of the typical specimens is not quite applicable to any of the forms that I have next to notice. Still I see no good reason for regarding as distinct species the individuals represented by figs. 19–22; for, although neither of them exactly corresponds with the above description, yet there are some important characters common to all, especially the uniform convexity of the valve, and the single dorsal sulcus. On the other hand, there is a considerable, though not an unlimited, variation in the shape of the valve; and, what appears to me to be of more importance, the marginal rim is in one variety highly developed (as in the type), and in others it is absent; nor do I find any reason to suppose that these latter individuals have *lost* their rims accidentally.

B. strangulata, var. α. Pl. VI. fig. 19.

Valve much less quadrate than the typical form; dorsal furrow faint, extending across two-thirds of the width of the valve (another but very faint impression occurs on the anterior part of the valve, but amounts to little more than an undulation in the general convexity of the surface); marginal rim strongly developed at the infero-anterior border, and tapering off posteriorly.

Fig. 19 is from a unique cast in Lower Silurian fossiliferous schist from Robeston Wathen, Pembrokeshire. (Mus. Pract. Geol.)

B. strangulata, var. β. Pl. VI. figs. 20, 21.

Carapace-valve (adult) narrow-oblong, with the ends rounded and the anterior extremity contracted; surface coarsely pitted; dorsal furrow short and deep, in the middle of the anterior half of the valve; anterior side of furrow slightly elevated in some of the casts, but not in the impression made by the outside; no trace of marginal rim.

Four specimens of this form occur (as casts or impressions) in dark-coloured fossiliferous schist, of Lower Silurian age, from Sholes Hook, Haverfordwest. (Mus. Pract. Geol.)

The cast and impression of a young individual (fig. 21) accompanies the foregoing. It is proportionally broader and shorter; nearly semicircular, but obliquely acute anteriorly; the sulcus is well defined, and its anterior edge is raised (in the cast); the surface appears to be smooth; there is no marginal rim.

B. strangulata, var. γ. Pl. VI. fig. 22.

Cast of carapace-valve very small; convex; narrow-oblong, narrower in front than behind; dorsal furrow short, strongly marked, and accompanied by an anterior tubercle; no marginal rim.

From Harnage, Shrewsbury; and accompanies *B. complicata* (fig. 5) and others: see p. 165.

With regard to *B. strangulata* and its varieties above mentioned, I would observe that M. Barrande's collection of the

Silurian Entomostraca of Bohemia (now in the British Museum) comprises several forms closely allied to this group.

9. *Beyrichia bicornis*, nov. sp. Pl. VI. fig. 23.

Carapace-valves flattened; impressed with a distinct, short, subcentral, dorsal pit-like furrow; a small semicylindrical tubercle rises up on either side of the furrow. Marginal rim well developed, sloping, and crested by a narrow continuous ridge. The carapace-valves, in one or two rare well-preserved specimens, are smooth; but in various stages of dissolution the surface puts on a deceptive pitted, reticulated, or carious aspect.

The well-defined outline, raised border, and bi-tubercled surface, with its deep subcentral notch, sufficiently characterize this interesting little species. It is from the Harnage rock before mentioned. (Mus. Pract. Geol.)

10. *Beyrichia seminulum*, nov. sp. Pl. VI. fig. 24.

Carapace-valves convex, almost symmetrically semicircular; coarsely punctate; impressed with an almost central dorsal furrow, extending across one-third of the width of the valve. Marginal rim distinct, uniform.

I met with this neat little species in the Wenlock schists of the Town Hill, Montgomery, as casts and impressions, in company with casts of *B. Klœdeni*.

11. *Beyrichia simplex*, Jones. Pl. VI. fig. 25.

Quart. Journ. Geol. Soc. 1853, vol. ix. p. 161. pl. 7. fig. 7.

Carapace-valves convex, smooth, somewhat ovate; posterior half of the valve much broader than the anterior; ventral border rounded; anterior and posterior borders obtusely angular; dorsal border somewhat angular, formed partly of the straight hinge-line (which is about half the length of the valve), and partly of the obliquely rounded upper margins of the two extremities. Dorsal furrow slight, subcentral, towards the anterior extremity. Marginal rim indistinct.

This species was established on numerous specimens, constant in form and character, accompanying *B. Bussacensis* in the Lower Silurian schists of Serra de Bussaco and Serra de Mucela, near Coimbra, Portugal.

B. simplex? var.? Pl. VI. figs. 26, 27.

Figs. 26 and 27 represent small individuals, which, with other similar but somewhat variable forms, occur in numbers in the Harnage rock already frequently referred to. For the most part, they much more nearly approach *B. simplex* than *B. strangulata*,—their only other ally. If fig. 22—one from amongst this crowd of minute individuals in the Harnage rock (and which, like others of the *Simplices*, have been hitherto regarded as *Cytherinæ*)—be placed in the same category with figs. 26 and 27, we can but see what a difference of form these little associates present.

Probably in mere casts of the external coverings of such minute animals, and with such general simplicity of outward form, we should not expect to arrive at exact specific determinations.

12. *Beyrichia mundula*, Jones. Pl. VI. figs. 28–31.

Annals and Mag. Nat. Hist. Ser. 2. No. 92 (Aug. 1855), p. 90. pl. 5. fig. 23.

Since writing the description of this Scandinavian species (*loc. cit.*), I have met with several very well-preserved specimens in the limestone No. 5 (*vide supra*, p. 84), some of which exhibit the well-marked marginal rim and striato-punctate surface (fig. 29 *b*). The generality of the individuals have a marked straightness of the hinge-line (about two-thirds the length of the valve), and a decided obliquity of the upper part of the margins of the extremities, and frequently a conspicuous angularity of the extremities themselves. In the specimens which have these characters most strongly marked, the valves have a tendency to be depressed towards their margins, and to lose the impression of the dorsal sulcus (figs. 30 & 31); thus resembling the carapace-valves of *Leperditia*,—a genus which I hope to treat of in my next notice of the Palæozoic Bivalved Entomostraca.

In the subjoined Table I have arranged the *Beyrichiæ* so as to indicate the geological distribution of the genus and its three subdivisions, as far as the species above described will permit. The few other species known in the United States, already referred to (p. 168), and the *Beyrichiæ* collected by M. Barrande and now to be seen in the British Museum, are all the species of which I am cognizant, with the exception of some Lower Silurian specimens of the *Simplex* group from Canada, which have been collected by Mr. W. E. Logan, and will, I trust, form part of the materials for a future notice on the Palæozoic Bivalved Entomostraca of Canada.

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—— strangulata, *var.* α	*	......	172
—— strangulata, *var.* β	*	......	172
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—— Ribeiriana	*	......	169
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—— Klœdeni, *var.* antiquata	......	*	167
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EXPLANATION OF PLATE VI.

Fig. 1. *Beyrichia complicata*, Salter (typical form): right valve. 2. Left valve.

Fig. 3. *B. complicata*: right valve. 4. Left valve.

Fig. 5. *B. complicata* (young): right valve.

Fig. 6. *B. complicata*, var. *decorata*, Jones: right valve.

Fig. 7. *B. Klœdeni*, M'Coy: right valve.

Fig. 8. *B. Klœdeni*, var. *antiquata*, Jones: right valve.

Fig. 9. *B. Klœdeni*, M'Coy: right valve.

Fig. 10. *B. Klœdeni*, var. *torosa*, Jones: left valve. 11. Right valve. 12. Left valve.
Fig. 13. *B. lata*, Vanuxem, sp.: right valve.
Fig. 14. *B. Bussacensis*, Jones: left valve.
Fig. 15. *B. Ribeiriana*, Jones: left valve.
Fig. 16. *B. affinis*, Jones: right valve.
Fig. 17. *B. Barrandiana*, Jones: left valve.
Fig. 18. *B. strangulata*, Salter: left valve.
Fig. 19. *B. strangulata*, var. α: right valve.
Fig. 20. *B. strangulata*, var. β: left valve. 21. Right valve (young).
Fig. 22. *B. strangulata*, var. γ: left valve.
Fig. 23 *a*. *B. bicornis*, Jones: left valve. 23 *b*. Ventral aspect of the same valve.
Fig. 24. *B. seminulum*, Jones: left valve.
Fig. 25. *B. simplex*, Jones: right valve.
Fig. 26. *B. simplex*?: right valve. 27. Right valve.
Fig 28. *B. mundula*, Jones: right valve. 29 *a*. Left valve. 29 *b*. Ventral aspect of part of the same valve. 30. Left valve. 31. Left valve.

XV.—*On the Heart and Circulation in the* Pycnogonidæ. By Dr. A. Krohn*.

[With a Plate.]

The opinion of Quatrefages that the Pycnogonidæ are destitute of a heart, has been contradicted by Zenker†, who has succeeded in recognizing this organ in *Nymphon gracile*. Zenker discovered it in the position where analogy would lead us to expect to meet with it; he describes it as a very delicate sac, furnished with ramified muscular fibres; its outlines may be most clearly distinguished in the neighbourhood of the last pair of legs. I had recently an opportunity, whilst examining a *Phoxichilus* (probably *P. spinosus*), of convincing myself most decidedly of the existence of the heart. I am thus enabled to furnish more exact details as to its form and structure.

The heart is a sac, of proportionably very large size, which is placed, as in all the Arthropoda, in the back, above the intestinal canal; it is seen to extend from the hinder margin of the last thoracic segment to the middle of the foremost one (Pl. VII. fig. 7). Whether it terminates at this point, or extends beyond it, must remain undecided, as further observations are prevented by the tubercle which rises on this part, upon the apex of which the four eyes are situated. The heart is divided into three chambers by two pairs of deep lateral notches or constrictions; the hinder

* From Wiegmann's Archiv for 1855, p. 6.
† Müller's Archiv, 1852, p. 383.

chamber is smaller than the middle, and this than the anterior one. The latter is very considerably enlarged immediately behind the above-mentioned tubercle, and is no doubt in free communication with the cavity of the body or the interstices (*lacunæ*) between the organs, and this is very probably the case also with the hinder chamber. In the bottom of each notch there is an opening for the entrance of the returning blood, so that there are four such apertures, arranged in pairs. From this description it is evident that the heart of the Pycnogonidæ agrees essentially in form and structure with that of the higher Arachnida.

The circulation goes on pretty rapidly in a distinctly marked course, and if the nutritive fluid contains a sufficient quantity of blood-corpuscles, may be easily observed. The chambers of the heart contract simultaneously. At each diastole, the blood returning from the organs is taken up by the heart through the four lateral openings and driven forwards at each systole. In this manner a small portion of the blood reaches the proboscis, whilst the greater part takes its course in the form of a considerable stream towards the abdomen. From this principal current, lateral streams are given off to the legs; these pass down one side of the respective legs and up the other, so as to return at last to the heart.

In conclusion I must remark, that Van Beneden has already observed a regular circulation of the blood in the legs of *Nymphon**. He could not discover the heart, and according to him, the impulse is given to this current of blood in the extremities by a peculiar, rhythmically contractile membrane, situated within the base of the legs. But as it is now certain that the blood circulates in all parts of the body by the action of the heart alone, we may very justly doubt the existence of any such arrangement as this in the legs of the Pycnogonidæ.

EXPLANATION OF PLATE VII.

Fig. 7. Sketch of the heart of *Phoxichilus*. The numbers 1–4 indicate the several thoracic segments; *a*, proboscis; *b*, abdomen; *c*, the four eyes; *d*, *d*, *d*, *d*, the legs; *e*, *e*, the stomach with its lateral cæca; *f*, intestine; *g*, the anterior, *h*, the middle, and *i*, the hinder chamber of the heart; *k*, *k*, the constrictions of the heart.

XVI.—*Abstract of a Monograph of the Family* Gorgonidæ. By M. Valenciennes.

M. Milne-Edwards has shown that the animals of the class of Polypes belong to two great orders. One of these, called *Anthozoa* (Zoanthaires), includes those animals which more or

* Froriep's Notizen, xxxvii. p. 72.

less resemble the *Actiniæ* so abundant on the coasts of all seas, characterized by their simple, conical, hollow tentacles, and by the numerous ovigenous lamellæ which rise in their internal cavity. The second order, to which M. Milne-Edwards has long since given the name of *Alcyonia*—fixing the zoological meaning of this word, borrowed from Pallas, which has been applied by other authors to the most dissimilar creatures—includes those polypes in which the mouth is surrounded only by eight pinnated tentacles, and in which there are only eight internal ovarian lamellæ; each tentacle is a conical tube, furnished on each side with shorter, filamentous secondary tentacles, which are inserted on the primary tentacle in the same manner as the barbs of a feather upon the stalk. All these polypes are united posteriorly to a common sarcoid body, forming true compound animals. This soft tissue, which is often gelatinous in its appearance, is consolidated by numerous calcareous concretions, entirely composed of carbonate of lime, and possessing determinate forms in each species, but often very different in different species, and also frequently exactly similar in very distinct species belonging to different genera. They must not be confounded with the spicules or acicules which also exist in the tissue of several parts of the polypes, principally round the oral orifice, or near the cells through which the body of the isolated animal is exserted. To these bodies I give the name of *sclerites*.

The masses produced by the aggregation of the *Alcyonia* are as varied in their form as the polypidoms of the *Anthozoa*, which have received the general name of Madrepores. The compound *Alcyonia* are sometimes protected by a simple epidermic sclerenchyma, without any solid internal parts; but sometimes there exists an axis, which is variable in its nature, form, and chemical composition.

Amongst the families established in this order by MM. Milne-Edwards and Dana, the family to which the latter has given the name of *Gorgonidæ*, and which has been divided by Milne-Edwards into several subfamilies, includes the species united by Pallas in the genus *Gorgonia*.

A work which I have long been occupied with, upon the numerous species of Sponges, has led me to compare their spicules with the sclerites of the *Gorgonidæ*. The examination of these corpuscles has enlarged the sphere of my observations, and some new researches have become the basis of a new classification of these zoophytes.

All my predecessors, with the exception of M. Milne-Edwards, only describing the *Gorgonidæ* from dried specimens, have founded their characters upon the arrangement of the divisions of the more or less delicate branches of what they call the *axis of* *the Gorgoniæ,* and upon the form and arrangement of the cells in the friable envelope of the branches, to which they give the name of *cortex.* M. Milne-Edwards has ascertained that this envelope, when examined upon living animals, is composed of a sort of contractile parenchyma, which is rendered arenaceous by the quantity of calcareous molecules contained in it. His extended knowledge of the organization of the polypes, has shown him the relations which exist between the envelope and the axis; and in order to render his idea more intelligible he has given the name of *sclerenchyma* to the external portion from which the extensible bodies of the polypes issue, and of *sclerobase* to the concealed portion, which he still regarded as composed of a horny matter.

It appears from what I have just stated, that a *Gorgonia* is a body formed by the union of numerous polypes upon a common body, enveloped by an arenaceous sclerenchyma surrounding another dendroid secretion, the sclerobase; just as a *Veretillum* is composed of numerous polypes protruded from a soft fleshy sclerenchyma. The sclerenchyma of the *Gorgonidæ* contains numerous sclerites. These, which are often microscopic, but are sometimes as much as 2 millimetres in length and consequently visible to the naked eye, occur in all the genera of this family. The following are some of the principal forms:—

1. The corpuscles have two small circles of tubercles at a distance from one another on a short axis; the tuberculate extremities resemble a small branch of cauliflower. These occur in *Junceella juncea, surculus* and *elongata, Gorgonella sulcifera, Ctenocella pectinata, Rhipidigorgia umbraculum, cribrum, arenata,* &c., and in the common coral of the Mediterranean.

2. Other sclerites are fusiform, with four or six circlets of tubercles. These occur in *Pterogorgia simplex, Plexaura virgea* and *petechizans, Phycogorgia foliata, Rhipidigorgia reticulum, Gorgonella cauliculus,* &c.

3. A third form is that of the clubbed sclerites, in which a single extremity is dilated, and furnished with ridges, like some ancient maces. These are found in *Gorgonia crinita, papillifera* and *placomus, Gorgonella betulina* and *ceratophyta, Plexaura homomalla, pensilis, parvula,* &c.

4. A fourth and new form is seen in the muricated sclerites with four or several points, and entirely covered with spines, which occur in *Plexaura aurantiaca, Plexaurella dichotoma, Gorgonia vermiculata,* &c.

5. A fifth form consists of larger or smaller scales, more or less covered with small spines. These are found in *Cricocella verticillaris* and *plumatilis, Primnoa lepadifera* and *antarctica, Gorgonia fungifera,* &c.

These sclerites exhibit the most agreeable colours: some are white and transparent like a fine crystal of Iceland spar, others violet like amethyst, others red or yellow. Their transparency has led to the supposition that these corpuscles were composed of small crystals, but M. Senarmont after the examination of several sorts has been unable to recognize any crystalline form in them, and does not hesitate to say that they are not crystals. Their similarity in such different species of *Gorgonidæ* proves that these selcrites cannot be employed in characterizing the genera, as has been supposed by some very excellent zoologists: they can only be taken into account in the diagnosis of the species.

The sclerenchyma thus formed is perforated with cells, which sometimes project from the surface like small warts, whilst in other species they are pierced as though with the point of a needle. These cells are sometimes margined with a small expansion which may be called a lip; other species have the cells surrounded by small scales.

A second organ, the study of which is of great importance, is the axis or *sclerobase*. A fact first established by my researches with the aid of M. Fremy, is, that this axis, notwithstanding its external appearance, does not consist of horn like that of the claws and hoofs of the Mammalia or the horns of Ruminants. It is a substance *sui generis*, which however approaches more closely to horn than to the chitine of the articulated animals. It is insoluble even in hot solution of potash, brought to the greatest possible concentration by boiling. Some species give up a portion of their colouring matter to muriatic acid; others yield nothing. I have met with some sclerobases which became soft, and even began to dissolve in this acid. It is therefore a new substance peculiar to the *Gorgonidæ*, like the conchyoline of the Mollusca, of which the shells of the genus *Pinna* furnish such large and fine specimens. I think we may designate this substance by the name of *corneine*, on account of its resemblance to the material of the hoofs and nails of the Mammalia. The analyses made by M. Fremy prove that it is isomeric with horn.

The sclerobase does not consist of corneine alone in all the species of *Gorgonidæ*. In a great number of species the axis contains a considerable quantity of carbonate of lime. Several species possess an axis which gives a very brisk effervescence with muriatic acid. This physiological fact is very important in the classification of the *Gorgonidæ*, and not less so in explaining the way in which the membranes of the polypes assist in the formation of the sclerenchyma and sclerobase. Those species with a calcareous sclerobase, which I unite under the name of *Gorgonellaceæ*, have the body prolonged into the common sarcoid mass, and are protected internally by a delicate membrane, which secretes a plate of corneine covered with carbonate of lime. The polypes in adding to their common body secrete fresh plates composed of calcareous matter and corneine, and by treating these axes with an acid which removes the lime, the superposed membranes are separated from each other. When the internal membrane, which is often thick, as in some *Plexauræ* and *Euniceæ*, only deposits corneine, the sclerobase is composed entirely of homogeneous layers of this substance; these have often been regarded as ligneous axes by observers who recognized in their lamellar structure a certain appearance of concentric layers like that of the ligneous layers of vegetables, although in reality there is no resemblance between the organization of these sclerobases and vegetable tissues.

These investigations have led me to revise the classification of these polypes and to arrange them as follows:—

Family I. Gorgonaceæ.

Axis not effervescing with muriatic acid.

Genus Gorgonia. Cells opening upon a small tubercle of the sclerenchyma, projecting from the stalk.

Sp. *verrucosa*, Pal., *placomus*, Linn., *graminea*, Pall., *palma*, Pall., and 11 other species.

Genus Plexaura. Cells opening by a simple hole pierced in the sclerenchyma, without projections or lips.

Sp. *virgulata*, Lamk., *sanguinea*, Lamk., *rosea*, Lamk., *flavida*, Lamk., *flexuosa*, Lamk., *homomalla*, Lamk., *friabilis*, Lamk., *vermiculata*, Lamk., *multicauda*, Lamk., *alba*, Lamk., *laxa*, Lamk., *petechizans*, Pall., and 13 other species.

Genus Eunicea. Cells placed in tubular prominences of the sclerenchyma, and opening under a sort of lip.

Sp. *plantaginea*, Lamk., *mammosa*, Lamk., and 6 other species.

Genus Pterogorgia. Cells opening in series on the two sides of a compressed stem.

Sp. *anceps*, Ehr., and 3 other species.

Genus Phycogorgia. Sclerobase dilated into membranous laminæ like a Fucus; sclerenchyma covered with cellular pores.

Sp. *fucata*, Val. (Mazatlan.)

Genus Hymenogorgia. Sclerenchyma dilated into foliaceous laminæ, supported on a sclerobase with simple, branched, rounded, slender, separate stems.

Sp. *quercifolia*, Val. (Guadaloupe.)

Genus PHYLLOGORGIA. Sclerenchyma with foliaceous expansions; branches of the sclerobase with frequent anastomoses.
Sp. *dilatata* and *foliata*, Val.

Genus RHIPIDIGORGIA. Branches of sclerobase rounded, frequently anastomosing to form a flabelliform network.
Sp. *umbraculum*, Lamk., *flabellum*, Linn., and 6 other species.

Family II. GORGONELLACEÆ.

Axis effervescing with muriatic acid.

Genus JUNCEELLA, Val. Stems straight, covered with polypiferous cells scattered upon the sclerobase.
Sp. *juncea, surculus, vimen, elongata, calyculata* and *hystrix*, Val.

Genus CTENOCELLA, Val. Sclerobase forming straight rods, pectinated on one side only of the principal stem.
Sp. *pectinata*, Val. (China.)

Genus GORGONELLA, Val. Sclerobase much divided, forming fine branches.
Sp. *violacea*, Lamk., *sarmentosa*, Lamk., and 3 others.

I have extended my researches to other polypes of different families, and they have given me the opportunity of observing several facts which have escaped previous observers, and which will serve to rectify some faulty diagnoses. The coral-fishers agree in saying that the extremities of the branches of coral are soft when first taken from the sea, and that they only become hard by desiccation. The truth of this may be ascertained by examining coral preserved in spirits.

On dissecting the *Melitæa ochracea*, Lamk., the parenchyma of the sarcoid envelope of the common body is seen to extend along the stems, and between the calcareous masses, of which the articulations of the sclerobase are composed. But it is incorrect to say that this sclerobase is composed of a series of joints separated by a corky tissue: it is the desiccation of the parenchyma that renders the separation of the joints too easy. Lamarck only examined dried individuals.

The sclerites of the *Melitææ* are small, scarcely measuring from 0·08 to 0·10 of a millimetre. They are smooth, cylindrical, rounded at both ends, and of a fine orange colour. These are mixed with others, of a longer form, and pointed at the two extremities; their colour is yellow and they measure 0·15 of a millimetre. With these sclerites I have seen others much smaller, measuring only 0·04 to 0·06 of a millimetre, of a fine orange-yellow colour, and furnished with two whorls of tubercles.

The articulations which separate the calcareous pieces of the sclerobase of *Isis*, consist of corneine. The sclerites of *Isis* are 0·18 to 0·20 mill. in length, with a swelling at each extremity; they are of a fine white colour.

The substance of the axis of *Pennatula phosphorea* has been analysed by M. Fremy. It contains a considerable quantity of phosphate of lime with the carbonate of lime. These are the only Radiated animals containing phosphate of lime, and this pecularity was the less expected as the axis of *Virgularia* and *Pavonaria* contain only carbonate of lime.

XVII.—*On the Genus* Assiminia. By Dr. J. E. Gray, F.R.S., V.P.Z.S.

To the Editors of the Annals of Natural History.

Gentlemen,

In the preceding Number of the 'Annals' Mr. Clark thinks he has proved that Dr. Leach's genus *Assiminia* is only a species of *Truncatella* of Risso. Mr. Clark's description proves the converse of his position. *Truncatella* should have a subcylindrical shell with a slender tapering tip, which falls off when the shell approaches adult age; hence the name of the genus: *Assiminia* has a broad conic shell with an acute tip which does not fall off; if it is to be a species of the same genus, the name of the latter ought to be changed.

The foot of *Truncatella* is small and peculiarly formed, and the eyes of all the species, according to Mr. Clark's observations, are large with a white iris; now this is not the case with *Assiminia*, and yet Mr. Clark regards it as a *Truncatella*.

Every naturalist has the right to restrict his genera as he pleases. I have only to observe that Mr. Clark's notions on this head are not those usually held by modern zoologists, and this must explain the proposed union; it is not so extraordinary as that of the species which he has combined together under the generic name of *Murex* in his late work, species which are by other authors referred to six distinct families. If we were to extend the views of Mr. Clark as applied to the British Mollusca to the exotic species, that is to say to the Mollusca known, many of our genera would contain from 500 to 700 species, which certainly would not facilitate the study of these animals. But the whole of Mr. Clark's theory is so opposed to sound logic, that I shall not proceed further.

I am, Gentlemen, yours truly,

J. E. Gray.

XVIII.—*On the Law which has regulated the Introduction of New Species.* By Alfred R. Wallace, F.R.G.S.

Every naturalist who has directed his attention to the subject of the geographical distribution of animals and plants, must have been interested in the singular facts which it presents. Many of these facts are quite different from what would have been anticipated, and have hitherto been considered as highly curious, but quite inexplicable. None of the explanations attempted from the time of Linnæus are now considered at all satisfactory; none of them have given a cause sufficient to account for the facts known at the time, or comprehensive enough to include all the new facts which have since been, and are daily being added. Of late years, however, a great light has been thrown upon the subject by geological investigations, which have shown that the present state of the earth, and the organisms now inhabiting it, are but the last stage of a long and uninterrupted series of changes which it has undergone, and consequently, that to endeavour to explain and account for its present condition without any reference to those changes (as has frequently been done) must lead to very imperfect and erroneous conclusions.

The facts proved by geology are briefly these:—That during an immense, but unknown period, the surface of the earth has undergone successive changes; land has sunk beneath the ocean, while fresh land has risen up from it; mountain chains have been elevated; islands have been formed into continents, and continents submerged till they have become islands; and these changes have taken place, not once merely, but perhaps hundreds, perhaps thousands of times:—That all these operations have been more or less continuous, but unequal in their progress, and during the whole series the organic life of the earth has undergone a corresponding alteration. This alteration also has been gradual, but complete; after a certain interval not a single species existing which had lived at the commencement of the period. This complete renewal of the forms of life also appears to have occurred several times:—That from the last of the Geological epochs to the present or Historical epoch, the change of organic life has been gradual: the first appearance of animals now existing can in many cases be traced, their numbers gradually increasing in the more recent formations, while other species continually die out and disappear, so that the present condition of the organic world is clearly derived by a natural process of gradual extinction and creation of species from that of the latest geological periods. We may therefore safely infer a like gradation and natural sequence from one geological epoch to another.

Now, taking this as a fair statement of the results of geological inquiry, we see that the present geographical distribution of life upon the earth must be the result of all the previous changes, both of the surface of the earth itself and of its inhabitants. Many causes no doubt have operated of which we must ever remain in ignorance, and we may therefore expect to find many details very difficult of explanation, and in attempting to give one, must allow ourselves to call into our service geological changes which it is highly probable may have occurred, though we have no direct evidence of their individual operation.

The great increase of our knowledge within the last twenty years, both of the present and past history of the organic world, has accumulated a body of facts which should afford a sufficient foundation for a comprehensive law embracing and explaining them all, and giving a direction to new researches. It is about ten years since the idea of such a law suggested itself to the writer of this paper, and he has since taken every opportunity of testing it by all the newly ascertained facts with which he has become acquainted, or has been able to observe himself. These have all served to convince him of the correctness of his hypothesis. Fully to enter into such a subject would occupy much space, and it is only in consequence of some views having been lately promulgated, he believes in a wrong direction, that he now ventures to present his ideas to the public, with only such obvious illustrations of the arguments and results as occur to him in a place far removed from all means of reference and exact information.

The following propositions in Organic Geography and Geology give the main facts on which the hypothesis is founded.

Geography.

1. Large groups, such as classes and orders, are generally spread over the whole earth, while smaller ones, such as families and genera, are frequently confined to one portion, often to a very limited district.
2. In widely distributed families the genera are often limited in range; in widely distributed genera, well-marked groups of species are peculiar to each geographical district.
3. When a group is confined to one district, and is rich in species, it is almost invariably the case that the most closely allied species are found in the same locality or in closely adjoining localities, and that therefore the natural sequence of the species by affinity is also geographical.
4. In countries of a similar climate, but separated by a wide sea or lofty mountains, the families, genera and species of the

one are often represented by closely allied families, genera and species peculiar to the other.

Geology.

5. The distribution of the organic world in time is very similar to its present distribution in space.
6. Most of the larger and some small groups extend through several geological periods.
7. In each period, however, there are peculiar groups, found nowhere else, and extending through one or several formations.
8. Species of one genus, or genera of one family occurring in the same geological time are more closely allied than those separated in time.
9. As generally in geography no species or genus occurs in two very distant localities without being also found in intermediate places, so in geology the life of a species or genus has not been interrupted. In other words, no group or species has come into existence twice.
10. The following law may be deduced from these facts :—*Every species has come into existence coincident both in space and time with a pre-existing closely allied species.*

This law agrees with, explains and illustrates all the facts connected with the following branches of the subject :—1st. The system of natural affinities. 2nd. The distribution of animals and plants in space. 3rd. The same in time, including all the phænomena of representative groups, and those which Professor Forbes supposed to manifest polarity. 4th. The phænomena of rudimentary organs. We will briefly endeavour to show its bearing upon each of these.

If the law above enunciated be true, it follows that the natural series of affinities will also represent the order in which the several species came into existence, each one having had for its immediate antitype a closely allied species existing at the time of its origin. It is evidently possible that two or three distinct species may have had a common antitype, and that each of these may again have become the antitypes from which other closely allied species were created. The effect of this would be, that so long as each species has had but one new species formed on its model, the line of affinities will be simple, and may be represented by placing the several species in direct succession in a straight line. But if two or more species have been independently formed on the plan of a common antitype, then the series of affinities will be compound, and can only be represented by a forked or many-branched line. Now, all attempts at a Natural classification and arrangement of organic beings show, that both these plans have obtained in creation. Sometimes the series of affinities can be well represented for a space by a direct progression from species to species or from group to group, but it is generally found impossible so to continue. There constantly occur two or more modifications of an organ or modifications of two distinct organs, leading us on to two distinct series of species, which at length differ so much from each other as to form distinct genera or families. These are the parallel series or representative groups of naturalists, and they often occur in different countries, or are found fossil in different formations. They are said to have an analogy to each other when they are so far removed from their common antitype as to differ in many important points of structure, while they still preserve a family resemblance. We thus see how difficult it is to determine in every case whether a given relation is an analogy or an affinity, for it is evident that as we go back along the parallel or divergent series, towards the common antitype, the analogy which existed between the two groups becomes an affinity. We are also made aware of the difficulty of arriving at a true classification, even in a small and perfect group;—in the actual state of nature it is almost impossible, the species being so numerous and the modifications of form and structure so varied, arising probably from the immense number of species which have served as antitypes for the existing species, and thus produced a complicated branching of the lines of affinity, as intricate as the twigs of a gnarled oak or the vascular system of the human body. Again, if we consider that we have only fragments of this vast system, the stem and main branches being represented by extinct species of which we have no knowledge, while a vast mass of limbs and boughs and minute twigs and scattered leaves is what we have to place in order, and determine the true position each originally occupied with regard to the others, the whole difficulty of the true Natural System of classification becomes apparent to us.

We shall thus find ourselves obliged to reject all those systems of classification which arrange species or groups in circles, as well as those which fix a definite number for the divisions of each group. The latter class have been very generally rejected by naturalists, as contrary to nature, notwithstanding the ability with which they have been advocated; but the circular system of affinities seems to have obtained a deeper hold, many eminent naturalists having to some extent adopted it. We have, however, never been able to find a case in which the circle has been closed by a direct and close affinity. In most cases a palpable analogy has been substituted, in others the affinity is very obscure or altogether doubtful. The complicated branching of the lines of affinities in extensive groups must also afford great facilities for giving a show of probability to any such purely artificial arrangements. Their death-blow was given by the admirable paper of the lamented Mr. Strickland, published in the 'Annals of Natural History,' in which he so clearly showed the true synthetical method of discovering the Natural System.

If we now consider the geographical distribution of animals and plants upon the earth, we shall find all the facts beautifully in accordance with, and readily explained by, the present hypothesis. A country having species, genera, and whole families peculiar to it, will be the necessary result of its having been isolated for a long period, sufficient for many series of species to have been created on the type of pre-existing ones, which, as well as many of the earlier-formed species, have become extinct, and thus made the groups appear isolated. If in any case the antitype had an extensive range, two or more groups of species might have been formed, each varying from it in a different manner, and thus producing several representative or analogous groups. The *Sylviadæ* of Europe and the *Sylvicolidæ* of North America, the *Heliconidæ* of South America and the *Euplœas* of the East, the group of *Trogons* inhabiting Asia, and that peculiar to South America, are examples that may be accounted for in this manner.

Such phænomena as are exhibited by the Galapagos Islands, which contain little groups of plants and animals peculiar to themselves, but most nearly allied to those of South America, have not hitherto received any, even a conjectural explanation. The Galapagos are a volcanic group of high antiquity, and have probably never been more closely connected with the continent than they are at present. They must have been first peopled, like other newly-formed islands, by the action of winds and currents, and at a period sufficiently remote to have had the original species die out, and the modified prototypes only remain. In the same way we can account for the separate islands having each their peculiar species, either on the supposition that the same original emigration peopled the whole of the islands with the same species from which differently modified prototypes were created, or that the islands were successively peopled from each other, but that new species have been created in each on the plan of the pre-existing ones. St. Helena is a similar case of a very ancient island having obtained an entirely peculiar, though limited, flora. On the other hand, no example is known of an island which can be proved geologically to be of very recent origin (late in the Tertiary, for instance), and yet possesses generic or family groups, or even many species peculiar to itself.

When a range of mountains has attained a great elevation, and has so remained during a long geological period, the species of the two sides at and near their bases will be often very different, representative species of some genera occurring, and even whole genera being peculiar to one side only, as is remarkably seen in the case of the Andes and Rocky Mountains. A similar phænomenon occurs when an island has been separated from a continent at a very early period. The shallow sea between the Peninsula of Malacca, Java, Sumatra and Borneo was probably a continent or large island at an early epoch, and may have become submerged as the volcanic ranges of Java and Sumatra were elevated. The organic results we see in the very considerable number of species of animals common to some or all of these countries, while at the same time a number of closely allied representative species exist peculiar to each, showing that a considerable period has elapsed since their separation. The facts of geographical distribution and of geology may thus mutually explain each other in doubtful cases, should the principles here advocated be clearly established.

In all those cases in which an island has been separated from a continent, or raised by volcanic or coralline action from the sea, or in which a mountain-chain has been elevated, in a recent geological epoch, the phænomena of peculiar groups or even of single representative species will not exist. Our own island is an example of this, its separation from the continent being geologically very recent, and we have consequently scarcely a species which is peculiar to it; while the Alpine range, one of the most recent mountain elevations, separates faunas and floras which scarcely differ more than may be due to climate and latitude alone.

The series of facts alluded to in Proposition 3, of closely allied species in rich groups being found geographically near each other, is most striking and important. Mr. Lovell Reeve has well exemplified it in his able and interesting paper on the Distribution of the *Bulimi*. It is also seen in the Humming-birds and Toucans, little groups of two or three closely allied species being often found in the same or closely adjoining districts, as we have had the good fortune of personally verifying. Fishes give evidence of a similar kind: each great river has its peculiar genera, and in more extensive genera its groups of closely allied species. But it is the same throughout Nature; every class and order of animals will contribute similar facts. Hitherto no attempt has been made to explain these singular phænomena, or to show how they have arisen. Why are the genera of Palms and of Orchids in almost every case confined to one hemisphere? Why are the closely allied species of brown-backed Trogons all found in the East, and the green-backed in the West? Why are the Macaws and the Cockatoos similarly restricted? Insects furnish a countless number of analogous examples;—the *Goliathi* of Africa, the *Ornithopteræ* of the Indian islands, the *Heliconidæ* of South America, the *Danaidæ* of the East, and in all, the most closely allied species found in geographical proximity. The question forces itself upon every thinking mind,—why are these things so? They could not be as they are, had no law regulated their creation and dispersion. The law here enunciated not merely explains, but necessitates the facts we see to exist, while the vast and long-continued geological changes of the earth readily account for the exceptions and apparent discrepancies that here and there occur. The writer's object in putting forward his views in the present imperfect manner is to submit them to the test of other minds, and to be made aware of all the facts supposed to be inconsistent with them. As his hypothesis is one which claims acceptance solely as explaining and connecting facts which exist in nature, he expects facts alone to be brought to disprove it; not *à-priori* arguments against its probability.

The phænomena of geological distribution are exactly analogous to those of geography. Closely allied species are found associated in the same beds, and the change from species to species appears to have been as gradual in time as in space. Geology, however, furnishes us with positive proof of the extinction and production of species, though it does not inform us how either has taken place. The extinction of species, however, offers but little difficulty, and the *modus operandi* has been well illustrated by Sir C. Lyell in his admirable 'Principles.' Geological changes, however gradual, must occasionally have modified external conditions to such an extent as to have rendered the existence of certain species impossible. The extinction would in most cases be effected by a gradual dying-out, but in some instances there might have been a sudden destruction of a species of limited range. To discover how the extinct species have from time to time been replaced by new ones down to the very latest geological period, is the most difficult, and at the same time the most interesting problem in the natural history of the earth. The present inquiry, which seeks to eliminate from known facts a law which has determined, to a certain degree, what species could and did appear at a given epoch, may, it is hoped, be considered as one step in the right direction towards a complete solution of it.

Much discussion has of late years taken place on the question, whether the succession of life upon the globe has been from a lower to a higher degree of organization? The admitted facts seem to show that there has been a general, but not a detailed progression. Mollusca and Radiata existed before Vertebrata, and the progression from Fishes to Reptiles and Mammalia, and also from the lower mammals to the higher, is indisputable. On the other hand, it is said that the Mollusca and Radiata of the very earliest periods were more highly organized than the great mass of those now existing, and that the very first fishes that have been discovered are by no means the lowest organized of the class. Now it is believed the present hypothesis will harmonize with all these facts, and in a great measure serve to explain them; for though it may appear to some readers essentially a theory of progression, it is in reality only one of gradual change. It is, however, by no means difficult to show that a real progression in the scale of organization is perfectly consistent with all the appearances, and even with apparent retrogression, should such occur.

Returning to the analogy of a branching tree, as the best mode of representing the natural arrangement of species and their successive creation, let us suppose that at an early geological epoch any group (say a class of the Mollusca) has attained to a great richness of species and a high organization. Now let this great branch of allied species, by geological mutations, be completely or partially destroyed. Subsequently a new branch springs from the same trunk, that is to say, new species are successively created, having for their antitypes the same lower organized species which had served as the antitypes for the former group, but which have survived the modified conditions which destroyed it. This new group being subject to these altered conditions, has modifications of structure and organization given to it, and becomes the representative group of the former one in another geological formation. It may, however, happen, that though later in time, the new series of species may never attain to so high a degree of organization as those preceding it, but in its turn become extinct, and give place to yet another modification from the same root, which may be of higher or lower organization, more or less numerous in species, and more or less varied in form and structure than either of those which preceded it. Again, each of these groups may not have become totally extinct, but may have left a few species, the modified prototypes of which have existed in each succeeding period, a faint memorial of their former grandeur and luxuriance. Thus every case of apparent retrogression may be in reality a progress, though an interrupted one: when some monarch of the forest loses a limb, it may be replaced by a feeble and sickly substitute. The foregoing remarks appear to apply to the case of the Mollusca, which, at a very early period, had reached a high organization and agreat development of forms and species in the Testaceous Cephalopoda. In each succeeding age modified species and genera replaced the former ones which had become extinct, and as we approach the present æra but few and small representatives of the group remain, while the Gasteropods and Bivalves have acquired an immense preponderance. In the long series of changes the earth has undergone, the process of peopling it with organic beings has been continually going on, and whenever any of the higher groups have become nearly or quite extinct, the lower forms which have better resisted the modified physical conditions have served as the antitypes on which to found the new races. In this manner alone, it is believed, can the representative groups at successive periods, and the risings and fallings in the scale of organization, be in every case explained.

The hypothesis of polarity, recently put forward by Professor Edward Forbes* to account for the abundance of generic forms at a very early period and at present, while in the intermediate epochs there is a gradual diminution and impoverishment, till the minimum occurred at the confines of the Palæozoic and Secondary epochs, appears to us quite unnecessary, as the facts may be readily accounted for on the principles already laid down. Between the Palæozoic and Neozoic periods of Professor Forbes, there is scarcely a species in common, and the greater part of the genera and families also disappear to be replaced by new ones. It is almost universally admitted that such a change in the organic world must have occupied a vast period of time. Of this interval we have no record; probably because the whole area of the early formations now exposed to our researches was elevated at the end of the Palæozoic period, and remained so through the interval required for the organic changes which resulted in the fauna and flora of the Secondary period. The records of this interval are buried beneath the ocean which covers three-fourths of the globe. Now it appears highly probable that a long period of quiescence or stability in the physical conditions of a district would be most favourable to the existence of organic life in the greatest abundance, both as regards individuals and also as to variety of species and generic groups, just as we now find that the places best adapted to the rapid growth and increase of individuals also contain the greatest profusion of species and the greatest variety of forms,—the tropics in comparison with the temperate and arctic regions. On the other hand, it seems no less probable that a change in the

* Since the above was written, the author has heard with sincere regret of the death of this eminent naturalist, from whom so much important work was expected. His remarks on the present paper,—a subject on which no man was more competent to decide,—were looked for with the greatest interest. Who shall supply his place?

physical conditions of a district, even small in amount if rapid, or even gradual if to a great amount, would be highly unfavourable to the existence of individuals, might cause the extinction of many species, and would probably be equally unfavourable to the creation of new ones. In this too we may find an analogy with the present state of our earth, for it has been shown to be the violent extremes and rapid changes of physical conditions, rather than the actual mean state in the temperate and frigid zones, which renders them less prolific than the tropical regions, as exemplified by the great distance beyond the tropics to which tropical forms penetrate when the climate is equable, and also by the richness in species and forms of tropical mountain regions which principally differ from the temperate zone in the uniformity of their climate. However this may be, it seems a fair assumption that during a period of geological repose the new species which we know to have been created would have appeared, that the creations would then exceed in number the extinctions, and therefore the number of species would increase. In a period of geological activity, on the other hand, it seems probable that the extinctions might exceed the creations, and the number of species consequently diminish. That such effects did take place in connexion with the causes to which we have imputed them, is shown in the case of the Coal formation, the faults and contortions of which show a period of great activity and violent convulsions, and it is in the formation immediately succeeding this that the poverty of forms of life is most apparent. We have then only to suppose a long period of somewhat similar action during the vast unknown interval at the termination of the Palæozoic period, and then a decreasing violence or rapidity through the Secondary period, to allow for the gradual repopulation of the earth with varied forms, and the whole of the facts are explained. We thus have a clue to the increase of the forms of life during certain periods, and their decrease during others, without recourse to any causes but those we know to have existed, and to effects fairly deducible from them. The precise manner in which the geological changes of the early formations were effected is so extremely obscure, that when we can explain important facts by a retardation at one time and an acceleration at another of a process which we know from its nature and from observation to have been unequal,—a cause so simple may surely be preferred to one so obscure and hypothetical as polarity.

I would also venture to suggest some reasons against the very nature of the theory of Professor Forbes. Our knowledge of the organic world during any geological epoch is necessarily very imperfect. Looking at the vast numbers of species and groups that have been discovered by geologists, this may be doubted; but we should compare their numbers not merely with those that now exist upon the earth, but with a far larger amount*. We have no reason for believing that the number of species on the earth at any former period was much less than at present; at all events the aquatic portion, with which geologists have most acquaintance, was probably often as great or greater. Now we know that there have been many complete changes of species; new sets of organisms have many times been introduced in place of old ones which have become extinct, so that the total amount which have existed on the earth from the earliest geological period must have borne about the same proportion to those now living, as the whole human race who have lived and died upon the earth, to the population at the present time. Again, at each epoch, the whole earth was no doubt, as now, more or less the theatre of life, and as the successive generations of each species died, their exuviæ and preservable parts would be deposited over every portion of the then existing seas and oceans, which we have reason for supposing to have been more, rather than less, extensive than at present. In order then to understand our possible knowledge of the early world and its inhabitants, we must compare, not the area of the whole field of our geological researches with the earth's surface, but the area of the examined portion of each formation separately with the whole earth. For example, during the Silurian period all the earth was Silurian, and animals were living and dying, and depositing their remains more or less over the whole area of the globe, and they were probably (the species at least) nearly as varied in different latitudes and longitudes as at present. What proportion do the Silurian districts bear to the whole surface of the globe, land and sea (for far more extensive Silurian districts probably exist beneath the ocean than above it), and what portion of the known Silurian districts has been actually examined for fossils? Would the area of rock actually laid open to the eye be the thousandth or the ten-thousandth part of the earth's surface? Ask the same question with regard to the Oolite or the Chalk, or even to particular beds of these when they differ considerably in their fossils, and you may then get some notion of how small a portion of the whole we know.

But yet more important is the probability, nay, almost the certainty, that whole formations containing the records of vast geological periods are entirely buried beneath the ocean, and for ever beyond our reach. Most of the gaps in the geological series may thus be filled up, and vast numbers of unknown and unimaginable animals, which might help to elucidate the affinities of the numerous isolated groups which are a perpetual puzzle to

[* See on this subject a paper by Professor Agassiz in the 'Annals' for November 1854.—Ed.]

the zoologist, may there be buried, till future revolutions may raise them in their turn above the waters, to afford materials for the study of whatever race of intelligent beings may then have succeeded us. These considerations must lead us to the conclusion, that our knowledge of the whole series of the former inhabitants of the earth is necessarily most imperfect and fragmentary,—as much so as our knowledge of the present organic world would be, were we forced to make our collections and observations only in spots equally limited in area and in number with those actually laid open for the collection of fossils. Now, the hypothesis of Professor Forbes is essentially one that assumes to a great extent the *completeness* of our knowledge of the *whole series* of organic beings which have existed on the earth. This appears to be a fatal objection to it, independently of all other considerations. It may be said that the same objections exist against every theory on such a subject, but this is not necessarily the case. The hypothesis put forward in this paper depends in no degree upon the completeness of our knowledge of the former condition of the organic world, but takes what facts we have as fragments of a vast whole, and deduces from them something of the nature and proportions of that whole which we can never know in detail. It is founded upon isolated groups of facts, recognizes their isolation, and endeavours to deduce from them the nature of the intervening portions.

Another important series of facts, quite in accordance with, and even necessary deductions from, the law now developed, are those of *rudimentary organs*. That these really do exist, and in most cases have no special function in the animal œconomy, is admitted by the first authorities in comparative anatomy. The minute limbs hidden beneath the skin in many of the snake-like lizards, the anal hooks of the boa constrictor, the complete series of jointed finger-bones in the paddle of the Manatus and whale, are a few of the most familiar instances. In botany a similar class of facts has been long recognized. Abortive stamens, rudimentary floral envelopes and undeveloped carpels, are of the most frequent occurrence. To every thoughtful naturalist the question must arise, What are these for? What have they to do with the great laws of creation? Do they not teach us something of the system of Nature? If each species has been created independently, and without any necessary relations with pre-existing species, what do these rudiments, these apparent imperfections mean? There must be a cause for them; they must be the necessary results of some great natural law. Now, if, as it has been endeavoured to be shown, the great law which has regulated the peopling of the earth with animal and vegetable life is, that every change shall be gradual; that no new creature shall be formed widely differing from anything before existing; that in this, as in everything else in Nature, there shall be gradation and harmony,—then these rudimentary organs are necessary, and are an essential part of the system of Nature. Ere the higher Vertebrata were formed, for instance, many steps were required, and many organs had to undergo modifications from the rudimental condition in which only they had as yet existed. We still see remaining an antitypal sketch of a wing adapted for flight in the scaly flapper of the penguin, and limbs first concealed beneath the skin, and then weakly protruding from it, were the necessary gradations before others should be formed fully adapted for locomotion. Many more of these modifications should we behold, and more complete series of them, had we a view of all the forms which have ceased to live. The great gaps that exist between fishes, reptiles, birds and mammals would then, no doubt, be softened down by intermediate groups, and the whole organic world would be seen to be an unbroken and harmonious system.

It has now been shown, though most briefly and imperfectly, how the law that "*Every species has come into existence coincident both in time and space with a pre-existing closely allied species,*" connects together and renders intelligible a vast number of independent and hitherto unexplained facts. The natural system of arrangement of organic beings, their geographical distribution, their geological sequence, the phænomena of representative and substituted groups in all their modifications, and the most singular peculiarities of anatomical structure, are all explained and illustrated by it, in perfect accordance with the vast mass of facts which the researches of modern naturalists have brought together, and, it is believed, not materially opposed to any of them. It also claims a superiority over previous hypotheses, on the ground that it not merely explains, but necessitates what exists. Granted the law, and many of the most important facts in Nature could not have been otherwise, but are almost as necessary deductions from it, as are the elliptic orbits of the planets from the law of gravitation.

Sarawak, Borneo, Feb. 1855.

XIX.—*On some new Species of* Hemipedina *from the Oolites.* By Thomas Wright, M.D., F.R.S.E.

Since the publication of our paper in the August Number of the 'Annals and Magazine of Natural History,' on the new genus *Hemipedina* and the Synopsis of the species included therein, our friend S. P. Woodward, Esq., has kindly sent us three new English forms of this group, one found in the calcareous grit of Berkshire, and two in the Kimmeridge clay of Bucks; our friend Thomas Davidson, Esq., has likewise communicated a figure of one found by M. Bouchard Chantereaux some years ago in the Kimmeridge clay of Boulogne-sur-Mer; we lose no time therefore in recording these additions to the Oolitic fauna, at the same time returning our hearty thanks to the kind friends who have so liberally communicated the specimens.

A. *Species from the Calcareous Grit.*

Hemipedina Marchamensis, Wright, nov. sp.

Test large, and depressed; ambulacral areas narrow, with two rows of marginal tubercles, nearly as large as those of the interambulacra, extending regularly and without interruption from the peristome to the apical disc, and separated by a zigzag line of small granules down the centre, the areas retaining a nearly uniform width throughout; poriferous zones form a slightly waved line, from every three pairs of pores being set slightly oblique to the line of the zones; interambulacral areas four times the width of the ambulacral, with eight rows of tubercles at the equator, each tubercular plate supporting four nearly equal-sized tubercles abreast; bosses prominent; areolas surrounded with incomplete circlets of small granules; mouth-opening less than one-third the diameter of the test; peristome unequally decagonal; five jaws, *in situ*, each jaw having two broad flat central ridges, and two oblique marginal ridges with two intervening depressions; teeth long, and obliquely truncated at the points.

Dimensions.—Transverse diameter $2\frac{9}{10}$ inches; height $1\frac{3}{10}$ inch?

Locality.—The calcareous grit of Marcham, Berks.

Coll. The Hon. R. Marsham.

B. *Species from the Kimmeridge Clay.*

Hemipedina Morrisii, Wright, nov. sp.

Form and size unknown; test small; ambulacral areas with two rows of regular prominent marginal tubercles gradually diminishing in size from the base to the apex of the areas, and separated by a zigzag line of small granules down the centre; poriferous zones slightly waved; pores large, the pairs separated by thin septa; interambulacral areas more than three times the width of the ambulacral, with six rows of tubercles at the equator, each plate supporting three nearly equal-sized tubercles abreast; bosses prominent; areolas surrounded by incomplete circlets of small granules.

Spines referred to this species long, round, slender, and sculptured with delicate longitudinal lines; articulating cavity small, with a smooth rim; head thick, with a thin prominent finely milled ring; body long, much more slender than the head.

Locality.—Kimmeridge clay, Hartwell, Bucks.

Coll. Professor Morris.

Hemipedina Cunningtonii, Wright, nov. sp.

Form unknown, upwards of an inch in diameter; ambulacral areas with two marginal rows of very small tubercles rather irregular in their mode of arrangement; poriferous zones nearly straight; interambulacral areas three times the width of the ambulacral, with two rows of tubercles situated on the zonal half of the tubercular plates, leaving thereby a wide intertubercular space which is filled with 8 to 10 rows of small granules; the bosses large and prominent, and the tubercles of a proportionate size; areolas surrounded by a complete circlet of small granules the same size as those filling the middle of the areas.

Locality.—Kimmeridge clay near Aylesbury. Collected by Professor Morris.

Coll. British Museum.

Foreign Species from the Kimmeridge Clay.

Hemipedina Bouchardii, Wright, nov. sp.

Test large, depressed; ambulacral areas with two rows of regular marginal tubercles extending without interruption from the peristome to the apical disc, and separated by a median zigzag line of small granules; poriferous zones straight; interambulacral areas three times the width of the ambulacral, with ten rows of tubercles at the equator, each tubercular plate having five tubercles abreast; areolas surrounded by circlets of small granules; spines slender, sculptured with longitudinal lines.

Dimensions.—Transverse diameter $2\frac{1}{10}$ inches?

Locality.—Kimmeridge clay, Boulogne-sur-Mer. Collected by M. Bouchard Chantereaux.

Coll. M. Bouchard Chantereaux at Boulogne.

In the present state of our knowledge it would be premature to suggest subdivisions, but it is clear that we have two distinct types in the genus *Hemipedina*: 1st, those with two rows of large tubercles, and a wide intertubercular granulated space in the middle of the interambulacral areas; and 2nd, those with four, six, eight or ten rows of nearly equal-sized tubercles in these areas at the equator.

XX.—*Short Biographical Notice of the late* Dr. Johnston *of Berwick-upon-Tweed.*

Not a twelvemonth has elapsed since our scientific public had to mourn the premature death of one of the most distinguished and amiable of its members. Cut off at an age when most men are but beginning to distinguish themselves, at a period of his life when he might have been expected to have even exceeded his previous admirable performances, and at the moment of his attaining a position in which his talents and kindliness of disposition might have exerted a most beneficial influence upon the rising generation of naturalists, the death of Edward Forbes produced a unanimous feeling of heart-felt regret amongst all who had received profit from his works, or enjoyed the pleasure of his personal acquaintance.

Scarcely nine months after the remains of Professor Forbes were carried to the tomb, we have again to lament the loss of another of the most distinguished naturalists of our country, Dr. George Johnston of Berwick-upon-Tweed; and although the light of this eminent man has not been extinguished at its noon, like that of the late Professor of Natural History at Edinburgh, he was still so far from the traditionally allotted period of human existence, and his most recent writings showed that the freshness and originality of his mind were so far from being impaired, that none could have anticipated that he was so soon to be taken from amongst us.

But it is not only as an eminent naturalist that Dr. Johnston has a claim upon the regard of the readers of the 'Annals,'—he possesses another title to their attention: from the first establishment of this Journal he was one of its conductors, and to the last moment of his existence he took an active interest in its progress. On this account, therefore, as well as from the interest which must necessarily attach to the history of a man of such great and varied attainments, we cannot allow his death to pass without consecrating a few pages to his memory, by recording the leading events of his quiet but eminently useful life.

Dr. Johnston was born at Simprin in Berwickshire on the 20th of July 1797. His father was a farmer, and was descended from a family, many members of which were well known on the borders as eminent agriculturists. Whilst he was still a child his father removed to Ilderton, near Wooler, in Northumberland, and here his earliest years were spent. His father died early, and Mrs. Johnston carried on the business successfully after his decease.

George Johnston, the subject of the present notice, was sent to school first in Kelso, and afterwards to the Grammar School of Berwick, where he was under the tuition of Mr. Gardiner, a teacher of some celebrity, who died at a very advanced age only a few months before his gifted pupil. From Berwick he went to the High School at Edinburgh, and in the year 1812 or 1813 commenced his medical studies in that city as a pupil of the celebrated Dr. Abercrombie. During his stay in Edinburgh he lived with Dr. Macrie, the distinguished historian and biographer of John Knox, who was a distant relation of his.

At the conclusion of his apprenticeship he became a member of the College of Surgeons, and afterwards visited London for the sake of hospital practice. Here he also studied under the celebrated anatomist Mr. Brooks. On his return to the North he commenced practice at Belford, a small town in Northumberland, where he met with the amiable and accomplished lady whom he afterwards married, and to whose ready pencil so many of his subsequent works are indebted for most of their illustrations.

In the year 1819 Dr. Johnston took his degree as Doctor of Medicine, and soon afterwards became a Fellow of the College of Surgeons of Edinburgh. He then removed to Berwick, where he established himself as a physician and speedily became one of the leading medical men in that town. Here he remained, devoting himself with unremitting application to the duties of his profession, until his death, which took place on the 30th of July last, at the age of 58.

The immediate cause of Dr. Johnston's death was paralysis, but he appears to have been indisposed for a considerable time. About two years ago, when visiting some patients in the country, he was exposed to a heavy shower of rain, which caused a severe cold, followed by general debility, from which he never entirely recovered. Some weeks since, he was advised to seek repose and relaxation from the anxious duties of his profession at the well-known Bridge of Allan, and it was here, about a fortnight before his death, that he experienced the attack under which he finally succumbed. He was removed to his residence in Berwick, where he shortly afterwards fell into a state of unconsciousness, which lasted with but few and brief intervals until, on the morning of the 30th July, he calmly passed from the scene of his labours.

Upon Dr. Johnston's scientific merits we need scarcely dwell at any great length. His published works, which must be well known to our readers, are all of the highest excellence, and some of them, although limited to British natural history, have been hailed as standard works upon the subjects of which they treat, even in distant countries.

Dr. Johnston was, however, essentially a British naturalist. Inspired by an ardent love for the beautiful district in which he was born and in which his boyish days were passed, he early devoted his attention to the investigation of the natural objects which this presented to him in profusion; and it is probably to this concentration of his energies upon one particular object, that he has been enabled, in the midst of the arduous and engrossing duties of a large medical practice, to do so much good service to science, and to raise an enduring monument to his own talents and perseverance.

His researches were by no means confined to a single branch of natural history, but Botany and the study of the marine Invertebrate animals occupied the greater part of his attention. One of his first works is a Flora of Berwick-upon-Tweed, published in 1829 and 1831, and about the same time he commenced a series of articles called "Illustrations in British Zoology" in 'Loudon's Magazine of Natural History.' In the same periodical he also published a Natural History of the Mollusca in an epistolary form, which was the foundation of the admirable 'Introduction to Conchology,' published many years after, in 1850. The 'History of British Zoophytes,' which has passed through two editions, and the 'History of British Sponges,' are further contributions to the zoology of this country, whilst his last published work, the 'Botany of the Eastern Borders,' is undoubtedly the most charming botanical work in our language. At the time of his death Dr. Johnston had just completed a Catalogue of the British non-parasitical Worms for the British Museum, which will shortly be published by the Trustees of that establishment.

In the accuracy of his observations and the clearness with which he describes them, he is probably without a rival amongst British zoologists since the days of Montagu; whilst, by a happy geniality of mind, he was enabled to invest subjects, apparently the driest in the world, with a peculiar charm, which renders many of his scientific works and papers interesting even to the general reader. The kindliness of disposition which is almost a necessary concomitant of this tone of mind, rendered him universally beloved in the scene of his professional labours; and, to use the words of a writer in the 'Berwick Advertiser,' "He never visited a house for the first time in his medical capacity which he did not leave as a friend." This general popularity was employed by him for the advancement of his favourite science, and he was the founder and first President of the Berwickshire Naturalists' Club, an association which has already given to the world some valuable papers upon the natural history of that district, and which has served as the model upon which similar societies have been established in other parts of the country, from the united labours of which we may expect great advantage to the progress of British zoology. In fact, both from his published works and the manner in which his personal influence was employed, we cannot but regard Dr. Johnston as one of those to whom natural history will be most indebted for its advancement in this country. He took great interest in the establishment and progress of the Mechanics' Institute in his town, and delivered many highly successful lectures there, not only on different branches of natural history, but also on the local traditions and antiquities of the Eastern Border, which had occupied a considerable share of his attention.

Another circumstance, which doubtless contributed greatly to his popularity amongst his neighbours, was the active part which he most unexpectedly took in public business during the stormy period of agitation in favour of Municipal and Parliamentary Reform, which intervened between the years 1830 and 1835. Well known as the accomplished physician and the studious philosopher, he appears rather to have astonished the good people of Berwick by a display of judgment and practical ability for which they probably had not given him credit. He speedily, however, took a prominent place in the politics of his native district, and was elected one of the members of the first Town Council in 1835. In this position he remained until the year 1850, and in the course of that period was three times elected to the office of Mayor, and twice to that of Sheriff. He was also for ten years an Alderman of Berwick. In public life he exhibited the same love of truth and kindliness of disposition which characterized him in private, and as a man of science; his judgment appears to have been greatly relied on by his colleagues, whilst his tact and good-nature enabled him to command constant respect and affection.

The best proof of this is to be found in the universal regret of his fellow-townsmen at the decease of one whom they justly regarded as "the most distinguished ornament of their town." The Mayor and Members of the Corporation, the Town Council and the members of the medical profession all followed his remains to the grave; the shops were closed during the ceremony of interment, and a great crowd of the townspeople assembled to witness the performance of the last rites over the body of one who had for many years been the object of their love and respect.

BIBLIOGRAPHICAL NOTICES.

The British Flora, comprising the Phænogamous or Flowering Plants and the Ferns. The 7th edition, with Additions and Corrections, &c. By Sir William Jackson Hooker, K.H., D.C.L. &c. &c., and George A. Walker Arnott, LL.D. &c. &c. Longman and Co. 1855. Pp. 618.

Having reviewed at considerable length the sixth edition of the 'British Flora,' we do not think it necessary to say much about the seventh. The plan of the work is unchanged, as are also for the most part the principles and opinions of its authors; nor have the last five years been by any means fruitful of discoveries in British botany. The remarks on species have frequently been abbreviated; many doubts have been more cautiously worded, and the imaginary grounds for them judiciously suppressed. Nearly every page still reminds us that we have to do with men more conversant with books and herbaria than with living uncultivated nature, who prefer tradition to observation, have a morbid horror of whatever is difficult to discover or to describe, and look down with something very like contempt on the habitual study of the vegetation of our own islands. But we are glad to recognize likewise sundry indications of an increasing disposition to do justice to the present race of botanists: and occasionally, as before, the Authors' extensive knowledge has enabled them to throw light on difficult questions, especially of synonymy. It is a pity that they have not examined more carefully the records of English periodical and other works. This remark applies particularly to the distribution of plants. They give so many localities that the omission of others in different districts destroys the value of their information as far as botanical geography is concerned. Mr. H. C. Watson's 'Cybele Britannica' alone (mentioned, by the way, in the Introduction) would have supplied many untoward omissions. We may mention in particular the case of the Cumberland habitat for *Lychnis alpina*, respecting which the old sceptical observation remains, though Mr. Daniel Oliver (Cyb. Brit. iii. 160) has lately verified its genuineness. Perhaps their rashness in dealing with the foreign distribution of plants as bearing on questions of British nativity may be excused by the comparative neglect with which this interesting subject has been treated: but it is strange that they do not see, as we formerly pointed out (vi. 383), that their argument against the nativity of *Thesium humile* would be equally valid against that of *T. humifusum*; and this is by no means a solitary case. On the subject of hybrids, their extreme anxiety to repudiate new species has led them into a curious inconsistency. In the Introduction (p. x.), Linnæus's maxim that no permanently fertile hybrids can be produced between truly distinct species is adopted, apparently on the authority of his *ipse dixit*; and from this maxim, in conjunction with Dr. Bell Salter's experiments respecting the supposed *Geum intermedium*, the specific identity of *G. rivale* and *G. urbanum* is deduced: whereas we are still told, in a note to the genus *Rubus* (p. 122), that the Authors "are almost quite convinced" that the modern British supposed species (of the fruticose section) are all "mere varieties approaching on the one side to *R. idæus*, on the other to *R. saxatilis*, with both of which *many fertile and permanent hybrids may have been formed, and are still forming.*" Can it be that the next edition will exhibit Raspberries, Blackberries, and Stoneberries (if we may coin a name) as the α, β, and γ of one capricious bush? Surely this is carrying zeal against neomaniacs rather too far. In one case however we cannot refuse assent to the Authors' suspicions of hybridity;—we mean, that of the British *Rumex pratensis*: we have met with it in many places, but always sparingly, and in company with both *R. crispus* and *R. obtusifolius*.

It may be well to subjoin a few remarks on different species. The descriptions of the "varieties" of *Thalictrum minus* are considerably amended; but our Authors have an unhappy knack of omitting the most important characters of species which they wish to combine: thus in this case they do not allude to the direction of the branches of the panicle. A remark about *Ranunculus hederaceus* becoming *R. cœnosus* near Glasgow through an artificial rise of temperature deserves attention; but we suspect the true *R. cœnosus* was not seen there at all,—a solution applicable to many other cases. Of plants formerly combined, *Fumaria parviflora* and *Vaillantii, Linaria repens* and *sepium* (Allm.), *Sparganium natans* and *minimum, Triticum junceum* and *laxum* are separated with greater or less degrees of doubt. *Polygala austriaca*, [*Hypericum anglicum* or *hircinum*], *Achillea tanacetifolia*, [*Cicendia Candollei*], *Salix acutifolia, Epipogon Gmelini, Potamogeton trichoides, Naias flexilis, Gymnogramma leptophylla*, and *Polypodium alpestre* appear for the first time, some of them of course under a similar qualification: by some strange carelessness, *Allium triquetrum* and *Carex brizoides* are altogether omitted. The confusion among the *Violæ* is not yet quite removed: it is satisfactory to learn that our Authors meant by *V. lactea* in the 6th edition *solely* the plant which they now follow Mr. Babington in calling *V. stagnina*; but they are quite mistaken in supposing that what that gentleman calls its 'rhizoma' is altogether caused by the soil, for the narrow-leaved var. *lancifolia* of the allied species grows by its side with stems altered and elongated by the soil and yet quite different. New but unsatisfactory arguments are introduced to defend the misapplication of the name *V. canina*: if by that name Linnæus wholly or chiefly meant Smith's *V. flavicornis*, its English origin has nothing to do with the matter; it would be mere English obstinacy to suppose that our popular vernacular usage is to give the law to continental science. We confess we should not be unwilling to see the name (in its Latin form) dropped altogether. The short synopsis of *Rubi*, exhibiting Dr. Bell Salter's views five years ago, is reprinted verbatim in the body of the work. The account of the *Hieracia* has been revised and enlarged with the aid of notes and specimens from Messrs. Backhouse and Baker, but is still merely provisional: we gladly echo the wish that the former gentleman may speedily publish a full account of his views. The Authors "think there can be no doubt that *Potamogeton flabellatus*, Bab., is what Chamisso and Schlechtendal consider the common form of *P. pectinatus*:" is it impertinent to ask whether they have ever seen Mr. Babington's plant at all? Again, have they any reason to believe that *Carex Davalliana* has been again found near Bath? It seems unquestionable that the former station was destroyed long ago, but it is here spoken of as if still existing. Once more, may we suggest that the remarks on the varieties of *Asplenium filix-fœmina* require correction? there is now an inextricable confusion of the present and the former wording.

We ought not to close this notice without again bearing witness to the richness of knowledge and courtesy of tone which distinguish the 'British Flora.' It may not be of absolute authority on controverted questions: but, besides acting as a useful check on those whose faults are of an opposite tendency, it supplies a large fund of valuable information not otherwise accessible.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 26, 1855.—Sir Benjamin Brodie, Bart., V.P., in the Chair.

"Some Observations on the Ova of the Salmon, in relation to the distribution of Species; in a letter addressed to Charles Darwin, Esq., M.A., V.P.R.S. &c." By John Davy, M.D., F.R.SS. Lond. & Edinb.

In this paper the author describes a series of experiments on the ova of the Salmon, made with the intent of ascertaining their power of endurance under a variety of circumstances without loss of life, with the expectation suggested by Mr. Darwin, that the results might possibly throw some light on the geographical distribution of fishes.

The details of the experiments are given in five sections. The results obtained were the following:—

1. That the ova of the Salmon in their advanced stage can be exposed only for a short time to the air if dry, at ordinary temperatures, without loss of life; but for a considerable time, if the temperature be low, and if the air be moist; the limit in the former case not having exceeded an hour, whilst in the latter it has exceeded many hours.

2. That the vitality of the ova was as well preserved in air saturated with moisture, as it would have been had they been in water.

3. That the ova may be included in ice without loss of vitality, provided the temperature is not so low as to freeze them.

4. That the ova, and also the fry recently produced, can bear for some time a temperature of about 80° or 82° in water, without materially suffering; but not without loss of life, if raised above 84° or 85°.

5. That the ova and young fry are speedily killed by a solution

of common salt nearly of the specific gravity of sea-water, viz. 1026; and also by a weaker solution of specific gravity 1016.

Finally, in reference to the inquiry regarding the distribution of the species of fishes, he expresses his belief that some of the results may be of useful application, especially those given in the second and third sections; inferring, that as in moist air, the vitality of the ova is capable of being long sustained, they may during rain or fog be conveyed from one river or lake to another adhering to some part of an animal, such as a Heron or Otter, and also during a time of snow or frost; and, further, that other of the results may be useful towards determining the fittest age of ova for transport for the purpose of stocking rivers, and likewise as a help to explain the habitats, and some of the habits of the migratory species.

"Brief sketch of the Anatomy of a new genus of pelagic Gasteropoda, named *Jasonilla*." By John Denis Macdonald, Esq., R.N.

This communication refers to a remarkable genus of pelagic Gasteropoda, characterized, like *Macgillivraya* and *Cheletropis*, by the presence of ciliated cephalic appendages, but having, as in the present instance, a beautifully transparent, cartilaginous and perfectly symmetrical shell. The author has seen but one species, which was frequently taken between Port Jackson and the Isle of Pines.

The shell resembles that of *Argonauta* in shape, is less than one-eighth of an inch in diameter, and the little animal, when fully retracted, occupies but a small portion of its cavity. The margin of the mantle is of considerable thickness, containing loosely-packed cells, similar to those of the middle or operculigerous lobe of many Pteropods. About eight ciliated arms, identical in character with those of *Macgillivraya*, &c., encircle the head, including the mouth, which is furnished with two massive lateral jaws bearing sharp prominent dental processes on the anterior border, and with a pair of simple tentacula having a dark ocellus at the outer side of the base of each. A well-formed foot arises by a narrow pedicle from the under surface of the body, immediately behind the ciliated collar. The creeping disc is elongated in form, subquadrate in front, and tapers off gradually towards the posterior extremity. The latter part, corresponding to the operculigerous lobe of other species, is speckled with little clusters of dark pigment-cells, disposed so much after the manner of those of the ciliated arms as to lead to the impression that it is one of the same series, or whorl of organs, to use botanical phraseology. A pectinate gill extends beneath the mantle, along the anterior third of the dorsal region, lying, as in most cases, in advance of the heart. The visceral mass of the body, though elongated, is but slightly curved upon itself, not exceeding half a turn. The lobules of the liver, distended with large amber-coloured oil-globules, may be distinctly seen through the transparent outer envelope and shell. Single spherical otolithes are contained in the acoustic sacs, and the lingual ribbon is lengthy and flexuous, presenting a row of uncini on each side, with a series of minute denticulations, pointing backwards on their anterior and posterior borders. The uncini of opposite sides interlock with one another so closely as to conceal the rudimentary segments of the rachis almost completely. The shell is cartilaginous, transparent, planorbicular, and perfectly symmetrical, presenting four rows of minute conical tuberculations on its convex or dorsal surface. The gyri of the involute nucleus are so curved as to leave a central perforation; the mouth of the tube encroaches considerably on the last whorl, and the outer lip is deeply notched between the two lateral rows of tubercles. The author has named the species *Jasonilla M^cLeayiana*. The paper is accompanied with illustrative figures.

June 14.—The Lord Wrottesley, President, in the Chair.

"Researches on the Foraminifera.—Part I. General Introduction, and Monograph of the Genus *Orbitolites*." By William B. Carpenter, M.D., F.R.S., F.G.S. &c.

The group of *Foraminifera* being one as to the structure and physiology of which our knowledge is confessedly very imperfect, and for the natural classification of which there is consequently no safe basis, the author has undertaken a careful study of some of its chief typical forms, in order to elucidate (so far as may be possible) their history as living beings, and to determine the value of the characters which they present to the systematist. In the present memoir, he details the structure of one of the lowest of these types, *Orbitolites*, with great minuteness; his object having been, not merely to present the *results* of his investigations, but also to exhibit the *method* by which they have been attained; that method essentially consisting in the minute examination and comparison of a *large number* of specimens.

The *Orbitolite* has been chiefly known, until recently, through the abundance of its *fossil* remains in the Eocene beds of the Paris basin; but the author, having been fortunate enough to obtain an extensive series of *recent* specimens, chiefly from the coast of Australia, has applied himself rather to these as his sources of information; especially as the *animals* of some of them have been sufficiently well preserved by immersion in spirits, to permit their characters to be well made out.

As might have been anticipated from our knowledge of their congeners, these animals belong to the *Rhizopodous* type; the soft body consisting of *sarcode*, without digestive cavity or organs of any kind; and being made up of a number of segments, equal and similar to each other, which are arranged in concentric zones round a central nucleus. This body is invested by a calcareous shell, in the substance of which no minute structure can be discerned, but which has the form of a circular disk, marked on the surface by concentric zones of closed cells, and having minute pores at the margin. Starting from the central nucleus,—which consists of a pear-shaped mass of sarcode, nearly surrounded by a larger mass connected with it by a peduncle,—the development of the Orbitolite may take place either upon a *simple*, or upon a *complex* type. In the former (which is indicated by the *circular* or *oval* form of the cells which show themselves at the surfaces of the disk, and by the *singleness* of the row of marginal pores), each zone consists of but a single layer of segments, connected together by a single annular stolon of sarcode; and the nucleus is connected with the first zone, and each zone with that which surrounds it, by radiating peduncles proceeding from this annulus, which, when issuing from the peripheral zone, will pass outwards through the marginal pores, probably in the form of *pseudopodia*. In the *complex* type, on the other hand (which is indicated by the *narrow* and *straight-sided* form of the superficial cells, and by the *multiplication* of the horizontal rows of marginal pores), the segments of the concentric zones are elongated into vertical columns with imperfect constrictions at intervals; instead of a single annular stolon, there are two, one at either end of these columns, between which, moreover, there are usually other lateral communications; whilst the radiating peduncles, which connect one zone with another, are also multiplied, so as to lie in several planes. Moreover, between each annular stolon and the neighbouring surface of the disk, there is a layer of superficial segments, distinct from the vertical columns, but connected with the annular stolons; these occupy the narrow elongated cells just mentioned, which constitute two *superficial* layers in the disks of this type, between which is the *intermediate* layer occupied by the columnar segments.

These two types seem to be so completely dissimilar, that they could scarcely have been supposed to belong to the same species; but the examination of a large number of specimens shows, that although one is often developed to a considerable size upon the simple type, whilst another commences even from the centre upon the complex type, yet that many individuals which begin life, and form an indefinite number of annuli, upon the simple type, then take on the more complex mode of development.

The author then points out what may be gathered from observation and from deduction respecting the *Nutrition* and mode of *Growth* of these creatures. He shows that the former is probably accomplished, as in other Rhizopods, by the entanglement and drawing in of minute vegetable particles, through the instrumentality of the pseudopodia; and that the addition of new zones probably takes place by the extension of the sarcode through the marginal pores, so as to form a complete annulus, thickened at intervals into segments, and narrowed between these into connecting stolons, the shell being probably produced by the calcification of their outer portions. And this view he supports by the results of the examination of a number of specimens, in which *reparation of injuries* has taken place. Regarding the *Reproduction* of Orbitolites, he is only able to suggest that certain minute spherical masses of sarcode, with which some of the cells are filled, may be *gemmules*; and that other bodies, enclosed in firm envelopes, which he has more rarely met with, but which seem to break their way out of the superficial cells, may be *ova*. But on this part of the inquiry, nothing save observation of the animals in their living state can give satisfactory results.

The regular type of structure just described is subject to numerous *variations*, into a minute description of which the author next enters; the general results being, that neither the shape nor dimensions of the entire disk, the size of the nucleus or of the cells forming the concentric zones, the surface-markings indicating the shape of the superficial cells, nor the early mode of growth (which, though typically *cyclical*, sometimes approximates to a *spiral*), can serve as distinctive characters of *species*; since, whilst they are all found to present most remarkable differences, these differences, being strictly gradational, can only be considered as distinguishing *individuals*. It thus follows that a very wide *range of variation* exists in this type; so that numerous forms which would be unhesitatingly accounted specifically different, if only *the most divergent examples* were brought into comparison, are found, by the discovery of those *intermediate links* which a large collection can alone supply, to belong to one and the same specific type.

After noticing some curious *monstrosities*, resulting from an unusual outgrowth of the central nucleus, the author proceeds to inquire into the *essential character* of the Orbitolite, and its relations to other types of structure. He places it among the very lowest forms of Foraminifera; and considers that it approximates closely to sponges, some of which have skeletons not very unlike the calcareous net-work which intervenes between its fleshy segments. Of the *species* which the genus has been reputed to include, he states that a large proportion really belong to the genus *Orbitoides*, whilst others are but varieties of the ordinary type. This last is the light in which he would regard the *Orbitolites complanata* of the Paris basin; which differs from the fully-developed Orbitolite of the Australian coast in some very peculiar features (marking a less complete evolution), which are occasionally met with among recent forms, and which are sometimes distinctly transitional towards the perfect type.

The author concludes by calling attention to some general principles, which arise out of the present inquiry, but which are applicable to all departments of Natural History, regarding the *kind* and *extent* of comparison on which alone specific distinctions can be securely based.

June 21.—The Lord Wrottesley, President, in the Chair.

"Notes on British Foraminifera." By J. Gwyn Jeffreys, Esq., F.R.S.

Having, during a great many years, directed my attention to the recent Foraminifera which inhabit our own shores, I venture to offer a few observations on this curious group, as Dr. Carpenter, who has favoured the Society with an interesting and valuable memoir on the subject, seems not to have had many opportunities of studying the animals in the recent state.

Rather more than twenty years ago I communicated to the Linnæan Society a paper on the subject, containing a diagnosis and figures of all the species. This paper was read and ordered to be printed in the Transactions of that Society; but it was withdrawn by me before publication, in consequence of my being dissatisfied with D'Orbigny's theory (which I had erroneously adopted), that the animals belonged to the Cephalopoda; and my subsequent observations were confirmed by the theory of Dujardin. I have since placed all my drawings and specimens at the disposal of Mr. Williamson of Manchester, who has given such a good earnest of what he can do in elucidating the natural history of this group, by his papers on *Lagena* and the Foraminiferous mud of the Levant.

The observations which I have made on many hundred recent and living specimens of various species, fully confirm Dr. Carpenter's view as to the simple and homogeneous nature of the animal. His idea of their reproduction by gemmation is also probably correct; although I cannot agree with him in considering the granules which are occasionally found in the cells as ova. These bodies I have frequently noticed, and especially in the *Lagenæ*; but they appeared to constitute the entire mass, and not merely a part of the animal. I am inclined to think they are only desiccated portions of the animal, separated from each other in consequence of the absence of any muscular or nervous structure. It may also be questionable if the term "ova" is rightly applicable to an animal which has no distinct organs of any kind. Possibly the fry may pass through a metamorphosis, as in the case of the Medusa.

Most of the Foraminifera are free, or only adhere by their pseudopodia to foreign substances. Such are the *Lagena* of Walker, *Nodosaria, Vorticialis* and *Textularia*, and the *Miliola* of Lamarck. The latter has some, although a very limited, power of locomotion; which is effected by exserting its pseudopodia to their full length, attaching itself by them to a piece of seaweed, and then contracting them like india-rubber, so as to draw the shell along with them. Some of the acephalous mollusks do the same by means of their byssus. This mode of progression is, however, exceedingly slow; and I have never seen, in the course of twenty-four hours, a longer journey than a quarter of an inch accomplished by a *Miliola*, so that, in comparison with it, a snail travels at a railroad pace.

Some are fixed or sessile, but not cemented at their base like the testaceous annelids. The only mode of attachment appears to be a thin film of sarcose. The *Lobatula* of Fleming, and the *Rosalia* and *Planorbulina* of D'Orbigny belong to this division.

Dr. Carpenter considers the Foraminifera to be phytophagous, in consequence of his having detected in some specimens, by the aid of the microscope, fragments of *Diatomaceæ* and other simple forms of vegetable life. But as I have dredged them alive at a depth of 108 fathoms (which is far below the Laminarian zone), and they are extremely abundant at from 40 to 70 fathoms, ten miles from land and beyond the range of any seaweed, it may be assumed without much difficulty, that many, if not most of them, are zoophagous, and prey on microscopic animals, perhaps even of a simpler form and structure than themselves. They are in their turn the food of mollusca, and appear to be especially relished by *Dentalium Entale*.

With respect to Dr. Carpenter's idea that they are allied to sponges, I may remark that *Polystomella crispa* (an elegant and not uncommon species) has its periphery set round at each segment with siliceous spicula, like the rowels of a spur. But as there is only one terminal cell, which is connected with all the others in the interior by one or more openings for the pseudopodia, the analogy is not complete, this being a solitary, and the sponge a compound or aggregate animal.

I believe the geographical range or distribution of species in this group to be regulated by the same laws as in the Mollusks and other marine animals. In the gulf of Genoa I have found (as might have been expected) species identical with those of our Hebridean coast, and *vice versâ*.

In common with Dr. Carpenter, I cannot help deploring the excessive multiplication of species in the present day, and I would include in this regret the unnecessary formation of genera. Another Linnæus is sadly wanted to correct this pernicious habit, both at home and abroad.

The group now under consideration exhibits a great tendency to variation of form, some of the combinations (especially in the case of *Marginulina*) being as complicated and various as a Chinese puzzle. It is, I believe, undeniable, that the variability of form is in an inverse ratio to the development of animals in the scale of Nature.

Having examined thousands (I may say myriads) of these elegant organisms, I am induced to suggest the following arrangement:—

1. *Lagena* (Walker) and *Entosolenia* (Williamson).
2. *Nodosaria* and *Marginulina* (D'Orb.), &c.
3. *Vorticialis* (D'Orb.), *Rotalia* (Lam.), *Lobatula* (Flem.), *Globigerina* (D'Orb.), &c.
4. *Textularia* (Defrance), *Uvigerina* (D'Orb.), &c.
5. *Miliola* (Lam.), *Biloculina* (D'Orb.), &c.

This division must, however, be modified by a more extended and cosmopolitan view of the subject, as I only profess to treat of the British species. To illustrate MacLeay's theory of a quinary and circular arrangement, the case may be put thus.

The first family is connected by the typical genus *Lagena* with the second, and by *Entosolina* with the fifth; the second is united with the third through *Marginulina*; the third with the fourth through *Globigerina*; and the fourth with the last through *Uvigerina*.

Whether these singular and little-known animals are Rhizopodes, or belong to the Amœba, remains yet to be satisfactorily made out.

London, June 18, 1855.

LINNÆAN SOCIETY.

January 16, 1855.—Thomas Bell, Esq., President, in the Chair.

Read, an extract from a Letter, addressed by the Rev. William Henry Hawker to the President, dated "Horndean, Hants, Dec. 11, 1854." After referring to his previous discovery of *Asplenium fontanum* in the neighbourhood of his place of residence, Mr. Hawker proceeds as follows:—

"My discoveries of the past year are not altogether without interest. Last year I paid a visit to the English Lakes, and had the good fortune to find *Polystichum Lonchitis* growing near Ulleswater. I brought away one plant and sent a frond to Newman, who, however, does not mention it in his new Edition. This year (in July) I went to the Lakes again and had the pleasure of confirming the above discovery; and, moreover, on my mentioning it to other collectors, a search was instituted, which has resulted in its turning up in several new localities in that district, *e. g.* Helvellyn, Fairfield, &c. This fern has never before, I believe, been found in the Lake country. Whilst there this year I went a few days' botanical ramble with Mr. Clowes of Windermere, and on one of these days, whilst clambering on a terrific precipice, I had the delight to find *Aspl. septentrionale* growing in such quantity, that I took away I suppose between 60 and 70 plants and left more than 100, and here right amongst them I found 2 plants of *Asplenium germanicum*! A guide was with me, who found close by *Woodsia Ilvensis* growing in some quantity. Three good things were they not, to be growing on a spot only a few yards square? It was on an outcrop of iron ore, which seems to me always to be a good 'matrix' (?) for ferns. This took place not many miles from Scaw Fell, though not on it. It was of course plain that the locality had never been before visited by a botanist. Mr. Clowes found *Euphorbia Cyparissias* growing on Whitbarrow Fells in great quantity. I have gathered it on the mountain limestone of Somersetshire near Wells, and I should think it will prove to be a true native; on the continent it is the commonest of weeds, especially where there is limestone. I followed your advice about keeping the *Helix Pomatia* till the spring, when I fed them up and kept them till impregnated, and then turned them out. The dry summer was rather against them, but I dare say they are all right, though I have not searched for them since. I have found another rare shell in the Ashford woods, *Clausilia Rolphii*—I think about its fifth or sixth locality in England.

"Last September and October I took a rapid run on the continent up the Rhine,—Heidelberg, Baden Baden, Basle, Soleure, Bern, Interlaken, the Simmenthal, Vevay, Geneva, over the Jura to Dijon, Fontainebleau, Paris, and home. The season was late; flowers mostly over, and deciduous ferns killed down, so that on the Alps I did not gather *Woodsia alpina* as I wished. I found on the Jura in one spot my favourite *Aspl. fontanum.* In the Pine forests of the Alps and Jura, *Polystichum Lonchitis* grows in the most wonderful luxuriance; I have dried some fronds 22 inches long! Its appearance is quite beautiful; I dried a good deal and brought away some live roots. *Aspl. septentrionale* too abounded on the alpine rocks. I found *Helix obvoluta* at Heidelberg at the foot of the walls of the Castle amongst *grass*, and also at Thun in a wood. *Helix Pomatia* was very common and abundant everywhere."

Read also a Letter addressed to the Secretary by John Hogg, Esq., F.R.S., F.L.S. &c., dated "Stockton-on-Tees, December 27th, 1854," of which the following is an extract:—

"Since my return home, I have had an opportunity of learning more particularly respecting the large fish which was stranded last September in the Tees Bay; and I have now not the least doubt that it was a common Tunny, and that too of a large size. One of the fishermen who had seen the fish, on cutting it said—the flesh looked like highly salted bacon, *i. e.* red with salt or saltpetre. He described it in size as 'being pretty well on to 60 stone,' which at 8 lbs. to the stone (meat weight) would give 480 lbs. The only freshly killed Tunny I ever saw was at Palermo; it was a good-sized fish and was carried on the shoulders of two strong fishermen, the one walking a few feet before the other. Pennant describes in his 'Brit. Zool.' (edit. 1812), vol. iii. p. 362, one which was caught at Inverary in 1769, as weighing 460 lbs. This then would probably be somewhat less than the Tees fish; and this is further shown by the following fact —Pennant says the tail 'measured 2 feet 7 inches between tip and tip' of its crescent-form. I yesterday measured the tail of the Tees fish, which gave 2 ft. $8\frac{1}{4}$ inches from tip to tip, thus having $1\frac{1}{4}$ inch more in the width of the crescent-tail than Pennant's, and consequently most likely it was the larger of the two. The fisherman had well preserved the tail, and it presents a beautiful specimen of a crescent, and very perfect, each half corresponding in a very accurate manner with the other. It is covered with a thick, nearly black skin, and quite smooth. I counted the caudal rays, and at first I made nineteen on one side and eighteen on the other; but on re-counting them I am more satisfied that they are equal, *i. e.* eighteen on each side or in each half. Between them I noticed most distinctly 'a cartilaginous keel between the sides of the tail,' as described by Cuvier in his generic characters of his genus *Thynnus*. Moreover, the fisherman (who is a very sensible man and a good bird-stuffer) on being shown Mr. Yarrell's figure of the Common Tunny, immediately recognized it and pronounced it at once to be the same fish."

Read, in conclusion, an "Extract from a Memoir on the Origin and Development of Vessels in Monocotyledonous and Dicotyledonous Plants." By Dr. Francisco Freire Allemão of Rio de Janeiro.

Dr. Allemão states that in 1849 he commenced a series of microscopical observations on several points of vegetable anatomy, and in particular on the origin and development of vessels in the roots of plants. In 1851 he read before the Vellozian Society of Rio de Janeiro a memoir in which the most important facts observed by him were shortly stated, which memoir he revised and published in 1852, as the third of his "Botanical Exercises," in the 'Trabalhos da Sociedade Velloziana,' p. 101. In the following year he pursued his investigations into the growth of vessels in germinating seeds, and extended them to the next stage in the development both of dicotyledonous and monocotyledonous plants. This inquiry is not yet completed, but Dr. Allemão transmits the extract communicated by Mr. Miers, together with a portion of the illustrative drawings, with the view of ascertaining whether his observations are really, as he believes them to be, new to science, and whether they are sufficiently exact.

The drawings represent first, a young plant of *Sida carpinifolia*, but little developed, showing the epigeal cotyledons still enveloped in their seminal integuments. The caulicle (radicle) is linear and without ramification. Seen under the microscope the nervures of the cotyledons are found to be composed solely of tracheal vessels, two of which constituting the midrib are continuous with those of the caulicle, which are four in number, distinct, entire, straight, parallel, and equidistant, descending more than half the length of the caulicle, the lower portion of which does not yet exhibit any vessels, nor does its radicular bulb show any tendency to form roots. In a somewhat more developed stage, the nervures of the cotyledons have their tracheæ considerably increased; the gemmule is seen under the form of a cellular tumour without vessels; the four tracheæ of the stem descend parallel to each other as far as the radicular bulb, and thus constitute the medullary sheath; no rootlets are yet observable. A further stage of development exhibits the same plant after the formation of rootlets, and the development of one of the leaves of the gemmule. In this stage the cotyledons have acquired a larger number of nervures; the nervures of the primordial leaf consist only of tracheæ, two of which forming the midrib descend by the stem to meet the four cotyledonary tracheæ; in the stem or primary merithal (radicle of authors) these tracheæ are as yet solitary for two-thirds of the upper portion of their length, but in the lower third they are accompanied and invested externally by dotted ducts. At the limit between stem and root where the rootlets are given off, the tracheæ of the stem terminate, and we see the commencement of the dotted or ligneous vessels, which begin to ascend in bundles through the stem outside the tracheæ and to descend, unaccompanied by tracheæ, through the roots and their ramifications.

From his investigations Dr. Allemão infers, first, that the tracheæ, which are the first vessels formed, derive their origin in the stem from the vital point in which the leaves originate, whence they ascend, forming bundles in the leaves, of which they constitute the nervures, and whence they descend through the stem to form the medullary sheath. Secondly, that roots do not exist in the embryo, but are formed in the young plant when, freed from its seminal envelopes, it penetrates the earth. [This is, however, subject to some exceptions in cases where the roots begin to sprout while contained within the seed.] The radicular bulb which is destined to produce them bears some analogy with the gemmule, and may be considered as a primary spongiole, through which the plant absorbs nutriment prior to the production of roots. Thirdly, that the fibrous, ligneous or reticulated vessels are formed posteriorly to the appearance of the tracheæ, their origin being at the vital point from which the roots proceed, whence they ascend in bundles through the stem until they reach the extremity of the nervures of the leaves, being always external to the tracheæ, and whence they descend through the root as far as the extremities of its ramifications, leaving almost always in its centre a kind of canal filled with cellular tissue, which is a true pith, and communicates with the herbaceous envelope by means of medullary rays, but is not enclosed by tracheæ in dicotyledonous plants. Tracheæ are to be found, however, in the roots of nearly all monocotyledonous plants, or if absent, their place is supplied by mixed or scalariform vessels. In this exposition of his views Dr. Allemão has gone beyond what appears on the face of the drawings sent, and has, he is aware, repeated several well-known facts: what he believes to be new in them is the extension of two vascular systems in opposite directions, and their increment at their respective extremities; in other words, the projection upwards and downwards of fibres or vascular bundles. Fourthly, that the radicular branches, as appendicular or radiated organs, are in their origin perpendicular to the fibres of the stem, and not continuous with them, contrary to the theory maintained by Gaudichaud.

The same facts are demonstrated in monocotyledonous plants by microscopical observations on the young rooting bulbs of *Fourcroya gigantea*. A longitudinal section passing through the centre of the bulb shows, on repeated and careful dissection, that the bulbous mass is formed of rather dense cellular tissue filled with a viscous lymph, the cells of which contain much fecula and a large quantity of raphides or solitary prisms. Of the numerous sheathing and concentric leaves, the central one, in its earliest development, is composed only of very fine cellular tissue; the one next in succession outwards is still cellular, but beginning to receive tracheal ramifications, which are the upper extremities of numerous simple tracheæ forming a crown around the vital point which Dr. Allemão regards as the limit between stem and leaves. These tracheæ are very slender, vermicular or fusiform, with a curvature in the middle, the convexities of which look towards the centre; extending upwards they penetrate the leaves in great number running parallel to each other, and passing downwards they cross and become external to the interior bundles taking a flexuose direction. In the succeeding leaves there are no simple tracheæ, but numerous tracheæ form bundles running parallel to each other as far as the extremities of the leaves, and giving off lateral and transverse branches which anastomose in a very beautiful manner. These vascular bundles also descend as far as the base of the bulb. Above they are formed entirely of tracheæ; lower down the tracheæ are accompanied on the outer side by dotted vessels, which extend upwards to penetrate the leaves and downwards to communicate with the root. In the roots the vascular system is composed of a certain number of bundles, parallelly disposed with admirable symmetry, among which are seen dotted and scalariform vessels, but no true tracheæ. A great number of microscopical observations made on various plants under different circumstances have confirmed these views, which Dr. Allemão considers unquestionable.

The paper was accompanied by a series of notes by Mr. Miers, in which, from his knowledge of his antecedent researches, published in the Proceedings of the Vellozian Society, he states it to have been the object of Dr. Allemão to test the validity of the theory first propounded by Du Petit-Thouars, and more recently modified and supported by Gaudichaud, which maintains, contrary to the views of Mirbel and others, that all the woody fibres of the stem proceed from the nascent leaf-buds and thence descend to the radicular extremity of plants. Dr. Allemão believes that his observations in no degree tend to support this theory. He takes as an example the *Cucurbita Pepo*, in which the dotted vessels are extremely large and conspicuous. In this plant no reticulated vessels are found in the last-formed leaves or in the internodes near the termination of the stem, although they exist in the lower and older leaves. He observed spiral vessels only in the stems and leaves as low as the 9th or 10th axil from the extremity of each branchlet; from that point as low as the 14th and 15th axils, other vessels are observed in the stem only; but below this point he found them in the stem, and more especially in the leaves, proving, as he believes, that all reticulated and dotted vessels ascend through the stem before they find their way into the leaves, in the progress of their growth upwards. He thinks that the formation of a circular tumour in the trunk of dicotyledonous plants above the line of a ligature tightly tied around it may be accounted for by reasoning on the facts which he conceives himself to have established, viz. that in the development of the vascular fibres of the stem, there always exists a vital centre from which they extend themselves in two opposite directions. This vital centre may be fixed, moveable, or accidental; fixed in woody fibres, moveable in tracheæ, and accidental in all adventitious formations. If, for instance, we take a cutting of any young branchlet, in which no natural bud is distinguishable, and plant half of it in the ground, several adventitious vital points make their appearance, the lowermost of which give out rootlets, and the uppermost leaf-buds. In this case, vital points or centres make their appearance in the vital zone of the cutting, which would never have existed in the natural condition of the branch. Applying this fact to the case of the ligature, he thinks it evident that the cambium or elaborated sap, or whatever may be the source of the tumour deposited between the wood and the bark, must assuredly proceed from the leaves towards the root, and meeting with this obstacle, becomes accumulated there; its tendency to organize itself not being distributed, a zone of adventitious or occasional vital centres soon appears in that point, whose two forces are quickly manifested; the ascending fibres continue to extend themselves without impediment, while those which should have descended, unable to overcome the impediment presented to their further progress, continue to grow, twisting and interlacing themselves, so as to form a tumour.

Mr. Miers then refers to the differences which Dr. Allemão believes to exist between his theory of the evolution of each fibre in opposite directions upwards and downwards, and that of Gaudichaud, in respect to which he thinks there must be either a misprint or a complete misapprehension of the views of Gaudichaud, who clearly traces the source of each bud, not from the point of external growth (as Dr. Allemão seems to infer), but from the seat of its origin around the medullary sheath, at the *nœud vital* or point of departure of each independent ascending and descending system of vascular fibre. The origin of numerous distinct bud-formations around the medullary sheath, and the extension of ascending spiral vessels and of corresponding descending dotted vessels from each of these separately, are maintained throughout by Gaudichaud in his "Recherches Générales" as an essential part of his theory, and minutely demonstrated in his figures, both in monocotyledonous and dicotyledonous plants. He even forcibly quotes the same circumstances of the intumescence of a stem produced by a ligature, and the germination of an apparently budless stem, in support of his views; between which and those of Dr. Allemão, Mr. Miers is consequently unable to perceive any essential difference.

Mr. Miers further quotes, from early works of Mirbel, the proof that, as long ago as 1802 and 1809, he accurately depicted and described the origin and formation of similar vessels in germinating seeds of Nelumbo and of the Common Haricot; and refers to plates by him in the 5th and 13th volumes of the 'Annales du Muséum,' showing the ascending system of spiral vessels in the plumule and cotyledons, and the descending system of dotted vessels in the radicle.

Dr. Allemão further states, that although the "bolbo radicular" is always the chief growing point of the radicle, he observed, in *Euphorbiaceæ*, four other cruciform branches, on the same horizontal plane, proceeding from this radicle. The same fact was described more than forty years ago by Auguste de St. Hilaire (Ann. du Mus. xix. p. 467) in the germination of a Ranunculaceous plant (*Ceratocephalus*). In this, besides the main shoot, growing in the same way as an ordinary exorhizal root, five other branching rootlets are shown to be produced on one plane, from the collar of the young root, which make their appearance through lacerations of the external coat. Their earliest indication is in the form of tubercles, through the investing covering of which these rootlets burst a passage, in all respects similar to the coleorhiza in the germinating embryos of Monocotyledonous plants. The coleorhiza is sometimes extended to some distance along the rootlet, but in other cases it forms merely a swelling round its base. The same appearance, although far from general, was observed by St. Hilaire in the germinating embryos of numerous other exorhizal plants, as *Myosurus, Plantago, Valerianella, Urtica, Senecio, Sonchus, Calendula, Matricaria, Veronica, Phaseolus, Medicago,* &c. In *Tropæolum* the radicle, although exorhizal, exhibits a kind of valve-like opening for the exit of the plumule, which has been called a coleorhiza: and a somewhat similar appearance is said to occur in the germination of the seed of *Viscum album*; this, however, Mr. Miers apprehends can refer only to the coleorhizal mode of bursting of the attenuated expansion of the thin covering of the albumen which is spread over the growing radicle.

Dr. Allemão, Mr. Miers adds, here considers the radicle of the embryo as forming part of the caulicle or stem, and the root as originating in the subsequent growth of the embryo, after it is released from its integuments, and produced by the expansion of the obtuse extremity of the radicle, which he calls the "gommo;" and Gaudichaud the *radicular bulb*. This view was taken by Turpin nearly twenty years ago, and represented by him, in the germination of *Solanum tuberosum* (Mém. Mus. xix. p. 19. t. 1), where all the radicular portion of the embryo is referred to the *tigelle* or ascending system, while the true root is represented as beginning from its sprouting point in the radicular bulb. It has not, however, been generally countenanced, and Mr. Miers states that he cannot perceive that it has any advantages over the more generally received theory which regards the radicle as an elementary root, commencing from the point of union of the cotyledons and their junction with the plumule. On the contrary, it is disproved by numberless facts, and more especially by one to which he lately called the attention of the Society, in the germination of the embryo of *Xanthochymus*, as figured by Dr. Roxburgh; in which (in addition to the principal root thrown out at the base of the seed, at the point which Dr. Allemão would call the radicular bulb) another secondary root is seen proceeding from the summit of the nucleus out of the ascending collar or *tigelle*, immediately below the scales, which appear to be minute cotyledons, showing that the main body of the nucleus or radicle belongs to the descending system of the root. It is more natural, Mr. Miers thinks, to conclude, in the case cited by Dr. Allemão, that the main descending shoot, growing out of the radicular bulb, and also the subsequent coleorhizal rootlets, are productions of that axile portion of the radicle, which Mr. Miers has called the *neorhiza*; and under this point of view he considers it easy to account for the coleorhizal character of the secondary rootlets in the germination of *Ceratocephalus*, as described by St. Hilaire. A very singular example of this sort of production is shown by Klotzsch, in the germination of the seeds of *Pistia* (Ueber *Pistia*, Berl. 1853, plate 1. f. C.D.E), where the many secondary rootlets, or branches of the neorhiza, force their way through the epirhizal covering of the main root, extending it as a coleorhiza, in the form of a long cylindrical tube, which at length breaks away, leaving a long sheath in the form of a thimble, covering the extremity of each growing rootlet, and which probably thus performs the functions of a spongiole.

BOTANICAL SOCIETY OF EDINBURGH.

Thursday, 12th July 1855.—Professor Balfour, President, in the Chair.

The following papers were read, viz.—

1. "On the Introduction of the Cinchona Tree into India." By Thomas Anderson, M.D., H.E.I.C.S.

The author gave an account of the peculiar character of the country inhabited by the Cinchona tree, and showed that similar districts existed in India where this valuable tree may be successfully grown. He also showed, by the great quantity of the bark that is used, that much profit must result to the cultivators.

2. "On the presence of Diatomaceæ, Phytolitharia, and Sponge Spicules, in Soils which support Vegetation." By William Gregory, M.D., F.R.S.E., Professor of Chemistry.

Ehrenberg, in his late work, 'Mikrogeologie,' has stated that in specimens of soils from all parts of the world, he has found many microscopic organisms; he divides these into Siliceous and Calcareous, the former including *Diatomaceæ*, *Phytolitharia*, and *Polycystina*, as well as Sponge spicules, the latter minute Mollusks and other shells. The present observations are confined to the siliceous organisms, and among these, chiefly to the *Diatomaceæ*, with *Phytolitharia* and Sponge spicules, the soils examined being such as are connected with fresh water, in which the *Polycystina* do not occur.

Many of Ehrenberg's observations were made on the small portions of soil found adhering to dried plants in herbaria, and I requested Professor Balfour to supply me with such portions of soil. By his kindness I obtained upwards of sixty such specimens, almost all of which were of very small bulk, on an average not exceeding that of a pinch of snuff, and sometimes less. Of these a certain number consisted chiefly of earth, with some half-decayed vegetable matter, and many contained hardly anything but decaying vegetable matter, with a mere trace of earth. Of course, the latter are not fair specimens of soil; but I have subjected all to the same treatment, namely boiling with nitro-muriatic acid, washing, straining through gauze, and examining the fine insoluble residue. This, of course, contained all the siliceous matter present, but it also contained much organic matter, of a brown or red colour, insoluble in acids, which, if necessary, might be destroyed by ignition, when it would leave a trifling ash.

In every case I found *Diatomaceæ* in the residue, as well as *Phytolitharia.* Sponge spicules, apparently of freshwater sponges, were less frequent, but occurred in many. In a few cases, where the acid caused effervescence, there was calcareous matter present, but in most, this was not the case.

Of course, in those cases in which the proportion of earth was small, the residue consisted chiefly of the insoluble organic matter, through which, however, Diatoms and Phytolitharia were scattered, in greater or smaller proportion.

In the cases where the proportion of earth was larger, the residue was much richer in Diatoms and Phytolitharia, but almost always contained also the dark insoluble organic matter. In several, the proportion of Diatoms in the residue was so large, that it had the appearance of a regular Diatomaceous gathering, after boiling with acids. The most remarkable soils in this respect were one from the Sandwich Islands, one from Lebanon, one from the roots of a German moss, and one from Ailsa Craig.

It is to be noticed, however, that *Diatomaceæ* were found in every case, without exception, and that in all, their proportion to the whole non-calcareous earthy residue was considerable, and often large. In many of those where the proportion of earth was smallest, there was no siliceous matter in the residue, except *Diatomaceæ* and *Phytolitharia.*

The soils examined were from various and distant localities ; there were about twenty from the Andes, several from Brazil and other parts of South America, a few from North America, a few from the West Indies, one from the Sandwich Islands, one from New Zealand, a few from India, one from Lebanon, a good many from Germany, some from France, a few from Spain, and some from Britain.

The great majority of the species of Diatoms in all these were found to coincide with our British forms, but a good many species occurred in the exotic soils which have not yet been found in Britain, and most of these not even in Europe, but which have been figured by Bailey, Ehrenberg, Kützing, Rabenhorst, &c.

A good many were observed, which, so far as I know at present, have not yet been figured or described. Lastly, a certain number of species, lately found by Smith, Greville, and others, as well as by myself in Britain, and some of which are scarce, have occurred in these exotic soils. Among these I may name here, *Navicula scutelloides,* W. Sm. (Lebanon), *Orthosira spinosa,* W. Sm., Grev. (Andes, Germany), *Cymbella turgida,* W. G. (Sandwich Islands), and *Navicula varians,* W. G. (various soils).

Of such species as are unknown to Europe, I shall only mention here *Terpsinoë musica,* one of the most striking of known forms, which I found in the first soil I examined, which was from Brazil. It is accompanied by *Nitzschia scalaris,* a fine form, which occurs in Britain, but is far from frequent here.

I am satisfied that a close examination of such specimens of soil, which are often thrown away in putting up specimens in herbaria, will bring to light many new forms, and supply us with many exotic and rare species. It is very desirable that collectors of plants should preserve a little of the earth adhering to their roots, and in this way copious materials would be obtained.

The above observations entirely confirm Ehrenberg's statements as to the distribution of the *Diatomaceæ*. They furnish evidence of the fact that these organisms are far less affected by climate and temperature than larger plants or animals; since many of the very same species are found in every latitude and in every country. For example, such common forms as *Achnanthidium lanceolatum*, *Achnanthes exilis*, *Gomphonema tenellum*, *G. constrictum*, *G. capitatum*, *Cocconeis Placentula*, *C. Pediculus*, *Cocconema lanceolatum*, *C. cymbiforme*, *Synedra radians*, *Navicula elliptica*, *N. rhomboides*, *Pinnularia viridis*, *P. major*, *P. oblonga*, *P. borealis*, *Surirella biseriata*, *S. ovata*, *Meridion circulare*, *M. constrictum*, *Cymbella maculata*, *C. scotica*, *C. cuspidata*, *Epithemia turgida*, *Ep. Argus*, *Himantidium Arcus*, *H. gracile*, *H. majus*, *Odontidium mesodon*, *Diatoma tenue*, *D. vulgare*, *Nitzschia linearis*, *N. amphioxys*, *Melosira varians*, and many others actually occur in every part of the world from whence these soils have come; and there is absolutely no difference between the exotic and the British forms.

Ehrenberg specifies two species, namely *Pinnularia borealis* (*P. latestriata*, W. G.) and *Eunotia amphioxys* (*Nitzschia amphioxys*, W. Sm.), as having been found by him in almost every instance. My results confirm this. In no one case have both of these been absent, and in at least nine-tenths of these soils both are present. They are often the predominant forms, and in a few cases almost the only forms present. *Gomphonema tenellum* and *Achnanthidium lanceolatum* are found in a large majority of these soils.

I am disposed to agree in opinion with Ehrenberg, that the microscopic organisms found in soils contribute materially to the increase of the soil. This is true both of the siliceous and calcareous forms. The *Diatomaceæ* live in moist earth. They obtain silica from the water, and at their death their shells are added to the soil. Where many are present, this process of transference of silica from the rock to the soil goes on very rapidly. We have so far evidence that they live in these soils, that we find them there very often in the state of self-division, which is not observed in old accumulations of the dead shells.

The peculiar capacity of the *Diatomaceæ* for resisting climatic changes, whereby the same species can live and thrive as well in the Arctic circle as under the line, corresponds well with the results of the study of the same organisms in the fossil state. In Ehrenberg's 'Mikrogeologie' will be found very fine figures of the Diatoms occurring in the different forms of Bergmehl, Tripoli or polishing slate, Kieselguhr, pumice, and other volcanic rocks, mountain limestone, amber, &c., and it will be seen that by far the greater number of the species are quite identical with recent ones. Microscopic organisms have been found so low down as the green sand of the Silurian system; but they rather belong to the *Polythalamia*. The earliest Diatoms, geologically speaking, as figured by Ehrenberg, agree in every point, as far as the great majority of the species is concerned, with those now living in our waters, and forming deposits which will become rock at some future time.

It was supposed that most of the species in the much more recent Bergmehl were no longer to be found living; but most of them have been since found. I myself have lately found two species of the Lapland Bergmehl to be still in existence, namely *Eunotia octodon* and *Synedra hemicyclus*; and *Eunotia incisa*, which occurs both in the Lapland and the Mull earths, has been found recent by me in a dozen British gatherings. Yet all these forms were supposed, not long since, to be exclusively fossil. We cannot say that there are no species exclusively fossil, but so many that have been thought so are daily found living, that it is probable the rest may be so found too, and at all events, a very large proportion of the forms in the oldest fossil deposits are absolutely identical with the forms of the present day.

I have only further to mention, that although so many species are universal in their habitat, some appear to be local. Thus, *Terpsinoë musica* does not occur in Europe, nor has it yet been found except in America, and, I think, in Australia.

Some species are decidedly Alpine; for example, *Orthosira spinosa*, which Professor Smith found on the Mont d'Or in Auvergne, and Professor Balfour on the Grampians. It occurs also in nearly every soil from the Andes.

3. "On the Effects of the Severe Frost of last winter on Plants in the neighbourhood of Sligo." By the Right Hon. John Wynne, of Haslewood.

ZOOLOGICAL SOCIETY.

April 11, 1854.—Dr. Gray, Vice-President, in the Chair.

Descriptions of two New Species of Pucrasia. By John Gould, F.R.S. etc.

Mr. Gould having recently found in the rich stores of the East India Company, at their house in Leadenhall Street, a new species of Pheasant, of the same form but remarkably different from the Pucras Pheasant, took the earliest opportunity, with Dr. Horsfield's permission, of bringing it under the notice of the Society. This fine bird, of which two specimens have been sent to the East India Company from Kafiristan by Dr. William Griffith, may be at once recognized by the uniform chestnut colouring of its mantle, breast and flanks, which has suggested the specific name of

Pucrasia castanea.

Forehead, cheeks, chin and lengthened portion of the crest dark shining green; hinder part of the head and the shorter portion of the crest dull sandy-buff, the two colours blending on the occiput; on each side of the neck an oval patch of white; lanceolate feathers of the neck, both above and below, breast and flanks, deep chestnut;

feathers of the upper part of the back black, stained with chestnut on the outer web and margined with grey; lower part of the back and rump grey, fading into white on the edges, and with a narrow streak of blackish-brown down the shaft; wing-coverts dark brown, largely edged with greyish and ashy-brown; primaries brown on the inner margins, cream-white on the outer ones; feathers of the lower part of the abdomen brownish-black, edged with whitish; under tail-coverts chestnut, with a black line down the centre, and fringed with white at the tip; upper tail-coverts ashy-grey, with a broad mark of blackish-brown down the centre, but not extending to the tip; tail-feathers black, the central ones broadly margined with grey freckled with black, the remainder fringed with whitish at the tip; bill black; feet horny-brown.

Total length, 23 inches; wing, $9\frac{3}{4}$; tail, $10\frac{1}{2}$; tarsi, $2\frac{5}{8}$.

Hab. Kafiristan.

Remark.—This species is altogether a stouter and larger bird than *Pucrasia macrolopha*.

Mr. Gould further remarked that, upon a careful examination and comparison of the Pheasants from Nepaul, which have usually been considered as identical with the *P. macrolopha*, with true examples of that species, he found them to differ so considerably, that he felt justified in characterizing the Nepaulese birds as distinct, under the name of

Pucrasia Nipalensis.

Forehead, cheeks, chin and lengthened portion of the crest deep shining green; hinder part of the head and the shorter portion of the crest buff, with lighter shafts, the two colours blending on the occiput; on each side of the neck an oval spot of white; feathers of the sides and back of the neck and upper part of the back brownish-black, with a narrow mark of rich chestnut down the centre, and edged with rufous or whitish; feathers of the lower part of the back brownish-black, with white shafts and edges; wing-coverts brownish-black, with white shafts and margins; scapularies broadly margined with deep reddish-buff; primaries brown on the internal web, deep buff on the outer; tertiaries pale chestnut, mottled with black along the shaft and towards the edge, which is sandy-buff; throat, centre of the breast and abdomen rich chestnut; flank-feathers brownish-black with white shafts, bordered on each side by a very fine line of chestnut, and narrowly edged with grey, the markings becoming larger and paler behind the thigh; under tail-coverts lively chestnut, with an oval spot of white at the tip of each; centre tail-feathers rufous, stained with black near the shaft, the remainder black on the inner web and at the tip, the outer webs chestnut, which colour curves round into and occupies a portion of the internal web near the tip; all fringed with white at the tips; bill black; feet horny-brown.

Total length, $20\frac{3}{4}$ inches; wing, $8\frac{1}{2}$; tail, 9; tarsi, $2\frac{1}{2}$.

Hab. Nepaul and Bhotan.

Remark.—In size this bird is the smallest of the three species of the genus, but it is by far the most highly coloured and beautifully marked; the mantle, the sides of the neck and the flank-feathers are conspicuously striated with black, chestnut and grey; the same parts in the other species being sombre in comparison.

Specimens are contained in the collection at the British Museum, in that of the East India Company, and, Mr. Gould believes, in that of the Jardin des Plantes at Paris.

April 25.—Dr. Gray, Vice-President, in the Chair.

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

Family Merulidæ.

Subfamily Timalinæ.

Genus Timalia.

Timalia Malcolmi, Sykes. Large Babbler.

This Large Babbler, though not generally so common, I believe, as *Timalia grisea*, I have shot in the Deccan in the districts near the city of Ahmednuggur. It is gregarious in its habits, flying about in flocks of eight or ten. It lives much on the ground, seeking its food, which consists of grasshoppers, beetles, black and white ants, and other insects, under large trees and hedgerows, scratching up and turning over the dead leaves with its strong claws. It also feeds on grain; the stomach of one which I examined contained bajocee seeds and the remains of black ants, of another the remains of black and white ants. This fact, I think, accounts for the habit of these birds, of scratching amongst the decayed leaves round the trunks of large trees, where both the black and white ants are sure to be found; indeed it is almost impossible to find a large tree without a colony of the former round its roots. I am not certain whether the nest and eggs in the Museum of the Zoological Society, marked as those of the Greater Thimalia, belong to this bird, or to *Timalia grisea*; but as I procured two or three specimens of the Large Babbler and not one of *T. grisea*, I think that there is every probability that the nest and eggs belong to this species. I believe that birds of the genus *Timalia* breed twice during the year, as I have found their nests in the months of May and October. The nest brought to me in the month of October was found in a tuft of high grass in a boggy piece of ground; it contained four eggs of a uniform rich blue, $\frac{9}{10}$ in. in length by nearly $\frac{7}{10}$ in. in width. The number of eggs does not exceed four. The nest above-mentioned was composed of coarse matted grass at the bottom, and finer bents on the sides, lined also with bents of grass; it was loosely put together.

There are the nest and eggs of another species of *Timalia* in the Museum of the Zoological Society; but not having put the bird off her nest, I am unable positively to assert to what species they belong. I believe, from the smallness of the eggs, that they probably belong to *Timalia hyperythra* or *T. hypoleuca*; but this point requires further investigation.

Subfamily Oriolinæ.

Genus Oriolus.

Oriolus aureus, Gmel. Indian Oriole or Mango Bird.

This is common in the Deccan, frequenting banian trees and topes of mangoes, whence its name. These birds are particularly fond of the fruit of the banian, or Indian fig; the gizzard of one which I shot was full of the seeds of this small fig. The Indian Oriole begins to breed in the month of June. A pair of these birds built their nest on the small forked branches of a flowering tree in my garden at Ahmednuggur. The nest was composed of various fibrous substances, amongst which pieces of hemp appeared to predominate; with this two of the branches were bound together; some fragments of part of a letter which had been torn up and thrown away were inserted; the handwriting on the paper I easily recognized as that of a lady at the station. The nest, in its position, and in the manner in which it was attached to the boughs, was much like that figured by Mr. Yarrell in his work on British Birds as the nest of the Golden Oriole. The nest, I believe, contained four eggs, of a white ground with claret-coloured spots. This nest, with the eggs, and a pair of the old birds, are in the possession of the Zoological Society.

Notice of a New Indian Swallow.

By Frederic Moore, Assist. East Ind. Comp. Museum.

The subject that I beg to lay before the Meeting this evening, is a new form belonging to the family *Hirundinidæ*, lately collected in Nepal and presented to the Museum of the East India Company by B. H. Hodgson, Esq., which is allied to, but certainly distinct from, the genus *Chelidon*, and for which the following anagrammatic name is proposed.

Delichon (nov. gen.).

Gen. Char. Bill short, thick, robust, gape rather wide, the culmen rounded, the nostrils basal, lateral and rounded. Wings rather long, with the first quill the longest. Tail short, and emarginated or nearly even at the end. Tarsi longer than the middle toe, and clothed with plumes. Toes long and clothed with plumes, the inner shorter than the outer; the claws moderate and curved.

Type, *D. Nipalensis*, Hodgs. n. sp.

Spec. Char. Top of the head, chin, cheeks, ear-coverts, nape, back, upper and under tail-coverts, fine glossy black; wings black, paler beneath, the upper coverts fringed with glossy black, the under coverts dusky black; tail black, fringed on the external webs with glossy black; a band of white across the rump; throat, breast, abdomen, lower part of flanks and vent white, upper part of flanks black; tarsi and toes covered with white plumes; claws pale flesh-colour; bill black.

Length from tip of the bill to the end of the tail, $3\frac{3}{4}$ inches; of wing, $3\frac{5}{8}$; of tail, $1\frac{5}{8}$; bill to front, $\frac{3}{16}$; to gape, $\frac{7}{16}$; height from chin to front, $\frac{1}{8}$; breadth at front, $\frac{3}{20}$; tarse, $\frac{7}{16}$; middle toe and claw, $\frac{9}{20}$; hind toe, $\frac{7}{20}$.

Hab. Nepal. (No. 963. Hodgs. Catal.)

This interesting bird differs from the type of the genus *Chelidon* by its smaller and more robust bill and by its shorter and even tail; the wings also are shorter. From the genus *Cotyle* it is at once distinguished by its plumed feet.

Notice of some New Species of Birds contained in the Museum of the Hon. East India Company.

By Frederic Moore, Assist. East Ind. Comp. Museum.

Family Merulidæ, Vigors.

Subfamily Timalina, Vigors.

Genus Pyctorhis, Hodgson (1844). *Chrysomma* (Blyth), Hodgson (1845).

1. Pyctorhis longirostris, Hodgson.

Forehead, crown, nape, back, rump, upper tail-coverts and tail rufous-brown, deepest on the crown, wings and tail, the last being distinctly rayed; chin, throat, base of lower mandible, middle of belly and vent white; ear-coverts, sides of the neck and breast pale rufescent, brightening on the flanks, thighs and under tail-coverts; under wing-coverts also rufescent; bill black, yellowish beneath at base; legs pale horny.

Length, $8\frac{1}{4}$ inches; of wing, $2\frac{3}{4}$; tail, $3\frac{1}{4}$; bill to frontal plumes, $\frac{5}{8}$; to gape, 1 inch; height from chin to front, $\frac{2}{10}$; tarse, 1 inch; middle toe and claw, $1\frac{1}{10}$; central and lateral ditto, $\frac{7}{10}$; hind ditto, $\frac{7}{10}$.

Hab. Nepal. (No. 892. Hodgs. Catal.)

This bird may be distinguished from *Pyct. sinensis* (better known under the name of *Timalia hypoleuca*) by its larger size, by the lengthened bill, the rufescent colour of the under parts, and by the absence of white before the eye. It may possibly be the species noticed by Mr. I. W. Frith, in the 'Journ. As. Soc. Beng.' xiii. p. 370, as being found in Bengal, which he states "differs from the common species in being about half larger."

I may here notice, in connexion with this genus, that Mr. Hodgson, in 'Proc. Zool. Soc.' 1845, p. 24, refers his genus *Pyctorhis* only to *sinensis*, and not to the bird named *rufifrons*, which is there described as an *Actinodura*, it being synonymous with the species previously described by Mr. Gould under the name of *Actinodura Egertoni*.

Family Sylviadæ, Vigors.

Subfamily Sylviana, Vigors.

Genus Horeites, Hodgson.

2. Horeites major, Hodgson.

Above olive-brown, ruddier on the wings; tail rounded, more of a dusky-brown, with the outer webs fringed with olive-brown; cap red-brown; a yellowish-ferruginous superciliary streak, extending over the ear-coverts; upper part of the latter ruddy-brown, lower ashy; throat, sides of neck, centre of breast and abdomen ashy-white; sides of the breast and flanks olive-brown; bill dark horn-colour, yellowish at base beneath; feet also yellowish.

Length, 5 inches; of wing, $2\frac{1}{2}$; tail, $2\frac{2}{10}$, outer feather $\frac{1}{2}$ an inch shorter than the middle; bill to front, $\frac{3}{8}$; to gape, $\frac{5}{8}$; tarsus, $\frac{9}{10}$; middle toe and claw, $\frac{7}{10}$; inner ditto, $\frac{5}{12}$; outer ditto rather more than $\frac{1}{2}$ an inch.

Hab. Nepal. (No. 946. Hodgs. Catal.)

This species may easily be distinguished by its greater size, and larger bill, the wings being much longer, though rounded as in the other species, and by the nearly total absence of ash-colour on the under parts; the feet also are much longer and stronger.

Genus Abrornis, Hodgson.

3. Abrornis poliogenys, Blyth.

Culicipeta poliogenys, Blyth, J. A. S. Beng. xvi. p. 441 (1847).

Rhipidura poliogenys, G. R. Gray, Gen. of Birds, iii. App. p. 12.

Hab. Darjeeling, Nepal. (No. 920. Hodgs. Catal.)

Head and nape, base of lower mandible and ear-coverts dark ash-grey, the loral feathers tipped with greyish-white; round the eye a clear white ring; back, rump and shoulders bright olive-green; wings dusky black, margined with olive-green, the greater coverts tipped with whitish-yellow; throat greyish-white, the rest of the under parts clear yellow; tail dusky on the six central feathers, which are margined with olive-green, the three outer being greenish-dusky on the terminal half of the outer web, the basal half with the whole of the inner web being white; upper mandible blackish horn-colour, lower yellowish; feet yellowish horn-colour.

Length about $4\frac{1}{4}$ inches; of wing, 2 inches; tail, $1\frac{3}{4}$; bill to front, $\frac{3}{10}$; to gape, $\frac{1}{2}$ an inch; and tarse the same.

"This species is nearly allied to *Abrornis xanthoschistos*, Hodgs., from which it differs in having the cheeks and ear-coverts, with the feathers commencing from the base of the lower mandible, of the same ash-grey colour as the head, and the throat greyish-white, instead of these parts being bright yellow as in that species."

4. Abrornis affinis, Hodgson †.

This species is closely allied to *A. poliogenys*, but differs from it in

† No. 920*, to distinguish it from 920 of Mr. Hodgson's Catalogue.

having the lores, base of lower mandible, lower portion of the ear-coverts, and the chin and throat, the same bright yellow as the rest of the under parts; the feathers of the crown are pale shafted, which is not the case in *poliogenys*; the tail is pale dusky, the two outer feathers only being white on the apical portion of the inner web, the basal portion of which is dusky; the outer web in both is pale dusky green; the other ten are fringed with greenish on the outer web. The wing in *affinis* is a quarter of an inch longer, but has the same markings; the tarsus is also longer by a tenth of an inch. Other characters agree in both species. The bill in this and *poliogenys* is broader than in *A. xanthoschistos*, Hodgson.

Hab. Nepal. (No. 920*. Hodgs. Catal.)

5. Abrornis albogularis, Hodgson.

Forehead, lores, over and under the eyes to nape, and ear-coverts brightish ferruginous, the crown being dusky ferruginous, passing to yellowish olive-green on the back and shoulders; the rump yellowish; wings black, margined with the colour of the back; tail pale dusky greenish, edged exteriorly throughout with yellowish-green; throat and base of lower mandible white, the feathers black at base; breast bright yellow; abdomen white, vent yellowish; bill horny, paler beneath; feet pale horny; the rictorial bristles black, strong, nearly as long as the bill.

Length, $3\frac{1}{2}$ inches; of wing, $1\frac{3}{4}$; the first quill $\frac{1}{2}$ an inch shorter than the second; third $\frac{7}{10}$ths longer than the first; fourth, fifth and sixth nearly equal, the fifth being the longest; tail, $1\frac{1}{2}$ inch; bill to frontal plumes, $\frac{3}{12}$; to gape, $\frac{5}{12}$; tarsus, $\frac{6}{10}$; middle toe and claw, $\frac{5}{12}$; hind ditto, $\frac{3}{8}$; tarsus and hind claw strong.

Hab. Nepal. (No. 936. Hodgson's Catal.)

On the Genus Modiolarca.

By Dr. John Edward Gray, F.R.S., P.B.S., V.P.Z.S. etc.

In the Synopsis of the British Museum for 1840, pp. 144, 155, I established a family of bivalve shells under the name of *Crenellidæ*, for the genera *Crenella* and *Modiolarca*, taking the character of the family from the animal of *Modiola trapezina*, the type of the genus *Modiolarca*, the only one that had then come under my examination. The following were the characters given:—

"The family of *Crenellidæ* chiefly differs from the former (*Mytilidæ*) in the mantle lobes being united together so as to leave only two posterior holes for the entrance and exit of the water, and a slit for the foot and beard. The hinge-margin is denticulated at each end, and the umbo is nearly central."

Shortly after, Mr. Alder described the animal of the British *Crenella undulata*, and found that the mantle was nearly as much open as that of the *Modiolæ*, and complained of the inaccuracy of the description; the fact being, that the two genera had very different animals, and that *Crenella* had been wrongly referred to the group, and taken as the patronymic of it.

I have lately had an opportunity of verifying my description of the animal of *Modiolarca,* and find that it exactly agrees with the above character, and that it has a very peculiar-formed foot, most resembling that found in some *Arcidæ,* which caused me to call the genus *Modiolarca**.

The following is a more particular description of the animal of the genus, which must be considered as the type of a peculiar family, called

Modiolarcadæ.

Crenellidæ, Gray, 1840.

Genus Modiolarca, Gray, 1840.

Mantle lobes united. Siphonal apertures two, distinct; anal moderate; branchial very large, inferior, simple edged; pedal aperture small, basal, subanterior. Gills four, thick, dependent, subtrigonal, truncated in front, narrow, produced and united together behind. Lips four, moderate. Palpi obsolete. Foot oblong, base truncated, lower end lanceolate, acute in front, with a subposterior, central cavity for the byssus.

Shell equivalve, oblong, thin; umbo subanterior. Hinge-teeth none, or rudimentary. Cartilage linear, external. Periostraca polished, hard.

The animal lives attached to floating sea-weed.

Modiolarca trapezina†=*Modiola trapezina,* Lamk. Hist. A. s.V. n. 17. ed. 2. vii. 24; Delessert, Icon. t. 13. fig. 7; Hanley, Cat. Recent Shells, 237.

MISCELLANEOUS.

MONSTROSITY OF ANTIRRHINUM MAJUS.

In a garden at Brixton I observed many spikes of the common Snapdragon, *Antirrhinum majus,* with larger and much brighter-coloured flowers than the rest. The flowers were divided to the base into five separate lobes, the upper lip of the common form of the flower being formed of two, the lower lip of three; the upper lobes were inequilateral, the upper side very straight, and the outer one curved with an enlarged end somewhat like the wing of a papilionaceous flower, and they were one-coloured and slightly twisted; the three lower lobes were equilateral, lanceolate, variously con-

* Two genera have been made out of this word. Dr. Beck when in this country made a note that I had called the genus *Modiolarca*; but he appeared to have read it *Modiolaria,* and that name has been used for it. The latter name is now chiefly used for the more oblong *Crenellæ.*

† Since the above was read, I find that M. Valenciennes has considered this shell as the type of a new genus, *Phascolicama* (see Gay's Chili, 1854); and Mr. Gould has, more lately, formed a genus for it, under the name of *Gaimarda.*—J. E. Gray.

torted and variously coloured, the limb very bright orange or red or white, and the claw yellow and bearded within. The stamens and other parts of the flower were of the usual form and number. On some spikes a few of the flowers were only slit to the base along the centre of the upper side, somewhat like the flowers of the genus *Lobelia*; and in another spike, some of the flowers had the upper and lateral lobe of each side united, the slits being between the two upper and on each side of the lower central lobes. The white variety of the plant offered the same modifications.—J. E. GRAY.

Notice of the Horns and Skull of the Arnee. By Dr. J. E. GRAY, F.R.S., P.B.S., V.P.Z.S. &c.

Colonel James Matthie has lately presented to the British Museum the skull and horns of an Arnee or Buffalo, killed by him near Fezpoor, Central Assam, on the 8th of April, 1842.

The horns are of a very large size, as proved by the accompanying measurement, being nearly as large as the separate horns without a skull, in the British Museum, which formerly formed part of Sir Hans Sloane's Collections, and were described and figured by him in the Philosophical Transactions for 1727, no. 397, p. 222, f. 23. These horns are 78 inches, or 6 feet 6 inches long.

The dimensions of Colonel Matthie's specimen are as follows, according to his measurement.

	ft.	in.
"Length of the skull from occiput to nose	2	4
Length of the horns round the outside of them and across the forehead	12	2
Length of line from tip to tip of the horns........	6	8
Circumference of right horn at base	1	$8\frac{1}{2}$
,, ,, left horn at base	1	8
Width across the forehead	0	11

"The horns do not exactly correspond in length and shape."

The occipital portion of the skull is very much developed, to give enlarged attachment to the muscles of the neck for the support of the horns.

I may observe, that the Arnee of Anderson, *Bee*, 1792 (the *Bos arne* of Kerr, 'Animal Kingdom,' 336. t. 295, copied into 'Shaw, Zoology,' iv. p. 400, t. 210), is only a large horned variety of the common Buffalo, with horns nearly regularly curved from the base. The horns presented by Colonel Matthie, on the other hand, are nearly straight for great part of their length, and only curved at the end. In this respect they agree with the horns in the British Museum, which Mr. Doyle, whose name is "given to a sort of stuffe worn in summer," discovered in a cellar in Wapping, and which he gave to Sir Hans Sloane for his kindness in attending him in sickness. These are described by the latter in the 'Philosophical Transactions' for 1727, no. 397, p. 222. f. 23; and re-described and figured by

Colonel Hamilton Smith as those of Bos Arnee in *Griffith, A. K.* iv. t. 201. f. 2, 3.

Dr. Hook read a lecture on Mr. Doyle's horns at Gresham College, and thought they were probably those of the *Sukotyro* or *Sucotaria*, described by Nieuhoff in his 'Voyages and Travels in the East' as found in Java. He compares the horns to the tusk of the elephant, which they somewhat resemble. Dr. Shaw thought otherwise, and formed a genus for Nieuhoff's animal, making a figure of it from his description (see *General Zool.* i. 226. t. 65). Illiger considered it more probably a Babyrusa. See *Illiger, Genera Mam.* 100.—*Proc. Zool. Soc.* Jan. 23, 1855.

METEOROLOGICAL OBSERVATIONS FOR JULY 1855.

Chiswick.—July 1. Very fine. 2. Heavy clouds : slight rain. 3, 4. Very fine. 5. Clear : hot and dry. 6. Foggy : very fine. 7, 8. Very fine. 9. Hazy : very fine : thunder, lightning and rain at night. 10. Fine : cloudy : very fine. 11. Constant and very heavy rain from early in the morning till night. 12, 13. Very fine. 14. Cloudy: very fine. 15. Cloudy and fine: rain. 16. Cloudy: heavy rain at night. 17. Fine: cloudy. 18. Very fine. 19. Rain. 20. Very fine. 21. Exceedingly fine. 22. Very fine. 23. Slight fog : sultry : rain. 24. Rain : cloudy. 25. Rain. 26. Densely overcast : constant and very heavy rain. 27. Overcast : heavy clouds and showers. 28. Cloudy : heavy showers. 29. Very fine. 30. Slight haze : very fine : overcast : rain at night. 31. Heavy rain : showery : clear and fine at night.

Mean temperature of the month	62°·99
Mean temperature of July 1854	61 ·59
Mean temperature of July for the last twenty-nine years ...	63 ·12
Average amount of rain in July	2·428 inches.

Boston.—July 1—4. Fine. 5—7. Cloudy. 8. Fine. 9. Cloudy. 10, 11. Cloudy : rain A.M. 12. Fine. 13. Cloudy. 14. Rain and hail A.M. 15. Fine. 16, 17. Cloudy : rain A.M. and P.M. 18. Cloudy. 19, 20. Cloudy : rain, with thunder A.M. and P.M. 21—23. Cloudy. 24, 25. Rain A.M. and P.M. 26. Fine : rain P.M. 27. Cloudy : rain P.M. 28. Fine : rain P.M. 29, 30. Fine. 31. Rain A.M. and P.M.

Sandwick Manse, Orkney.—July 1. Damp A.M. : showers P.M. 2. Showers A.M. : drops P.M. 3. Rain A.M. : damp P.M. 4. Bright A.M. : cloudy P.M. 5. Cloudy A.M. : fog P.M. 6. Bright, fine A.M. : clear, fine P.M. 7. Bright, fine A.M. and P.M. 8. Bright, fine A.M. : clear, fine P.M. 9. Clear, fine A.M. : vapour, fine P.M. 10. Hazy A.M. : clear, fine P.M. 11. Fine A.M. and P.M. 12. Bright, fine A.M. : fine, fog P.M. 13. Fog A.M. : fine, fog P.M. 14. Fog A.M. : thunder showers, fog P.M. 15. Fog A.M. : showers P.M. 16. Rain A.M. : showers P.M. 17. Damp A.M. : cloudy P.M. 18. Cloudy A.M. and P.M. 19. Bright A.M. : hazy, fine P.M. 20. Bright A.M. : clear, fine P.M. 21. Clear A.M. : drops P.M. 22. Cloudy A.M. and P.M. 23. Cloudy A.M. : showers P.M. 24. Bright A.M. : fine, fog P.M. 25. Cloudy A.M. : fine, fog P.M. 26. Rain A.M. : fog P.M. 27. Rain, fog A.M. : showers, thunder and lightning, clear P.M. 28. Bright A.M. : fine, drops P.M. 29. Rain A.M. : damp P.M. 30. Cloudy A.M. : fine, vapour P.M. 31. Cloudy A.M. : fine P.M.

Mean temperature of July for twenty-eight previous years .	55°·08
Mean temperature of this month	59 ·19
Mean temperature of July 1854	55 ·25
Average quantity of rain in July for fifteen previous years...	2·41 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.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1855. July.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	30·163	30·161	29·52	29·78	29·96	76	60	68	59	53	sw.	ssw.	wsw.	....	....	·32
2.	30·193	30·153	29·58	29·97	29·97	78	57	72·5	55	53	sw.	ssw.	w.	·01	....	·17
3.	30·181	30·082	29·63	30·00	30·10	79	56	61	52	52½	n.	nw.	nw.	....	....	·08
4.	30·100	30·091	29·58	30·18	30·18	77	37	64	55½	52	n.	ne.	nne.	....	....	....
5.	30·121	30·038	29·63	30·14	30·09	81	38	57·5	52½	50½	ne.	nnw.	e.	....	....	....
☾ 6.	30·045	30·027	29·62	30·07	30·07	77	44	59·5	56½	54	w.	n.	e.	....	....	....
7.	30·079	30·064	29·64	30·08	30·07	74	50	64	67	59	e.	nne.	se.	....	....	....
8.	30·025	29·867	29·55	30·04	29·97	79	55	65	68½	57½	se.	e.	se.	....	....	....
9.	29·775	29·599	29·43	29·89	29·85	80	59	57	64	53	e.	e.	e.	·14	....	....
10.	29·608	29·585	29·13	29·79	29·77	82	59	73	57	54	sw.	s.	ese.	·48	·05	....
11.	29·541	29·516	29·12	29·77	29·83	71	55	58·5	70½	60	n.	n.	se.	1·07	·40	....
12.	29·840	29·747	29·27	29·83	29·90	81	52	66	74½	60	nw.	n.	nw.	....	....	....
13.	29·959	29·931	29·44	29·92	29·87	79	55	71	58	55	sw.	sw.	ese.	....	....	....
● 14.	29·858	29·822	29·33	29·82	29·70	76	53	61	66	57	sw.	nne.	sse.	·29	·10	....
15.	29·919	29·772	29·34	29·67	29·70	75	55	68	61	56	sw.	ssw.	nw.	·41	·40	·01
16.	29·617	29·464	29·10	29·59	29·58	73	46	68	59½	57	sw.	s.	ne.	·40	....	·12
17.	29·648	29·543	29·00	29·61	29·65	66	51	58	58	56	sw.	w.	n.	....	1·35	·05
18.	29·744	29·724	29·20	29·62	29·59	76	46	65	58	56	sw.	w.	......	·01	·13	....
19.	29·654	29·567	29·12	29·55	29·56	64	46	60	58	55	s.	s.	......	·36	....	....
20.	29·951	29·745	29·22	29·71	29·92	73	41	62·5	60	55	w.	nnw.	......	....	·28	....
21.	30·107	30·049	29·58	29·92	29·91	80	45	59	62	60	w.	nw.	s.	....	·16	....
☽ 22.	30·156	30·114	29·62	29·95	30·04	78	52	72	70	62	w.	w.	se.	....	....	....
23.	30·020	29·765	29·47	29·98	29·80	83	59	75	72	62½	sw.	se.	se.	·68	....	....
24.	29·696	29·606	29·10	29·70	29·71	71	52	67	65	62	sw.	sw.	e.	·14	·10	·15
25.	29·716	29·672	29·13	29·76	29·82	73	49	63·5	65	60	sw.	ene.	e.	·20	·21	....
26.	29·777	29·720	29·28	29·82	29·82	63	50	63	60	60	s.	sw.	e.	1·22	·26	·14
27.	29·842	29·782	29·29	29·62	29·78	75	49	64	60	59	sw.	sw.	ese.	·45	·29	·78
28.	29·876	29·870	29·34	29·83	29·83	72	50	64	65½	58	sw.	ssw.	w.	·06	·19	·03
○ 29.	29·927	29·899	29·34	29·68	29·79	77	53	63	58	55½	w.	w.	se.	....	·03	1·08
30.	29·872	29·828	29·34	29·87	29·83	75	55	64	63	56	sw.	nw.	se.	·24	....	·04
31.	29·750	29·736	29·20	29·76	29·70	71	42	65	61	58	sw.	w.	e.	·14	·15	....
Mean.	29·895	29·823	29·36	29·836	29·850	75·32	50·67	64·5	61·67	56·72				6·30	4·10	2·97

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XXI.—*The Vegetable Individual, in its relation to Species.* By Dr. Alexander Braun, Professor of Botany in the University of Berlin, &c.* Translated by Chas. Francis Stone.

Part I.—Introduction and History†.

In Organic Nature the two principal phænomena, in which the shifting scenes of Life are unfolded, are individual development and individual propagation. Through them the intricate course of Nature, and its living chain of organized beings, are refreshed and renewed. Every new generation seems to bring back the old form; still, to the investigator who looks deeper into the graves of the past, a slow, but certain, progress reveals itself even in this apparently identical succession. If Nature is to be for us something more than a labyrinth of varied and intricate phænomena; and if, in the apparent disorder, the hidden threads of the connexion are to become visible, we must first of all separate and compare the different spheres of life, placing them higher or lower according to their rank. The starting-points which Nature offers for such a purpose are, the *Individual* and the *Species*; whose reciprocal relations, however simple they may at first appear, when followed out to particulars lead to difficulties which demand an accurate examination‡. From the botanist such an

* From the Transactions of the Royal Prussian Academy of Sciences for 1853.—Reprinted from Silliman's American Journal for May 1855.

† I have omitted the author's brief introductory remarks.—*Transl.*

‡ Should any one be inclined to doubt that the nature of the vegetable individual needs a further discussion, I would beg him to turn to the latest works on Botany and compare the passages which treat of the plant's individuality. I take Kützing's Grundzüge der phil. Botanik (2nd Part), as we have a right to demand from a work that lays claim to philosophical

examination is particularly demanded; as the vegetable ideal presented to us by the science in its earlier stages has been obscured by conceptions obtained from the animal kingdom having been transferred to Botany, though based upon the mistaken assumption that plants possess the same independent individuality as animals, the same organs with equally well-defined functions, and the same mutually dependent relations of the vital activities. And the investigations of late years, forsaking the old views more and more, have arrived at no well-defined conclusions, and, particularly as regards vegetable individuality, seem to lead more to negative than to positive results. After all, this should not surprise us; for even a superficial investigation shows relations in plants which will hardly harmonize with the common conceptions of individuality, and which require a careful review.

In the whole realm of organic nature, we know of not a single species of which any one individual is a perfect representative: on the contrary, we see each species adding generation to generation, by multiplying the individuals in time and space, until its day has ended, whether from internal or external causes. In this particular, the species resembles the individual itself; having its allotted age, though measured by days of a higher order, and its appointed cycle of life,—in which the individuals appear as members occupying a certain time and place,—resembling the

development, a fundamental discussion of this subject, since it is the ground-work of the whole science. The first two paragraphs under the heading "Das Pflanzenindividuum als Organismus," read as follows: "By individual we here mean a single vegetable body not organically connected with a similar vegetable body. Vegetable individuals have the power of developing the general phænomena of vegetable life by themselves, unassisted by any other individual of the same species. It is the nature of an organism to consist of members. . . . . The possession of members is the first, as well as the most essential condition of the existence of the vegetable individual." Not one of these assertions is true of vegetable individuals, either in the broader or the narrower signification of the term. To say nothing of the connexion in which the individuals appear which are successively developed by shoot-formation, the coalescence of stocks which were originally separate is no rarity. Are the pines of the pine-forest no individuals, because, as Göppert has shown, they are connected with each other by their roots? Do the filaments of *Zygnema* cease to be individuals when they copulate? Are the cells of *Hydrodictyon* and *Pediastrum*, originally separate, no longer individuals when they have joined themselves into a net or a star? To refute the second assertion, we may refer to diœcious plants; to refute the third, we refer to the one-celled Algæ and Fungi, a part of which, at least, are of such a character that we can by no means ascribe to them an *organization* in the usual acceptation of the term. However, we may regard it as an improvement, that Kützing's 'Grundzüge' treats of the vegetable individual at all; for the earlier manuals do not even mention this important subject, but commence their account of plants with descriptions of the root, stem and other organs, or, as it has been preferred of late years, of the cells and vesicles.

successive relative forms through which the individual passes. For the organic individual does not manifest itself in one single permanent form, but in a succession of forms, now gradually connected, now broadly interrupted; and these last, especially in plants, may attain to an independence which gives them the character of a subordinate species. To this analogy between individuals and species it may be objected, that, in most cases, a very remarkable metamorphosis is connected with the successive forms of the individual, while within the sphere of the species the consecutive members continue to have essentially the same character*. But, however important this fact may be, still we may assert of the individual as well as of the species, that it completes the cycle of its existence in a succession of subordinate generations, while, on the other hand, we may affirm of the species, that, like the individual, it exhibits a determinate cycle of development†. In comparing the processes of propagation with the process of the formation of the individual, cell-formation, which lies at the foundation of both, reveals the intimate connexion which exists between the small and the great spheres of development; while the numerous cases which admit of a double explanation (since they may be ascribed with almost equal justice to the inferior cycle of development of the individual, or to the superior one of the species) establish the close relationship of both. The above-mentioned circumstance, that the cycle of development does not present as graduated a progress in the species as it does in the individual, seems to suggest that the most reliable view of the analogy between the species and the individual is that in which the species is not compared with the whole cycle of the individual's successive development, but with the *single steps* of the metamorphosis (which of course has its own subordinate members), and in which the species itself is regarded as an inferior "momentum" of a still more comprehensive cycle of development; but to determine this would lead us too far from our subject ‡. In a word, the relation of the individual to the species is that of an inferior cycle of development to a superior: the individual is a *member* of the species. However, although they are under one and the same specific law, all the members of the species are not identical: a single member only represents the idea of the species more or less incompletely; and certain members, or series of members, are thus reciprocal

* Those of the forms and properties which persist through the successive generations determine the species. Link, Grundlehren der Kraüterkunde, vi. p. 11.

† The species is an individual of a higher rank (higher power). Link, *l. c.* p. 11.

‡ Cf. the Author's work on Verjüngung (1849), note to p. 344.

complements. The regular relations here brought to view will form the principal subject of the present investigation. But we must first carefully determine the sphere of the individual. The individual shall not and may not be considered by itself: it must be viewed in the successive generations to which it belongs. This succession may be similar or dissimilar, simple or complicated by divisions, continuous or graduated by cyclical changes. It is by this that the phænomena of fissiparous and alternate generation may be explained. It is only by a consideration of these relations that the nature of the individual itself, as a subordinate sphere of the species' development, can be rightly comprehended, and that the single individuals in their worth and importance, in their relations to each other and to the whole realized cycle of the species, can be understood.

Preliminary Remarks on Vegetable Individuality: different views in regard to it.

We must determine what constitutes the vegetable individual, before we can investigate its relations to the whole cycle of generation of the species. But it is this determination itself which presents so many difficulties; and these difficulties become the greater, the further we push our investigations. Individuality in plants seems as obscure and ambiguous, as in animals (at least in their higher orders) it appears clear and simple; so that, as Steinheil remarks, it escapes us just when we are upon the point of seizing it*; and investigators might even conclude that we can realize no other individuality than that which is manifested in the totality of the species. The first obstacle to our comprehending the vegetable individual as a single sphere of conformation, as a morphological whole, is the disconnected and separate character which obtains in the most heterogeneous modifications of vegetable organisms. For nowhere in the vegetable kingdom do we perceive that indissoluble connexion, and those pervading reciprocal functions, which in the animal kingdom we are accustomed to associate with the idea of an individual organism. Nevertheless, by starting from a comparison with animals we get an apposite point of departure for a comprehension of the plant's individuality. Among the higher animals, the individual appears as a member of a race produced by sexual generation; and this very test may be applied to plants, except in the very lowest forms, to which sexual generation does not apply at all,

* "Dans chacun de ces organes nous nous croyons au premier aspect sur le point de saisir l'individualité normale, et partout elle nous échappe." Steinheil, De l'Individualité végétale (1836), p. 9.

or not positively. Without at present discussing the question whether the vegetable individual thus conceived is truly analogous to the animal individual, we may here state, that this conception carried out to its consequences, involves the assumption that all the plant-stocks produced, not by sexual generation, but by any mode of vegetable division, are not individuals, but only parts of the primary individual to which they owe their origin; as Gallesio has in fact contended*. Botanists have often asserted that it is the individual † alone, which is reproduced by slips (branches, buds, tubercles, &c.), and their opinion coincides with this view. Still, how are we to distinguish plant-stocks of such an origin, from those derived from seeds? The former take root, ramify, blossom, ripen their fruit and seeds, just as the latter do, so that in a physiological sense they are complete individuals ‡. For example, let us cast a glance at the weeping-willow (*Salix Babylonica*). It is well known that this tree, which was originally brought from the banks of the Euphrates, is always propagated by slips; for with us it never bears seeds—not because our climate is unfavourable, but because in our gardens there is no fructifying male tree §. According to Lou-

* Gallesio, Teoria della Riproduzione vegetale (1816), a work, which I am sorry to say I have not been able to consult myself. Huxley (upon Animal Individuality, in the Ann. and Mag. of Nat. Hist. June 1852), holding corresponding views, regards all the animals which spring from an egg by non-sexual increase, as *one* individual, or, as he expresses it, as a representative of the individual by successive coexisting separable forms;—regards as such, for example, the sum total of all the *Aphides*, produced in successive generations, by non-sexual increase, from the first "nurse" which sprung from the egg. If we assume with Bonnet that one nurse encloses one hundred young *Aphides* in the tenth generation (and according to Kyber they often reach even a higher number), the series would amount to much more than a billion (1,010,101,010,101,010,101). Those who regard sexual reproduction as the criterion of individuality must admit this as a perfectly legitimate consequence of their view.

† "Gemmæ individuum continuant cum semina speciem propagent." Link, Elem. Phil. Botan. ed. 2. vol. i. p. 332. "Continuant," in antithesis to "propagent," cannot be mistaken. Again, Endlicher and Unger, Grundzüge der Bot. p. 85, say: "In these cases (*i. e.* when the buds drop off) the bud-formation is a true propagation, by which the individual is multiplied; though we must distinguish this mode of propagation from that of generation, by which the species is reproduced." Here the meaning is obvious, though the expression is perfectly paradoxical; for how can we imagine that the individuals are multiplied without the species being reproduced? I have elsewhere attempted to show what is here meant, by representing non-sexual propagation as a propagation *subordinate* to the cycle of sexual reproduction (cf. Verjüngung, pp. 26, 27).

‡ In many cases the experienced gardener can distinguish them, but certainly not in all; in some the difference is very remarkable: *e. g.* in *Araucariæ* raised from branches.

§ This has the advantage of avoiding the disagreeable seed-down. For the same reason, it is said, in China they cultivate the male tree only.

don (Arboret. Brit.), the weeping-willow was sent to England in 1730, by a French merchant named Vernon. It was planted in Twickenham Park, whence it spread rapidly over England and the continent. The tree, from which the first slips that were brought to Europe were taken, was most probably a cultivated one itself, raised from a slip. However this may be, could the descent of all our weeping-willows be traced, it would undoubtedly lead us back to a willow, a female willow, grown in its native country from a seed. And so, on this account, we are to regard all the beautiful weeping-willows of our gardens and our cemeteries—and surely they are perfect trees—not as individual stocks, but as the *disjecta membra* of a primary trunk, now hidden in mythical darkness! In other cases this primary trunk is known with perfect certainty. It can be proved by history that many hybrids and varieties have been produced in one single exemplar; though they now ornament our gardens far and wide, having increased by means of slips, as they do not bear seeds. This was the case of the famous *Cytisus Adami*, which sprung, shortly before the year 1825, from the mingling of *C. purpureus* and *C. Laburnum*. The single parent-stock, preserved in the garden of the celebrated Adam in Paris, has long since disappeared; but its scions and scions' scions have grown up into fine trees in half the gardens of Europe*. In the view just stated, they all form but one individual! To support such a view, its partisans adduce the fact of certain individual particularities being preserved (in diœcious plants especially the gender), when propagated by slips. In general this is true, and for practical gardening, *e. g.* for the cultivation of the finer kinds of fruit, of the greatest importance; but exceptions are not rare; among which the well-known re-division of *Cytisus Adami* into its two primary stocks is one of the most striking and remarkable. In our gardens the rule is, that from slips the weeping-willow produces female trees; still some exceptions may be noted here. Napoleon's grave in St. Helena is shaded by a weeping-willow, which has become the subject of scientific discussions. It was supposed to belong to a species (*Salix Napoleonis*) indigenous to that island; but Loudon's exhaustive researches show that it is descended from our weeping-willows, one of which was carried from England to St. Helena in 1810. Branches of this *Salix Napoleonis* were brought back to England, and to the astonishment of botanists they bore *male* flowers. Since up to that time no male weeping-willows had been seen in England, a change of gender must have been produced through

* Cf. Verjüngung, pp. 337 and xi. In another place I shall communicate the history of this hybrid, which has since been investigated.

vegetative increase. A similar case has also occurred in Germany. In the Grand-ducal Gardens at Schwetzingen there is a weeping-willow, which, although a descendant from the common parent tree of all European weeping-willows, has changed its gender to such a degree, that we not only find on it the most heterogeneous stages of transition from female flowers to male ones, but on many branches purely male catkins are produced*. Besides these cases, a curled variety of weeping-willow, *Salix crispa* or *S. annularis* of the gardens, is known; which, as it is a mere garden plant, has probably been produced by slip-propagation. If it be true that we sometimes obtain varieties with hanging branches from several kinds of trees by grafting the slips inverted, we should have one of the most remarkable examples of the production of a singular peculiarity by non-sexual increase. But even if such exceptions did not exist, and if in every case a series of peculiarities which are extinguished in seminal propagation were continued by grafting, yet we cannot perceive how we can seriously refuse an individual existence to such stocks as these, produced, it is true, by non-sexual propagation, but still completely separated externally, developing in different places and under the most dissimilar relations, and exhibiting subordinate differences indefinitely, though with certain similar characteristics. But if we were to make any concessions on this point, we should be carried irresistibly on to others.

Most of the modes of non-sexual propagation thus far considered agree in this particular: that some *shoot* of the plant, whether it be undeveloped (eye, bud), or developed (branch, sucker, layer, &c.), is separated from the parent-stock by natural development itself, or by artificial means. As the nature of the separable part is not changed by the separation, it is no great step to attribute individuality to the shoot (or as it is commonly called, the bud), even when it is not separated from the stock. Each single plant-stock could then be no longer regarded as an individual in the usual meaning of the term, but as a united family of individual shoots;—a view which seems to be of high antiquity; as passages are found in Aristotle† and Hippo-

* This tree was first observed by C. Schimper in 1827. Some remarks upon it may be found in Spenner's Flora Friburgensis, vol. iii. p. 1061.

† Cf. Wimmer, Phytologiæ Aristotelicæ Fragmenta, §§ 23–28, 66 et 113. I cannot discover that explicit acknowledgement of the individuality of shoots or buds, which is said by Schultz (Anaphytose, p. 24) to be found in Aristotle, either in Schultz's quotations, or even in Wimmer's complete collection of the passages in Aristotle referring to plants. It is true that Aristotle repeatedly speaks of the divisibility of plants; says that separated parts of plants may continue to exist; that on this account many trees may spring from a single source; that many plants are propagated by slips (*ἀπὸ σπαραγμάτων ἀποφυτευομένων*), and by lateral bud-formation (*τῷ*

crates * which are interpreted in this sense. In later times, this view has been more or less advocated, especially by De la Hire †, Linnæus, Darwin ‡, Batsch, Goethe, Röper, Schleiden §, and others.

But, even in this narrower view of vegetable individuality, the same difficulty meets us; for the shoot itself is divisible, and new stocks may be produced by its parts; *i. e.* by the members of the stem and its leaf or leaf-whorl ||. Besides, the several members of the shoot are not contemporaneous creations, but, developing successively out of and over each other, they constitute a successive generation, composed of divisions each of which repeats essentially the same form, each of which may be compared to the embryonic plant originally developed in the seed, and consisting of its stemlet with one or two leaves (cotyledons). Thus the shoot itself came to be regarded as a *succession of individual vegetable members*, built up one above the other, like the stories of a house. The earliest traces of this view may be found in Darwin's 'Phytologia' ¶; it was developed at a later period in various ways and with various modifications: *e. g.* by Agardh**,

παραβλαστάνειν), *e. g.* the bulbous plants; but he does not state his opinion of the parts which develope after such a separation, and explains the phænomena in general, by saying that the vegetable soul of plants (θρεπτικὴ ψυχὴ) is simple in actuality (ἐντελέχεια), though multiple in capacity (δυνάμει).

* According to Moquin-Tandon, Teratologie, p. 5.

† Hist. de l'Acad. Roy. des Sciences, 1708, p. 233. De la Hire regards all the branches as new plants proceeding from hidden ovules. Myriads of these ovules, he thinks, exist between the bark and the wood; more or less of them come to maturity, according to circumstances.

‡ Darwin, Phytologia (1800), p. 1. "If a bud be torn from the branch of a tree, or cut out and planted in the earth . . . .; or if it be inserted into the bark of another tree, it will grow and become a plant in every respect like its parent. This evinces, that every bud of a tree is an individual vegetable being, and the tree therefore is a family or swarm of individual plants . . . ."

§ I shall consider the views of these authors more at large in the next section.

|| I adduce this point in connexion with the history of the views held by botanists in regard to vegetable individuality, in the terms in which it has been usually expressed; further on I shall show that this view needs qualification. The individual members of the stem cannot expand into a new stock by direct development, like the separated shoot; they have this property only by being connected with a lateral sprout, by means of the eye which they bear, or have the power of producing. This view naturally brings us back to the shoot as the individual.

¶ P. 9; where even the single well-defined stem-members of different herbaceous plants are described as so many buds, and hence as so many individuals.

** Agardh, Essai de réduire la Physiologie végétale à des principes fondamentaux, 1829 (Ann. des Sci. Nat. tom. xvii. p. 86).

Engelmann*, Steinheil† and Gaudichaud‡—the last of whom calls the member of the shoot elevated to the rank of an individual vegetable being, "the phyton," and ascribes to it not only a stem and leaves, but even a root, by which he imagines it is connected with the preceding phytons, as the first phyton (the embryonic plant) is connected with the ground. Steenstrup § and Forbes || employ a similar view for their comparison of alternate generation in plants with that in the lower animals.

But this restriction of vegetable individuality could not stop here; for even the members of the shoot, the "phyta" or "stories," are themselves too complex organisms not to present subordinate divisions, which, like the whole member, possess a certain independence, and under certain circumstances may even give birth to new stocks. Although botanists have attempted to view the petiole as the lower part of the leaf¶, or *vice versâ*, the leaf as the upper part of the petiole** (so as not to be compelled to divide the phytons of the structure themselves into relatively independent members), this much at least is certain (and it is the important point here), that each of these two parts is capable of producing new growths by itself; yes, this capacity is enjoyed even by different determinate or casual parts of either member. It is well known that the leaf of *Bryophyllum* produces sprouts in every notch on its edges, while on the other hand, caducous leaves of many bulbous plants (*e. g. Eucomis regia* according to Hedwig, *Ornithogalum thyrsoides* according to Turpin††) produce new plants in the form of bulblets on any portion of the whole of the upper surface. The petiole itself under certain circumstances has the power of producing the so-called adventitious buds, not only on the portions determined by the position of the leaf (leaf-axil), but sometimes on any other portions; a power enjoyed by the root in many cases. Hence parts of plants, otherwise most dissimilar, when they contain cambium,

* Engelmann, De Antholysi (1832), p. 12.

† Steinheil, L'Individualité dans le Règne végétale. 1836.

‡ Gaudichaud, Recherches sur l'Organographie, la Physiologie et l'Organogénie des Végétaux. 1841.

§ Steenstrup, On Alternate Generation (1842), p. 128. As this important little work may be supposed to be in every one's hands, I refrain from quoting this interesting passage.

|| Forbes, On the Morphology of the Reproductive System of Sertularian Zoophytes, &c., Ann. and Mag. of Nat. Hist. vol. xiv. (1844), p. 385.

¶ Ernst Mayer, Die Metamorphose der Pflanze und ihre Widersacher. Linnæa, 1832, p. 401.

** Hochstetter, Aufbau der Graspflanze. (Würtemberger Jahreshefte. 1847 and 1848.)

†† Cf. Treviranus, Pflanzenphysiologie, where several examples are adduced.

may have the power of reproducing the plant*. This is the foundation of the *Schultz-Schultzenstein-ian* doctrine of *anaphytons*; viz. those vegetable members "which, even when separated from the plant, continue to live, bud, and develope†," and which are hence regarded as the individuals proper, as the true elementary forms or morphological elements; and it is by various combinations of these that the organs (commonly so-called), root, stalk and leaf, are formed, by the repetition of which the whole plant is built up and indefinitely renewed.

But where are the limits of the anaphytons? How shall lines be drawn to include all the buds of the root, stalk and leaf, from which new formations may spring? Aub. du Petit-Thouars‡, who had already developed doctrines similar to those of the anaphyton-theory, attempts to draw the line between individuals by means of the cellular tissue, regarding every vascular bundle as an individual, since it has in itself, and independently of all others, the means of its growth, its preservation, and the reproduction of new bundles. But it is difficult to perceive how, in such a view, the labyrinth of anastomosing bundles (not less complicated in the majority of petioles than in most reticulated leaves) can be disentangled and resolved into separate individuals, and why the same independence and the same rank should not be allowed to the parts of the vascular bundles. And how shall we regard the lower plants, which have no fibres at all? If our conclusions are to be anything more than mere arbitrary assumptions, we must go still farther; and we shall find no halting-place till we reach *the cell*, the true seat of every renovation in the plant, the starting-point of all non-sexual increase§,

* Aristotle himself says that plants possess the power of reproducing "stalk and root" in every one of their parts (*πανταχῇ γὰρ ἔχει καὶ ῥίζαν καὶ καυλὸν δύναμιν.* Vit. long. et brev. c. 6. p. 467).

† Schultz, Die Anaphytose (1848), and System der Morphologie (1847). The passage quoted is taken from his later work, Verjüngung in Pflanzenreich (1851). The remark made above, when treating of the members of the petiole, holds good here. The so-called anaphyta can by no means grow into new plants themselves; on the contrary, the new plant is produced as a germ, which is not identical with the anaphytons.

‡ Essais sur la Végétation considérée dans le développement des bourgeons (1809), cf. *e. g.* p. 174. "C'est donc le bourgeon en qui réside toute l'énergie végétale; aussi le regarde-t-on depuis longtemps comme un individu . . . . D'après les principes que j'ai développés dans mes précédens mémoires, il faut aller plus loin, car je crois que chaque fibre végétale est un *individu*, puisqu'elle a en soi, indépendamment des autres, les moyens d'accroissement, de conservation et de réproduction."

§ Earlier investigations into the origin of adventitious buds had made it probable that, in its formation, each new shoot arises from a single cell. The first convincing proof of this fact was given by Hofmeister (Vergleichende Untersuchung u. s. w. der Coniferen, p. 94), in *Equisetum.* The propagating cells on the foliage and edges of the leaves of Liverwort, which as it is of sexual propagation*. The cell has a better right to be considered as the vegetable individual than any other subordinate member of the plant; when connected with other cells it still continues to be an independent sphere of formation, sharply defined and, in youth at least, completely isolated†. Before the universal law of cell-formation was known, and before botanists had succeeded in reducing all the elementary organs of plants to cells, Turpin hit upon the idea of seeking the vegetable individual in the cell; though his views did not rest on as solid a foundation as Schleiden's assertion, that "in a scientific point of view, the cell is the vegetable individual ‡."

The most reliable authorities have agreed that new cells can never be formed externally to, but only within, other cells already formed §, so that cell-multiplication must be regarded as a propagation, while all the cells of the mature plant must be regarded as the progeny of the first embryonic cell. Besides, each and every plant is at first a cell; and there are single-celled plants in the strictest sense of the term, in which the first formation of new cells is that destined to reproduction; *i. e.* the germinating cells or spores ||. Again, there are other plants in which the cell-generations contained between the first generation (which sprung from spores) and the last (itself returning into spores) separate from each other, so that all the cells belonging to one cycle of vegetable development are segregated, and live com-

develope into new plants, have long been known. The spores of the Cryptogamia belong here, as they are cells originating and developing nonsexually.

* Pollen-cells, and the embryonic utricle and germinating cells,—as well as those of the archegonium of the higher Cryptogamia.

† Malpighi himself (Anatom. Plant. 1675) calls cells utriculi, or sacculi, though he distinguishes the wood and bast-cells as "*fibræ*," the vascular cells as "*fistulæ*," and the cells containing milky sap as "*vasa specialia.*" As early as 1805, Link (Römer's Archiv, iii. p. 439) had expressed himself very explicitly in regard to the isolated position and the independence of cells: "Quævis cellula sistit organon peculiare, nullo hiatu nec poris conspicuis præditum in vicina organa transeuntibus. Conspicies non raro cellulam rubro colore tinctam inter reliquas virides."

‡ Schleiden, Grundzüge, 1te Aufl. 1842, vol. ii. p. 4 [Eng. trans. (1849), p. 127 T.].

§ Cf. Schleiden, Grundzüge, i. p. 267 [Eng. trans. p. 103 T.]: "The process of the propagation of cells, by the formation of new cells in their interior, is a universal law in the vegetable kingdom." Mohl, Anat. und Phys. d. veg. Zelle, 1851, p. 53: "Cell-formation in plants takes place only in the cavities of older cells, not between or upon them." Schacht, Die Pflanzenzelle (1852), p. 47: "The formation of new vegetable cells always takes place in the interior of cells already formed."

|| E. g., *Ascidium*, *Chytridium*, *Codiolium* (a genus lately discovered in Heligoland), *Sciadium*, *Hydrodictyon* (the last two with "colonial formation").

pletely independent of each other *. The importance of the cell as an individual seems to be decided by these facts; that of the entire plant, as a superior whole composed of individual cells, seems to be settled, and a firm foundation for the doctrine of vegetable individuality to be gained. But let us try to obtain a clearer view of some of the most important of these facts. The view which regards all cell-formation as a process of reproduction rests upon observations of the formation of free daughter-cells, (blastidia) in the contents of the mother-cells (matrices),—the so-called *free*, or *endogenous*, cell-formation. Schleiden, who discovered this process, and Karsten †, the most decided and original of his followers, regarded endogenous formation as the universal law of cell-formation. By this view the whole doctrine was turned in a wrong course, from which it could only be gradually recovered by the discovery, or rather the farther investigation, of another mode of cell-formation, which Nägeli designated as "wandständige," Unger as "merismatic," and Mohl as "cell-formation by division of the primordial utricle." But even at this day the misconception caused by generalizing the view that new cells are formed *within* old ones, has not been entirely removed. I have already ‡ called attention to the fact that cells are divided which have no cell-wall, which is often the case among the Algæ §. In several genera in which numerous spores are formed in one mother-cell, its entire contents first divide into two parts (the so-called daughter-cells), which, without first secreting a cell-wall, immediately divide again into two; and this process may be repeated over and over ||, according to the number of spores which are to be formed (8, 16, 32, &c.). In the second and subsequent divisions there is no formation of new cells *in* old ones, of daughter-cells *in* mother-cells, and hence no reproduction, in the sense of one or more individuals being produced *in* an old one. The *entire* mother-cell is converted into two filial cells; the filial cells are nothing but the mother-cell divided. And this is essentially the case in every cell-formation by division; for the wall of the mother-cell (within which the division generally takes place) certainly is not the living mother-cell, but

* Many Palmellaceæ, Desmidiaceæ, and Diatomeæ. Cf. Braun, Verjüngung, p. 132 *et seq.*

† H. Karsten (De Cella Vitali, 1843) emphatically rejects every mode of cell-formation by division and by sprouting, and asserts that every cell originates at its first appearance as a dot-like utriculus; regarding all formations found in the contents of the cell as cell-brood.

‡ Cf. Verjüngung, p. 245.

§ E. g., *Protococcus* (*viridis*), *Characium*, *Pediastrum*, *Ulothrix*, *Enteromorpha*, *Ulva*, &c., during the process of spore-formation.

|| Nägeli (Monocellular Algæ, p. 28) calls such cell-generations "transitory generations."

merely its cast-off garment, its perishing shell. Cell-formation by division (called the "merismatic" or "wandständige") is that which obtains through the whole realm of vegetative development; while free cell-formation occurs only in fructification. Thus, the same phænomenon, which, regarded as endogenous cell-formation, seemed so favourable to the importance of the cell as the vegetable individual, when more justly comprehended only brings us back to the divisibility of the vegetable organism, repeated in the most heterogeneous spheres. But still more: even the cell whose contents are not converted by division into new cells, but remain simple, presents phænomena which can hardly be reconciled with their view by those who regard such a cell as an individual, isolated in space and independent in time. In the genera *Vaucheria, Bryopsis, Caulerpa,* and other related Algæ in the family of *Siphoniæ,* we find such cases, examples of the most extraordinary kind of cell-formation. The single cell, which forms the vegetable organism of these plants, has in fact a development which may continue indefinitely. Certain parts of the elongated stem-like cell shoot forth into branches which lengthen by an independent terminal growth, without separating from the cavity of the maternal trunk by any partition. The principal trunk of the cell is either creeping, with an indefinite terminal growth, though dying off from behind (*Caulerpa prolifera* *), or it is upright and deciduous, while the sucker-like branches, club-shaped at the ends, and filled with a denser contents, are perennial (*Vaucheria tuberosa* †). In both cases the branches separate from the dying trunk, closing up at the bottom; and thousands of new trunks may thus be produced without any proper cell-formation. Thus the cell leads us back to the point from which we started at the tree; and, as we could not refuse individuality to the ramifications of the tree, neither can we refuse it to the ramifications of the cell. Hence we cannot regard the cell as an absolutely single being, completely isolated and indivisible. Shall we penetrate still further into the anatomy of the cell itself, in the hope of possibly finding a valid vegetable individual? All that we discover here is, first, the vesicles, spherules and granules in the contents of the cell (amylum, chlorophyll and other pigment-vesicles, spherules of fat, and, finally, the granules of the viscous cell-contents, whose chemical nature it is difficult to determine); and secondly, the

* Cf. Nägeli's important paper on this plant (Zeitschrift für wissen. Bot. i. p. 134), especially the exposition of the above-mentioned relations beginning p. 158.

† A new species from the vicinity of Lake Neuenberg in Switzerland, remarkable for its purely furcated ramifications, with constrictions at the bottom of the branches, as well as for the club-shaped suckers at the ends.

fibres, which compose the cell-membrane according to the old view advanced by Grew and lately revived by Meyen * and J. Agardh †. These parts, it is true, have often been regarded as the elementary forms ‡ of plants, or their primary "individualized" bodies §; the attempts, however, to represent them as the true and real vegetable individuals are not numerous; and they astonish us by their daring rather than entice to imitation. Turpin, who commenced by considering plants to be composed of different kinds of individual cells, which he compared with various lower plants (especially the Algæ-genera *Protococcus* and *Conferva*), afterwards expanded his views, so as to regard the cells themselves as individuals of a second rank; while he considered the true primary individuals to be the granules of the cell-contents, from which, in his opinion, the cell (cell-wall) is formed by agglomeration ||. Mayer of Bonn, basing his theory upon molecular motions, considers the smallest granules of the cell-contents as individuals possessing animal life (biospheres), which build up plants for their dwellings. "Like hamadryads these sensitive monads inhabit the secret halls of the bark-palaces we

* Meyen, Pflanzenphysiol. i. p. 45; answered by Mohl, in his Vermischte Schriften, p. 314.

† J. Agardh, De Cell. Veg. fibrillis tenuissimis contexta (1852). Notwithstanding the importance of the author's new investigations, they still need a more searching examination, as some points directly contradict well-ascertained facts, *e. g.* the direct transition of the fibres from the outer to the inner layers of the cell-wall. The whole theory of the formation of cells by the uninterrupted growth of fibres cannot be admitted in view of the undoubted independence of the formation of the cell-wall from the contents. Mohl is certainly right in regarding the fibrous division and divisibility of many cellular tissues as a mere structural relation of the membrane (which in other parts is continuous); and he thinks it depends upon the peculiar mode of agglomeration of the molecules. As such molecules of the cell-wall are invisible, I think it preferable to regard it as dependent upon a regular change of the relations of density.

‡ Kützing, Phil. Bot. i. p. 125, 129, does not regard the cell as the elementary form of plants, but as a complicated structure itself, and preceded by many other more simple forms, which he comprehends under the name of "molecular tissue," and which, he says, present in themselves many lower vegetable forms;—plants which are not even cells!

§ Unger, Grundz. d. Anat. u. Phys. der Pflanzen, p. 4. The cell is represented as the "elementary vegetable organ;" but the vesicles, fibres and granules within it are further distinguished as very minute, "individualized" bodies.

|| Turpin, "Sur le nombre deux" (Mém. du Musée, xvi. 1827, p. 305): "Ainsi des individus globuleux, rapprochés simplement contigus, forment la membrane de la vésicule Individu du tissu cellulaire, le filament Individu du tissu tigellulaire, et la membrane cuticulaire Individu. Des agglomérations de ces derniers constituent les Individualités, provenantes des bourgeons développés, et enfin, celles-ci achèvent *l'Individualité composée* d'un arbre."

call plants, and here silently hold their dances and celebrate their orgies *."

Farther than this we cannot go: if we did, we should have to leave *specific* vegetable life, and, instead of investigating its most minute spheres of formation, the visible cells, vesicles, granules or monads, turn to the invisible *individua* † of brute matter, so as to consider plants as phænomena of appellant and repellant, coherent and incoherent atoms. If we must understand by an individual, a being perfectly simple and indivisible, this is our last refuge, in which we may indeed reach an individual, but not a *vegetable* individual; for this would then be identical with the material individual common to all corporeal existence. But, even if we could give up all hopes of a specific vegetable individual, doubt would still linger round these physical individuals; for even the existence of the universal primary particles of bodies—the material individuals, the atoms,—is not conclusively established. No eye has seen them; we do not even think of considering them as objects of direct perception; we only accept them as an hypothesis, to eke out our theories of motion and of chemical affinity; and to enable us to compute their relations. The question might easily be asked, whether the same phænomena may not be as well explained by assuming the continuity, expansibility, and penetrability of matter. However this may be, the question concerning the existence of atoms certainly lies beyond the limits of botanical investigation; and if the existence of vegetable individuals depends on this question, the botanist must despair of proving it. Thus the question at which we have now arrived is this: can we speak of individuals in botany? and this is identical with another: are plants mere products of the operations of matter (*i. e.* of a substance self-moving, uniting and separating by an innate force), and hence non-entities, or mere phænomena resulting from, or produced by, the blind forces of nature; or may we ascribe to plants an independent existence in nature, notwithstanding their connexion with the external world?

If what we call plants are nothing but complex chemical and physical *processes*, then we can no longer speak of their individuals and species in the sense the words usually bear; for the mere phænomena of the operations of the primary substance, which have no other efficient principle than the forces of this substance, cannot be regarded as self-existent beings, or as peculiar (specific) kinds of these beings, or as single (individual) modifications of them. This is, in fact, the result towards which the

* Mayer, Supplemente zum Lehre vom Kreislauf (1837), p. 49. I am acquainted with Mayer's views through Meyen's Pflanzenphys. ii. p. 256

† Cicero calls the atoms "individua."

later physiological investigations are hastening, grounded on the positive results of investigations in the physical sciences. Even vegetable physiology cannot resist this tendency of science, although it struggles more or less against these conclusions *. The operations by which plants, and all organic beings, form and preserve their organisms, were formerly ascribed to peculiar vital forces; but the physiology of our day would recognize in the vital functions of the organism the same forces by which the processes of inorganic nature are performed. Thus physiology becomes physics and chemistry, or, according to the usual conception of the physical and chemical processes themselves, the "mechanics" of organic nature in the most comprehensive meaning of the term mechanics. And thus the life of the enchanter is unveiled, who had seemed to be the immediate cause of his own works; the lofty partition-wall between organic and inorganic nature falls, and one common foundation is laid for investigating all material processes in every realm of nature. This important result is reached: the existence of the higher orders of natural phænomena, which had been regarded as the peculiar realm of Life, is referred to the same natural causes (the same material substance and the same kind of forces) by which the lower orders, those of "inanimate" nature, have their being and perform their functions. Still further conclusions may be attempted, and it is in the nature of scientific progress that these attempts should be made. As physical forces seem to be everywhere indissolubly connected with matter, and as a fixed regularity displays itself in their operations, men were found bold enough to consider the totality of natural phænomena as the result of original primary substances, cooperating with determinate forces, according to the laws of a blind necessity;—a natural mechanism revolving in its endless orbit †.

Though this view seems to explain all the phænomena of nature from one principle, in fact it precludes any real explanation

* Even Schleiden, the most prominent and most decided of the representatives of this tendency, seeks to counterbalance the deadening effects of the purely materialistic view by an æsthetic one (Die Pflanze und ihr Leben; last lecture, D. Æsthetik der Pflanzenwelt).

† As far as concerns natural history these views are developed, *e. g.* in both of Mohlschott's works, D. Physiol. des Stoffwechsels in Pflanzen u. Thieren (1851), and D. Kreislauf des Lebens (1852); in the last-mentioned work we find such sentences as these: "The miracle of nature is the interchange of matter, the first cause of physical life," p. 83. "Creative omnipotence means the relations of matter," p. 258. "The hinge round which the wisdom of the present day is turning is the doctrine of the interchanges of matter," p. 363.—The doctrine, that the universe is the play of attrahent and repellant atoms, belongs, after all, to the "wisdom" of the past, professed by Democritus and Epicurus.

of them, that is, when exclusively applied to their solution. That which is eternally necessary can only be conceived as eternally carried out; and thus any real event becomes an absurdity. If the "mechanical" (physical and chemical) forces of nature are necessarily active, then if any motion is to take place, the first impulse, the proximate cause, cannot be explained by the nature of the motion; it must be another principle above necessity; and this is true not only of nature as a whole, but also of every particular motion in nature as well. Thus not only the first impulse, but the universally apparent final cause, remains an inexplicable riddle in the doctrine of blind necessity. Hence the insufficiency of the "physical" theory, compared with the "teleological*," is peculiarly obvious in the realms of organic nature, where the final cause of each particular life appears so distinctly. The advocates of the physical view perceive this; but they explain the fitness of means to ends in nature as a whole, and in its individual parts, by supposing matter, with its blind forces, to have been created by an intelligent Being†. But we can regard this as a germ of an explanation only in proportion as it is also granted, that the intellect of the Creator lies not only behind and without nature and her processes of development, but that, as if incorporated in nature, it is taken into the destiny of each created being, in proportion to its individuality. But this again presupposes the admission of a substantiality of nature fit for such an hypothesis;—a substantiality not grounded on mere matter, like a blind force; but which, on the contrary, must comprehend matter as subordinate to itself, and must realize itself through matter:—an assumption which modifies the physical view essentially, and would seem to be a modification of some ideal, or teleological theory.

Without underrating the great importance which the physical view possesses for vegetable physiology, still we must confess that we cannot find in it the key to a conception of vegetable individuality; for, after all, this must be sought for, not in the external conformation, but in the essence of the plant, determined

* Cf. Schwann, Microscopische Untersuchungen über die Uebereinstimmung in der Structur u. d. Wachsthum d. Thiere u. Pflanzen (1839), especially p. 221–225; on the other side, Eschricht, D. Physische Leben (1852), in sections ii. and iii.

† "The fitness of means to ends, in every organism, even a superior degree of this individual fitness, cannot be denied; but in this (the physical) view, the cause of the fitness does not consist in the fact that every organism is produced by an individual force tending towards a certain end, but, like the cause of the fitness of means to ends in the organic world, that matter is the creation of an intelligent Being." Schwann, *l. c.* p. 221, and, in almost the same words, p. 224.

from within. This leads us from the last negative results to an historical view of the attempts at a positive explanation.

It is evident from the foregoing review that, if we would not give up all hope of conceiving plants as *beings, realized in individual conformations,* we must not allow so great and decisive an importance to the external divisibility of their organism as has been usually done. We must seek a decision in the essential concatenation of all the steps in the plant's development forming one whole, according to one idea. This is the tendency of the concluding remark of Nägeli, to which he is led by the relations of growth and propagation in *Caulerpa,* when he says, that indivisibility of form is not an element essential to individuality—which, indeed, must be constructed upon a new, and somewhat less material basis. Link calls attention to this same unity, which is expressed in the whole development of the plant, and which forms the essence of its individuality, in the following true words: "We cannot recognize an individual unless we are convinced that it remains the same in different periods of its existence *." Now the question is just this: how can we perceive such a oneness of essence amid these changes of form and material? How do we perceive that, with all its divisibility, the plant remains after all really one and the same individual?

Every development presents a succession of phænomena, which, while they present themselves in a regular order, also show unmistakeably a point of departure, an end, and a course between the two advancing after a fixed plan, and which indicate a common internal principle †. They point to an internal vital principle ‡ common to the whole succession;—to a principle which

* Link, Elem. Phil. Bot. ed. 2. p. 11.

† Du Petit-Thouars, *l. c.* p. 234: "L'individu est un être dont toutes les parties sont subordonnées à un principe unique d'existence." Link, Elem. Phil. Bot. ed. 2. p. 3: "Nos individuum vocamus, quod ab uno eodemque principio interno determinatum est, ad idealem potius quam ad realem respicientes divisionem."

‡ Spring, Ueber d. Begriffe v. Gattung, Art u. Abart (1838), p. 55. "It is this indwelling principle which makes the individual; and in natural history, every body is an individual in as far as it really exists as a single being, whose existence is determined by a peculiar indwelling vital principle." Spring afterwards distinguishes the *systematical* and the *physiological* individual: in the former one phase of the development is comprehended, in the latter the whole metamorphosis. The physiological individual comprehends an assemblage of forms, which might be regarded by a casual observer as so many systematical individuals. Still, a true systematist must protest against such a purely subjective distinction of systematical and physiological individuals. However much the embryos of Mosses resemble Confervæ, or the larva of an insect resembles a worm, a true systematist will not separate the young individual from the developed

must be conceived of, not only as an idea which guides the whole process, or as a force determining the specific type of this plastic succession, but also as a living essence, comprehending the idea as its internal determination, and the force as the means of its realization;—an essence which precedes and shapes the external existence; as intentions precede and determine acts*. If, in ac-

one; and genera which are founded upon our ignorance of their successive development, as *Protonema, Lepra, Sclerotium,* &c., must be given up by the systematist himself. True, we shall be called upon at a later point in this inquiry to decide, whether a sphere of development which really belongs to the individual can present itself to us so divided that the divisions themselves attain to the importance of subordinate individuals.

* Aristotle describes the internal essence of plants as a "plastic soul" (*θρεπτικὴ ψυχὴ, τοῦ ζῶντος σώματος αἰτία καὶ ἀρχή*). Cf. Wimmer, Phytol. Arist. Frag. c. iii. De Pl. Vita atque Anima. The charge of anthropomorphism has been made against such a view, which attempts to conceive of nature as a chain of essences, both in the reciprocal relations of her forces, and in her internal developments; but, if man himself is a member of nature, if he is the highest member in the order of natural beings, that member which presents the most complete unison of all the phases of life in nature,—then all his knowledge of nature must be connected with his knowledge of himself. However meanly we may estimate this knowledge at the present stage of psychological science, still it is sufficient to assure man of his own "ego." And if man is justified in regarding himself as a human being, by analogy he is justified in regarding his relations, the animals, in the same manner, as animal beings; plants as vegetable beings; and every single animal, every single plant, as an individual being (even though included in a higher entity). To attain a unity of idea in Natural History, man must apply this idea farther down in the scale of nature, and must regard minerals, even the elements themselves, as beings of their own kind. But the materialist will reply, Individual beings are only the elementary substance: all other beings, so called, are formed by a temporary composition and cooperation of these. But who has seen these elements of chemical combinations, as *elements,* or has proved their existence in any way? But even if they should exist as such, is it not conceivable that a higher being should include the lower beings? We say, hydrogen and oxygen form water; but it would do as well to say, water forms itself out of hydrogen and oxygen. The elements do not form the plant; the plant forms its body out of the elements. We may declare both these views to be hypotheses; but of hypotheses that is preferable which is nearest to man,—I would almost say, most necessary to man's nature, when he proceeds from the data of his own existence. Shall the elements have a stronger claim to be acknowledged as real existences than man himself? Or will any one say that it is a more daring hypothesis to assume that man thinks; that brutes move themselves; that plants themselves produce the determinate form of their organism, than to suppose that elementary substances in their connexions and cooperations produce the phænomena of thought, voluntary motion, and typical conformation? But after all, is it not true that the elementary substance is everywhere present? that without it none of the phænomena just mentioned can occur? Certainly this is so; the higher stages cannot be realized without the lower, which enable them to exist; but these higher stages can never be explained by, and comprehended in, the lower. No one, as yet, has shown even the shadow of a possibility of explaining, from the things themselves merely, why the ele-

cordance with this idea, we regard external development as the revelation of the internal essence, which exhibits its purport in the processes it undergoes in connexion with the world without it, and whose realization is thus produced by a determinate sphere of activities, necessary for such a realization, then, *vice versâ*, we may infer the essential unity of each particular sphere of development from the complete unity of the functions relating to this realization. This leads us to the attempts made at a physiological determination of the vegetable individual. The usual definition, and one entirely in accordance with the physiological point of view, is that an individual is a perfect representative of the character of the species, possessing all the functions necessary to the continuance of the species. Now if we would conceive of a physiological individual, in the broadest meaning of the term, we should certainly be compelled to demand that our conception should be such as to exhibit not only single phases, but all the phases of the specific life during its entire development; that it should realize all the capabilities of the specific being, and thus present to us the whole plan, the whole destiny of the species. If we examine the preceding conclusions from this point of view, it will be evident that single cells cannot be such individuals; for, although the whole construction of the plant and all the functions of its life are carried on by means of the cells, still, viewed as a connected whole, the cells are only single stones, single elements, in the great mechanism of the

mentary particles form a mineral kingdom, a vegetable kingdom, an animal kingdom, and man. And why do they not fulfil their task after an eternal, immutable manner, since such a fulfilment is one of their necessary, eternal, and immutable properties? Why have they succeeded in composing man only in the most recent geological epoch? Why have they not from eternity produced in man's brain the theory of their actions, and thus, in accordance with their eternity, eternally manifested and glorified themselves? The most industrious investigations into the relations of the physical world promise us a deeper insight into the regular connexions of all the parts of nature; into the cunning mechanism which carries on and upholds all natural life. Still, a key to the interior of this structure, and an admission to the essence of plastic nature in her operations, cannot be found by our investigations, if, by presumptuous hypotheses, they debar us from the higher realms of development, especially those of organic nature and of human life. Flesh and blood are hypotheses; but mind is truth, says a well-known writer; and Des Cartes could find a proof of his own existence and of that of the world around him in his mind alone. It would be a strange contradiction, if the investigation of the most distant realms into which the human mind can penetrate should rob us of what is nearest and surest, the intellectual *ego* itself, the starting-point of all investigations. But he who has not recognized the foundations of the spiritual world in nature itself, must of consequence deny their existence in man, if he would not lose, in an inexplicable dualism, the hope of obtaining coherent views of nature.

organism. Any single member of a plant (as the internode and leaf) corresponds no more to such a physiological individual than does the cell; for plants undergo their metamorphoses in their successive members; and the various processes of their preservation, reproduction and propagation are connected with the various steps of these metamorphoses. Nor can it be the shoot; for that usually does not embrace all the steps of the metamorphosis; besides, the functions are variously distributed in the shoot; and in many cases, this takes place for the reciprocal completion of the functions. Besides, whatever is characteristic in ramification and in growth depends upon the combined shoots, and without these it is impossible to conceive of trees, for instance. Then we come back to the whole plant-stock! Nay, farther; we cannot stop at the plant-stock; for the single stocks are far from being perfect representatives of all the phases and tendencies of the specific life. I would refer to the division according to gender, or the modes of fructification, which is often made in botany; the diœcious and triœcious * relations, and farther, to the varieties, especially to those which do not possess essential organs and functions, which belong to the species as such; *e. g.* those varieties which never bear blossoms (ball-acacias), or which never produce fruit (congested blossoms), or which never perfect seeds (currant-grape, cultivated bananas and bread-fruit trees). Besides, no stock is exactly similar to another: we ascertain only the limits of the possible relations of the specific form by a comparison of many stocks. As in animal physiology the solution of the problem of the life of many animals depends upon their social relations (societies composed of couples or of flocks, or of self-governing states), so in vegetable physiology it depends upon characteristic physiological traits whether plants live singly and dispersed, or in societies. For example, in considering the life of turf-mosses, we must determine whether they grow in great sods or in carpets; and of grasses, whether they form meadows; or of trees, forests. Even the relations of geographical distribution, which are discovered by a comparison of all the stocks, depend upon the physiological character of the plants: plants of sensitive and inflexible constitutions are found only within narrow limits; while plants of adaptive and pliant constitutions are more widely distributed, become migratory plants, and by degrees spread over almost all parts of the earth, if their seeds possess the necessary properties.

* Triœcious plants are exceedingly rare among Phanerogamia (*Ceratonia*, some kinds of *Rhus*), but are more common among the Cryptogamiæ; perhaps we may add the Floridie. In *Polysiphonia violacea* I have found three kinds of stocks mixed, and in the same stage of development in the same place (upon the same thread in *Chorda Filum*).

From these considerations, and many others which might be adduced, it is obvious that there are no determinate limits to a purely physiological conception of the vegetable individual; and that we may expand the definition of the individual until it coincides with that of the species itself.

How then can we steer a middle course, between the morphological view, which results in indefinite subdivision, and the physiological, which ends in indefinite expansion? The physiological view has shown that none of the divisions or spheres of formation, which have been regarded as the individual ones, fully realizes the idea of the species; and that each needs the others to render this idea complete. The morphological view has shown, in the same manner, that there are subordinate and comprehensive spheres of development, none of which exhibits complete independence, since all appear in unequal degrees, as more or less perfect members of the entire succession of the specific development. If we would discover the individual under such circumstances, we must not demand of it all that belongs to the species; for this is *completely* represented only in the totality of the individuals, not in any single individual. We must answer this question: Which member of the graduated potential series in the sphere of development subordinate to that of the species deserves *pre-eminently* the title of individual? And we shall be compelled to reply: That which exhibits the most complete independence and definiteness. Good use has decided in regard to man (and the higher animals), and it justifies itself by the fact, that what is usually termed an individual undoubtedly possesses great organic independence: and this is true both of its subordinate spheres (*i. e.* the members of the organism, down to the cells) and of those by which the individual is comprehended (family, state, race, &c.). By means of comparison and analogy, the signification of the more doubtful spheres of development among the lower animals and plants may receive some new light from such a view. I propose to attempt this in the second part of this investigation, but now I will only subjoin a few general remarks.

In the conception of individuality, there are two elements; that of multiplicity and that of unity. Each development exhibits multiplicity; but this multiplicity is not equally subordinate to the unity in every development. The more complete this subordination, the more perfect is the individuality; for it is only this subordination to the unity which binds up the multiplicity of the conformation into an indivisible organism. The less complete the subordination, the more perfect will be the independence of the parts, and the more indefinite will be the individuality of the whole. If we apply this view to plants, whatever is dubious in our conception of vegetable individuality will be explained. Successive development, we may say, is the peculiar nature of plants, which, beyond the power exhibited in the process of formation and propagation, possess no higher vital power; while in animals the process of the formation of the body appears only as an operation preparatory to its connexion with a higher vital activity. For animals, in addition to their powers of external manifestations, have a power of internal vital comprehension, which expresses itself in the life of the soul (by which animals possess an internal centre, from which the organism is governed and regulated). It is the soul alone which connects in indivisible unity, and for reciprocal services, the products of the plastic power, and gives to the organism of animals the character of a definite individuality. Among plants the case is different: plants in their operations are active solely in one direction, externally—are split up, so to say, in the process of external conformation, so that the parts appear less connected, as compared with the plant as a whole more independent, and more divisible among themselves. Thus the vegetable organism is a *dividual*, rather than an individual; a multiplicity * rather than a unity; *i. e.* a whole whose parts hold the same relation to each other as individuals to each other, but which present spheres as indivisible as the whole itself. This is the doctrine of the *relative* † individuality of plants, which Steinheil has especially noticed. According to this doctrine, different orders of vegetable individuals, as it were different powers of individuality, are distinguished. In the same manner DeCandolle ‡ distinguishes the cell-individual (*l'individu cellulaire*, in which he has been preceded by Turpin); the bud-individual (*l'individu bourgeon*, after Darwin); the slip-individual (*l'individu bouture*); the stock-individual, or the vegetable individual (*l'individu végétal* penes quem est jus et norma loquendi); and the embryo-individual (*l'individu embryon*), which, in accordance with the

* "Planta est multitudo." Engelmann, De Antholysi, p. 12.

† Steinheil, *l. c.*, especially p. 4 and p. 17: "Les végétaux ne peuvent arriver à l'individualité absolue; ils se présentent à nous dans un état, qu'on peut désigner par le nom d'individualité relative; ce qui distingue cette partie de la création du règne minéral, où l'individualité est nulle, et du règne animal, où elle est presque toujours absolue."

‡ DeCandolle, Physiologie Végét. p. 957. The author does not attach much importance to his division, as he says he has assumed it for convenience of expression, and to avoid the usual confusion of language. His son Alphonse DeCandolle considers it quite an arbitrary matter which part of the plant we call the individual: "Les végétaux sont évidemment des êtres composés: mais jusqu'où veut-on les décomposer, pour que les élémens s'appellent des individus? C'est une chose arbitraire, qui dépend de l'idée par laquelle on se laisse dominer" (after Steinheil, p. 6).

meaning in which Gallesio used the term, comprehends all that proceeds from one germ, even if multiplied by division. Since the slip-individual is essentially the same as the bud-individual (*i. e.* shoot-individual), we have four degrees of individuality, in which at least one more might have been easily inserted, between the cell and the shoot-individual), *i. e.* the member or "story"-individual (Gaudichaud's *phyton*). With this view Schleiden's division is connected: he distinguishes the cell as the plant of the first order; the shoot as that of the second, which he calls the *simple* plant (a term borrowed from C. F. Wolf, who used it in the same sense); the whole stock as that of the third order, which he designates as the *composite* plant. By a searching investigation into the shoot, I shall endeavour to decide whether all these relative individuals can be considered *individuals* with the same justice; or whether, after all, one of them does not deserve the title pre-eminently, corresponding to the animal individual. In either case Goethe's words may be applied with perfect justice to plants and their individuality :—

> Freuet euch des wahren Scheins,
> Euch des ernsten Spieles;
> *Kein Lebendiges ist Eins*
> *Immer ist's ein Vieles.*

Herder, in speaking of the works of the Creator, says: "Every one of Thy works Thou makest *one* and perfect, and like itself alone."

This sentence presents the other aspect of existence, by which the multiform is one; and every unity in the one-sidedness and incompleteness of all single manifestations, is after all a perfect whole. These words lead us to the internal essence of things, referring us at the same time to the primary ideas, which Nature comprehends and realizes in Life.

[To be continued.]

XXII.—*Note on the Subgenus* Limea, *Bronn.* By John Lycett, Esq.*

The present note is intended to direct attention to a peculiarity connected with the external surface of *Limea*, trivial in its zoological importance, but which is calculated from its persistency to be a useful aid to the palæontologist in the absence of hinge characters.

* Read to the Cotteswold Naturalists' Club, August 28th, 1855.

The subgenus *Limea* has hitherto been distinguished from *Lima* solely by the presence of a series of parallel teeth upon each side of the hinge-plate, a feature which cannot be ascertained in the majority of specimens; and the only British species of *Limea* hitherto described has so little in its general aspect to separate it from the young condition of *Lima duplicata* (a shell which is associated with it in the same beds), that any clear external distinction which can be ascertained between them is worthy of notice, more especially when it will also be found to characterize *Limea* as a subgenus.

It is in the auricles that the distinctive feature resides, and it is immediately connected with the hinge-plate beneath: it will be found that the radiating lines which usually ornament the surfaces of the auricles in the Pectens and Limæ also exist in *Limea*, but that in the latter they abruptly disappear towards the outer angle of each auricle, leaving a small triangular smooth area, which is traversed transversely downwards and inwards by a few elevations; these are placed immediately over and correspond to the grooves which separate the teeth upon the hinge-plate. In all well-preserved specimens this kind of surface is visible upon one or both of the auricles, its distinctness depending upon the condition of the specimen with reference to fossilization and the greater or less prominence of the internal features.

Limea duplicata is abundant in the shelly oolite of Leckhampton Hill; there is also another more ornamented but undescribed species higher in the same formation, and found at many localities in the upper Ragstones of the Cotteswold Inferior Oolite. The peculiarity of the auricles is observable equally in both these species.

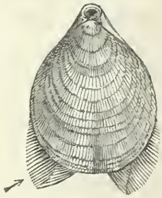
XXIII.—*Notes on the Brachiopoda observed in a Dredging Tour with Mr. M'Andrew on the Coast of Norway, in the summer of the present year.* By Lucas Barrett, F.G.S.*

In the course of our cruise we met with four species of Brachiopoda, belonging to three out of the four recent families of those shells. Fresh specimens of one or more of these were obtained almost daily for two months, and as during that time we were within the Arctic circle, enjoying perpetual sunlight, the opportunity of watching their movements was extremely favourable.

1. *Terebratulina caput-serpentis.* This species shows more of

* Communicated by the Author, having been read at the Meeting of the British Association at Glasgow, Sept. 18, 1855.

itself than any other, and protrudes its cirri further; it was met with everywhere, in small numbers, in 30 to 150 fathoms, often attached to *Oculina*. The cirri on the reflected part of the arms are shorter than those on the first part, as shown in the woodcut. The cirri were almost constantly in motion, and often observed to convey small particles to the channel at their base. When placed in a small glass of sea water the valves gradually opened. Individuals remaining attached to other objects manifested a remarkable power and disposition to move on their pedicles. Detached specimens could be moved about without causing the animal to close its valves. If any of the protruded cirri were touched, the cirri were retracted and the valves closed with a snap, but soon after opened again. When the oral arms are retracted the cirri are bent up, but are gradually uncoiled and straightened when the shell is opened, before which the animal has often been observed to protrude a few of its cirri and move them about, as if to ascertain if any danger threatened. Only on one occasion a current was observed to set in on one side between the two rows of cirri. I had been attempting to ascertain the existence of currents, by introducing small quantities of indigo into the water surrounding the animal with a camel's-hair brush; three times the water was forcibly drawn in, and particles of indigo were seen to glide along the groove at the base of the cirri in the direction of the mouth.



Terebratulina caput-serpentis.

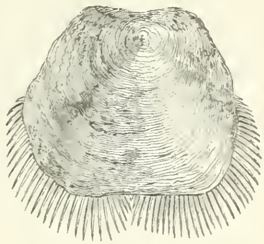
2. *Waldheimia cranium* occurred on several occasions between Vigten Islands and the North Cape, in 25 to 150 fathoms, attached to stones, Balani, &c.; only once in plenty at Omnæsöe. This species belongs to the division of Terebratulidæ with a long loop, and the oral arms are so fixed to the calcareous skeleton as to be incapable of motion, except at their spiral terminations: it has been supposed that these conjoined spiral ends could be unrolled, like the proboscis of a butterfly; but I never saw any disposition of the kind manifested. This species is more lively than *caput-serpentis*, moving often on its pedicle, also more easily alarmed; the cirri are not protruded beyond the margins of the valves; when the shell is closed they are bent up. No currents were detected, though frequently sought for.

Waldheimia cranium.

3. *Rhynchonella psittacea* was moderately abundant in the extreme north, from Tromsöe to the North Cape, in a living state, in 70 to 150 fathoms water. Dead valves were found at Hammerfest in mud. I found *Rhynchonella* very difficult to examine, the animal being extremely timid and closing its valves on the slightest movement. The coiled arms are extended, so that the cirri when unbent come as far as the margin of the shell. I have frequently seen this species with its valves open, but it never protruded its arms.

Rhynchonella psittacea.

4. *Crania anomala*, Müll. sp., was met with between Drontheim and Tromsöe, attached to stones, shells, &c., in 40 to 150 fathoms water; the cirri are protruded, but not the arms, beyond the margin of the shell. The valve opens by moving upon the straight side as on a hinge, without sliding the valve.



Crania anomala, Müll. sp.

XXIV.—*On the Young States of some Annelides.* By R. Leuckart *.

[With a Plate.]

In his copious "Observations on the Anatomy and Development of some Invertebrate Marine Animals," Busch has figured (pl. 8. figs. 1–4) the larva of an Annelide of unknown origin, which is particularly remarkable in many respects, and especially from its possession of strong spines and fringes of cilia upon the individual segments. In the spring of 1853 I not unfrequently took similar larvæ from the surface of the sea near Nice and Villa Franca. The stage of development in which they occurred agreed pretty well with that observed by Busch, at least in most of the specimens: younger larvæ were never found, but some occurred which had proceeded a little further, and these proved their increased development especially by the partial or even complete loss of the above-mentioned spines. When the temporary nature of this peculiar apparatus of bristles was established, it was tolerably easy, by the consideration of the other

* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1855, p. 63.

characters, to ascertain the pedigree of our larva, or at all events its nearest allies. These, in my opinion, are to be found in the family of the *Ariciæ*, and indeed in the group with two long tentacular cirri (*Ariciæ Naideæ*, Oerst.; *Spioidea*, Grube), probably amongst the species of the genus *Spio* or *Nerine*.

Before setting forth the reasons in favour of my supposition, we must first of all get a good notion of the larva itself; especially as Busch's statements do not take up every point, and are also erroneous in this respect, that he treats the dorsal surface of the worm as the ventral surface, and *vice versâ*.

The most developed individuals that occurred to me (Pl. VII. fig. 1) measured $2\frac{1}{2}$ lines and were of a brownish colour. They were rather slender, about $\frac{5}{12}$ths of a line in width anteriorly, tapering towards the hinder extremity and flattened on the back, so that the height of the body (fig. 3) was scarcely more than half its breadth. They swam, at least so it appeared to me, almost exclusively by the action of the circlets and rows of cilia, the arrangement of which has already been described by Busch. As soon as they were interrupted in their movements, they rolled themselves up into a flat spiral and sank to the bottom.

The segments of the body (fig. 1) had already attained a considerable number (about fifty). They exhibit a very uniform structure, but gradually decrease in development from before backwards. The head consists of a short, broad, nearly quadrangular tubercle, which is but indistinctly separated from the first segment of the body, and bears, between the rounded anterior angles, a short tentaculiform process (frontal tentacle) of a conical form. The upper surface of the head is furnished with four black ocelli placed at a considerable distance from the median line, and standing in a line which is but slightly curved backwards. The posterior and inner eyes are the largest, and are sometimes divided on one side into two spots placed close together. No refractive media could be found in them. At each side of the head there is a very considerable tentacle (a tentacular cirrus) which arises from the angle between the head and the protuberant upper lip, and curves backwards like a horn over the first segment. Where this meets the upper lip, the latter bears a tuft of long cilia, which Busch has regarded, certainly correctly, as the remains of the crown of cilia.

The anterior segment of the body is produced forwards at the ventral surface almost to the base of the frontal tentacle (fig. 2), and here forms a lip-like protuberance in front of the mouth; this is the upper lip already mentioned, which at the same time marks the boundary between the buccal segment and the head. Even without this process the first segment of the body is the longest, although on the back it only measures about one-third of its width. The next following segments certainly yield but little to this in length, but the later ones from about the middle of the body diminish rather rapidly to a considerable extent. On each of these segments four pedal tubercles (fig. 3) may be distinguished (not two, as stated by Busch); two of them are dorsal and two ventral, they are placed on the nearly perpendicular lateral surfaces, and have the form of slight, but very distinctly marked elevations. The bristles of the two pairs of pedal tubercles are of different forms; the dorsal tubercles contain edged capillary bristles (fig. 4), the ventral ones on the contrary extended uncini, the ends of which (as shown in fig. 5) form two unequally developed teeth. As is usually the case under such circumstances, the capillary bristles are the longest. The number of bristles diminishes gradually towards the hinder extremity; on the anterior segments it amounts to six or seven, on the posterior ones only to two or three. Above the dorsal pedal tubercle there rises a slender cirrus, clothed with short cilia; the length of this is however constantly less than that of the bristles, even in the anterior half of the body.

The segments are further distinguished by the peculiar ciliary lobes or combs described by Busch (figs. 2 & 3), which are situated on the ventral surface and occupy about the middle of the space between the ventral pedal tubercles and the median line. The cilia of which these are composed agree in size and development with the remains of the ciliary wreath, at least on the anterior segments, but they gradually diminish considerably both in size and number as we proceed backwards. In front I not unfrequently counted twelve or even more hairs, standing regularly close together in a transverse line; on the hinder segments there were only from six to eight. The two first segments of the body form an exception to this, as they are quite destitute of these ciliary combs, but instead of them are covered on the ventral surface with a uniform soft coat of cilia.

The last segment of the body is destitute of bristles, but is considerably broader and longer than the preceding rings. It forms as it were an annular protuberance around the anus, and is margined with a circle of powerful cilia.

Of internal organs the intestinal canal alone could be distinguished; it exhibits a very great development in our animal. Its commencement forms an œsophagus, without a protrusible proboscis or any armature; but with fleshy walls, which are dilated on each side into tolerably wide cæca in the second, third and fourth segments. In the fifth segment the stomach commences; it contains a greatly developed, yellow glandular layer, by which it is very clearly distinguished even at the first glance from the œsophagus; although it appears otherwise to be only a direct continuation of the latter. This appears also, especially as the stomach possesses the same lateral cæca as the œsophagus; these indeed gradually diminish posteriorly and entirely disappear about the second third of the body, but at the same time (with the exception of the first cæcum) appear very much longer and more considerable than the corresponding processes of the œsophagus. The glandular layer of the stomach is lost upon the intestine, where it is replaced by a greater development of the muscular membrane. The muscular walls, as in the œsophagus, are marked with black pigment spots.

The preceding description only applies exactly, as has been said, to the most developed specimens of our worms; the younger ones are not only smaller and furnished with a less number of segments (35 to 50), but are also particularly distinguished by the toothed bristles or spines described by Busch. Where these spines were still most completely retained, I observed in the first place a strong tuft on each side of the first segment of the body, inserted upon the dorsal surface behind the tentacular cirrus (fig. 2), and consisting of three or four, or sometimes only two very large shafts, which were armed with short spine-like teeth, and extended nearly half the length of the body. The other segments bore similar, but very much shorter spines, which were also upon the dorsal surface above the dorsal cirrus (fig. 3), but never more than two together. The length of these spines, on the anterior segments at least, might be about equal to the breadth of the segment to which they belonged, but they gradually diminished in length posteriorly, as Busch has already stated. Similar organs were never found between the pedal tubercles.

It is difficult to suppose that the loss of the spines in the larger specimens is only accidental. For this, the number of the spineless individuals was too large. Moreover the spined specimens universally exhibited the greatest variety in the number of their spines and in the presence of these upon the individual segments. Sometimes the spines of the anterior segment were wanting, whilst the others were still uninjured; sometimes it was the latter that were absent to a greater or less extent. Occasionally specimens were found (like fig. 1) which only possessed a few (two or three) spines on some particular spots of their bodies.

Under such circumstances I have no hesitation whatever, as indeed has already been observed, in regarding these remarkable appendages as a temporary adornment. But it is probable that these spines do not constitute the only provisional organs of our larvæ. The circles and combs of cilia may also doubtless be placed in the same category, for the developed Annelida, as far as we know with certainty, are always destitute of such apparatus. It is true that Quatrefages professes to have observed some small Annelida with permanent tufts of cilia, but the animals in question are still but imperfectly known,—still less have they been ascertained to be fully developed species.

If we leave these bristles out of the question, there remains a slender worm, with an eye-bearing cephalic tubercle, and two tentacular cirri, with a simple (not protrusible) unarmed œsophagus, slightly developed dorsal cirri, and differently formed simple bristles in the pedal tubercles, which are also but slightly prominent. Of course many changes take place in this animal before it arrives at its perfect development and sexual maturity, but these will hardly be of great importance; they will probably be confined to the enlargement of the tentacular and dorsal cirri.

If we consider this proved, there can be little doubt as to the systematic position, or, which is the same thing, the origin of our animal. Our worm is one of the so-called *Dorsibranchiata*, and indeed belongs to the family of the *Ariciæ** as circumscribed by Oersted (Wiegmann's Archiv, 1844, i. p. 103). The existence of a single pair of tentacular cirri refers it to the group of *Ariciæ Naidinæ*, and the uniform structure of all the individual segments of the body places it under the genus *Nerine* or *Spio*. Without a knowledge of the mature form, it is difficult to decide to which of these two genera the worm belongs; this will depend especially upon the subsequent condition of the apical segment, which in *Nerine* is provided, as is well known, with a sucker-like circle of papillæ.

Of the two genera above mentioned, we know at present in the Mediterranean only a single representative, and that but imperfectly—the *Lumbricus cirratulus* of Delle Chiaje. At the moment I have unfortunately no opportunity of consulting the Memoir in which this worm is figured (tab. 64. fig. 16), and must therefore leave it undecided whether our larva may be referred to this species.

The developed *Spiones* and *Nerinæ* live in mud, where they form regular passages and tubes; the free pelagic life of our larva is therefore subsequently, probably after the loss of the cilia, exchanged for another and very different residence.

If, however, further proofs of the derivation of our larva from a Spioid Annelide be required, we need only refer to the

* For comparison of the form of the bristles I may refer here to my description of *Leucodore mutica* (Wiegm. Arch. 1849, i. p. 200). With regard to the structure of the œsophagus I may also mention the genus *Aonis*, which, according to my observations (Wagner's Zoot. ii. p. 307), in this respect agrees most closely with our larva.

similarity existing between it and the supposed larva of *Leucodore ciliata*, figured by Oersted (Consp. Annul. Danic. tab. 6. fig. 96). It is true that I have not this figure by me at present, but as far as I can remember, exactly the same powerful bristles occur in this, which so remarkably characterize our larva in the first period of its life, and these are also exactly similar in arrangement and development. I am not certain whether Oersted has recognized the peculiar structure of these bristles, but I scarcely think he can have done so, as otherwise I should hardly have approximated to it a larva with simple (permanent) bristles which I found in Heligoland, as was the case in the papers which I published in conjunction with Frey (p. 99).

Similar temporary bristles occur however in other Annelidan larvæ, and even in some which are considerably removed from our animals. I will not refer to the larva figured by Busch (tab. 7. figs. 5 & 6) as an example of this, as its derivation is still entirely unknown, and it might possibly be nearly allied to our *Spio*. But I may recall the fact that Quatrefages has described an exactly similar structure in the larva of the genus *Hermella* (Ann. des Sci. Nat. 1848, vol. x. p. 153). It is true that there are no observations as to the subsequent shedding of these bristles, but nevertheless there can be no doubt upon the point, for the developed *Hermellæ* are destitute of them, as I know from my own observations. These bristles have nothing in common with the paleæ afterwards possessed by the animal.

So much for the spinous Annelidan larva from Trieste and Nice and its genetic relations, which, I hope, have been pretty correctly recognized. Let us now pass to another larva, also discovered and described by Busch, which is figured on tab. 9. figs. 1–8 of the work above quoted, and which has a great resemblance to the *Mesotrocha sex-oculata* of the same observer.

We have recently obtained information as to the origin of the latter from Müller (Monatsber. der Berl. Akad. 1854, p. 395). We now know that it is the larva of the *Chætopterus Norvegicus*, discovered by Sars. With this information we may probably explain the second *Mesotrocha*, found by Busch at Trieste. It may probably prove to be the larva of the *Chætopterus pergamentaceus* (*Tricœlia variopedata*, Ren.), found at Trieste, of which I have given a more exact description in Wiegmann's Archiv for 1849, p. 340. On a previous occasion (Gött. Gel. Anz. 1852, p. 857) I expressed the opinion that we might perhaps suppose the Annelidan larvæ of the *Mesotrocha* type to be the descendants of a *Serpula*, or of some other worm in which the segments of the anterior part of the body were distinguished, as in *Serpula*, from the other segments by the form, structure and position of the pedal tubercles; and, in fact, this supposition appears now to be completely justified, although the determination of the species was incorrect.

The connexion between the *Mesotrocha* of Trieste and the *Chætopterus pergamentaceus* is rendered in the highest degree probable by the structure of the bristles. The same forms which Busch has figured from the segments before the circlet of cilia in his *Mesotrocha,* have also been observed and described by me on the anterior part of the body of our *Chætopterus.* Even the peculiar broad bristles which Busch found upon the fifth segment of his larva reappear in the mature worm (but on the fourth segment), only they are less distinctly serrated, and occur in greater number,—as indeed the number of bristles in general is much more considerable in the mature state.

If we are once convinced of the identity of *Mesotrocha* and *Chætopterus,* it becomes easy to refer the two forms to one another, and thus, even without direct observation, to obtain a tolerably complete view of the metamorphoses of the animal in question.

I have shown, as above quoted, that *Chætopterus* is furnished, like the other Annelida, with a true cephalic tubercle. In the developed state this part is certainly very rudimentary, so that it might previously have been overlooked; but in the larva it is very greatly developed, and appears produced over the mouth into a disc, like an upper lip*. To this upper lip in the larva a bilobed lower lip is opposed, the two lobes of which only require to be fused together to form the peculiar labial apparatus of the mature animal. The two tentacles placed in our larva at the sides of the mouth also occur in *Chætopterus,* according to my observations, although much less developed in proportion, and, to a certain extent, aborted, like the cephalic tubercle and the eyes.

The segments which in the larva intervene between the head and the circlet of cilia form (together with the head) the fore-body of the mature animal. But their number still requires increase; Busch only counted nine segments, whilst in my worms there were twelve or thirteen. The new segments are evidently formed at the hinder extremity of the fore-body; that is to say, between the fore- and middle body, as sufficiently appears from the position of the above-mentioned serrated bristles; this, as far as I know, is the only instance of the kind amongst the Annelida. With the last segments of the fore-body, *Mesotrocha* is also destitute of the large wing-like

* From the formation of the head in the larva, it is established beyond a doubt that Sars has really, as I formerly stated, taken the back of *Chætopterus* for its belly.

appendages, which, according to my view, are produced by the metamorphosis of the last pedal tubercles of that part of the body, as also of the uncini which I have indicated on its last two segments.

The second division of the body in *Mesotrocha,* which commences with the circle of cilia, represents the middle and hinder parts of the body of our *Chætopterus,* but apparently requires a still greater increase for its complete development, as Busch only counted eleven segments in this part of his larva, whilst in the mature state more than double the number occurs. When, however, Busch denies the possession of setose feet to this division of the body, he probably only had the subulate bristles of the anterior part of the body in his eye, for the eleven pairs of rudimentary feet with "longish oval bodies" which are inserted in them, undoubtedly represent setose feet, and are probably the first indications of the ventral tubercles furnished with uncini. Busch even states, that the inserted bodies are denticulated, as I have found to be the case with the uncini of *Chætopterus.* It is interesting also that these ventral pedal tubercles possess a bilaterally symmetrical distribution on all the segments, whilst in the anterior segments of the middle part of the body they are subsequently, as is well known, fused into a single median organ. The dorsal tubercles which occur on the abdomen of the mature *Chætopterus* appear to be developed subsequently.

My regarding the segments lying behind the circles of cilia as representing both the middle of the body and the abdomen of *Chætopterus,* arises from the observation of Busch, that the dorsal surface of these segments is gradually produced on each side, close to the median line, into a tolerably long and vibrating process. Busch considers these processes to be branchiæ, and concludes accordingly that *Mesotrocha* is the larva of a Dorsibranchiate Annelide; he consequently assumes that these processes are persistent in their original form, whilst in my opinion (which however is only founded on the supposed identity of our larva with the *Chætopterus* of Trieste) they are gradually converted, by growing together in the middle, into the scale-like appendages which communicate to the segments of the middle of the body, and also, although much less remarkably, to the first segments of the abdomen, their well-known lenticular or conical form. The development of these processes commences close behind the rings of cilia, and gradually extends thence backwards,—how far has not yet been observed. The oldest larvæ of *Mesotrocha* which presented themselves for examination, exhibited these processes fully developed only on the first four segments; consequently, exactly on those segments which are subsequently converted into the middle body, and which, as is well known, present by far the largest appendages.

The mature *Chætopterus* lives in a free tube formed by itself. In this respect it is not without interest that we learn from Busch, that the larvæ observed not unfrequently exuded a slimy mass in the last days of their existence, with which they attached themselves to the side of the vessel in which they were kept.

I regret that during my residence in the Mediterranean I had no opportunity of becoming acquainted, by my own observations, with these interesting larvæ, which appear to possess rather a wide distribution. In this case it is probable that many other points of resemblance with the structure of *Chætopterus* would have been discovered. But in Nice the larvæ of Annelides are generally rarities, at least it was so while I was there. Except the spinose forms above described, only a few were discovered, and these mostly at a time when my attention was taken up with other investigations. Amongst these few there is however one upon which I may add a few words, although, properly speaking, the name of larva is no longer applicable to it, as it scarcely exhibits any traces of its provisional organs. It is a young *Alciope* (*A. Raynaudii*), which I took up one day in the Bay of Villa Franca with a number of Firoloides, amongst which it was swimming about*.

The beautiful, transparent little animal (Pl. VII. fig. 6) measured 4½ lines, and its body consisted of three distinctly separated regions,—the head with the neck, the true body, and a tail,—although the mature animal, as is well known, exhibits no trace of any such division†. The middle region was by far the largest of these divisions; it measured about three lines in length and nearly a fourth of this in breadth; it was broadest in the middle and gradually diminished a little towards the extremities, especially in front. In this middle region eight segments were distinctly to be recognized; they resembled those of the mature animal in every respect, so that I need not describe them particularly. But I may observe, that the bristles of the first pair of pedal tubercles were very much shorter and less numerous than those of the others, and especially the hinder ones, which were the most developed in every respect. The neck was considerably narrower than the foremost segment to which it was attached, and probably measured scarcely a third of the greatest breadth of the middle region. It was as long as broad, and exhibited three segments, or rather three pairs of segmental appendages,

* I also met with *Alciope candida* several times in the Bay of Villa Franca.

† See Krohn, Wiegmann's Archiv, 1845, p. 171.

which certainly were greatly inferior in size to the corresponding appendages of the middle of the body, and were further distinguished from these by the absence of bristles, and of the black glandular pigment-spots, which, as is well known, are placed on the segments beneath all the other pedal tubercles. The appendages of the two hindmost pairs were cleft, that is to say, they each consisted of a dorsal and ventral cirrus, which however both possessed the same cylindrical form. The foremost segmental appendage on the contrary was perfectly simple, and appeared in the form of a small, stumpy cirrus, which projected close behind the eyes of the animal. The anterior part of the neck bore a distinct range of cilia, running round behind the eyes and mouth, which appears, from the observations of Krohn, to be persistent on the ventral surface. The head had already acquired exactly its future form and structure, but I could not succeed in distinguishing the central frontal tentacle, which, however, is but slightly marked even in the perfect animal. The globular eyes project on either side but little beyond the neck; it is well known that in *A. Raynaudii* they by no means attain the same colossal dimensions as in *A. candida*. Close to the mouth, and underneath the eyes, a very considerable tubercle stands out right and left, a kind of an upper lip, between the lobes of which an elongated disc-like lower lip projects from behind.

The caudal portion of the animal forms a narrow, stump-like appendage, which at its root is scarcely half so broad as the preceding terminal segment of the middle region of the body, gradually tapers to its apex, and is about 1 line in length (rather less than more). Microscopic examination shows that this tail is annulated; a number of narrow segments may be distinguished in it, which gradually diminish in size and development posteriorly. The foremost segments already possess the future dorsal feet with their bristles and black glands; these characteristics are gradually lost by the posterior ones, until about the last fourth of the tail, which forms an undivided mass with a rounded apex. I distinguished eleven distinct caudal segments (with bristles), and behind these two or three other indistinct (without bristles), which were just separated from the apical piece.

Regarding the internal structure I can say nothing that has not already been mentioned by Krohn. The nervous system is very distinct, at least as far as the middle of the tail, where it gradually withdraws itself from observation in consequence of the increasing opacity of the substance of the body. The anus lies at the extreme apex of the tail, so that the intestine passes through the entire length of the body. But it is only as far as the root of the caudal appendage that it possesses the structure described by Krohn. Beyond that point it narrows suddenly to about a fourth of its previous width, and then proceeds in the form of a thin straight tube to the anus. The only vessel observed was the pulsating dorsal vessel. Lateral glands are deficient.

The changes through which the worm has to pass before it returns to the perfect form of its parent, are of two kinds. In the first place the neck will gradually shorten and disappear, with the exception of its segmental appendages*, so that the head will appear to sit immediately upon the first pair of setose feet. The segments of the caudal appendage then gradually increase in number and become developed so completely, that at last the difference between them and those of the middle of the body is lost. The temporary existence of this distinction perhaps indicates, that a state of rest intervenes between the formation of the middle region and that of the posterior segments, during which the plastic processes are entirely confined to the development of the parts already formed. The formation of the posterior segments of the body as here exhibited, presents so remarkable a resemblance to the reproduction of the body after mutilation, that I should not have regarded our worm as a normal stage in the development of *Alc. Raynaudii,* if its small size, the structure of the neck, and especially the presence of a range of cilia behind the head, had not sufficiently indicated that it was an immature and undeveloped creature.

Supplementary Notice.

Long after I had sent the preceding sheets to the press, the 'Magasin de Zoologie' for the year 1843, with a paper by Quatrefages upon some new Annelides from Normandy, which had hitherto escaped my notice (and which is not even mentioned in Grube's Monograph), came accidentally into my hands. At pl. 3. fig. 7. of this work, a Spioid Annelide is figured under the name of *Malacoceros longirostris,* which from its appearance and the description annexed may probably be the mature state of the spinous larva observed by Busch and myself. The formation of the cephalic tubercle especially is perfectly similar, and it is from

* Krohn only mentions four tentacular cirri on each side in *A. Raynaudii,* but leaves it uncertain whether these represent the appendages of two or four segments. This point may perhaps be settled by my observations. On the other hand it must still remain undecided, whether th small foremost cirrus gradually disappears or has been overlooked by Krohn.

this also that Quatrefages has derived the name of his species. The length of the developed animal is from $2\frac{1}{2}$ to 3 inches,—that of the two tentacular cirri, 9 lines. The only thing that might perhaps be urged with reason against the identity of the two animals, is the circumstance that the first segment of the body, according to Quatrefages, is destitute of the dorsal pedal tubercle; but with regard to this point of difference I should be rather inclined to suppose that there is an error of some kind. Eyes are wanting in the developed animal, as in many other mature worms (and Mollusca) which possess those organs in their young state. The distinction which appears in this respect between the larvæ and the mature animals, only shows that Quatrefages has established his new genus *Malacoceros* without sufficient reason, for the want of eyes is the only character by which it is distinguished from *Nerine*.

The difference of habitat appears to be of no consequence, especially as our larva has a tolerably wide distribution. I certainly do not know where Busch observed his specimens; but J. Müller states (Arch. für Anat. 1854, p. 92) that he has found it at Marseilles. Müller however only speaks of a very "similar" larva, but, apparently, merely because his specimen wanted the long spines of the first segment. It is with reason that J. Müller also points out the great similarity that exists between the large spine-like bristles of our *Nerine* larvæ and the strong bristles of the singular *Mitrariæ*. I think that this circumstance may even justify us in supposing that the tufts of bristles in *Mitraria* are also mere larval organs. At any rate it seems to me that *Mitraria* is scarcely anything but the larva of an Annelide with a provisional apparatus of bristles, as indeed Müller himself has lately indicated (*loc. cit. sup.*). It is much to be regretted that Quatrefages could not follow the development of his *Hermella*-larvæ for a longer period; we should then probably have obtained further data for the elucidation of the species of *Mitrariæ*. I will not however assert directly that the *Mitrariæ* are actually larvæ of *Hermellæ*, for that would be going too far with our present knowledge, although the elongated capitate bristles, which J. Müller has described, together with the ordinary spines, in the species observed by him, remind one unmistakeably of the forms of the peculiar paleæ of the *Hermellæ*.

As regards *Mesotrocha* and its metamorphosis into *Chætopterus*, M. Müller has given his interesting observations upon this subject in full in the Archiv für Anat. und Physiol. 1855, p. 1. In connexion therewith M. Müller also mentions the larva discovered by Busch, the relations of which to *Chætopterus pergamentaceus* I have endeavoured to prove, and expresses his opinion that it does not belong to the genus *Chætopterus* itself, but to some other, unknown, but very nearly allied worm. Since I have become better acquainted with the metamorphosis of the *Mesotrocha sexoculata* from Müller's statements, I must now agree with him entirely in this opinion. The course of development of *Mesotrocha*, which I took as the basis of my arguments, and could only deduce from the comparison of *Mesotrocha* with the mature *Chætopterus*, certainly agrees in general with this process as observed by Müller; but I was wrong in supposing that the lenticular processes of the middle segments of the body were produced by a fusion of the lateral dorsal appendages which occur in the larva described by Busch. The remarkable form of the segments in question is the result rather of a peculiar development of the bodies of the segments, without the participation of any segmental appendages, as indeed I had previously assumed, in opposition to the assertion of Audouin, in my description of *Chætopterus pergamentaceus*. On the other hand, M. Müller was able to convince himself, that the large wing-like processes on the last segments of the anterior part of the body in *Chætopterus* appeared at first only as simple dorsal processes, and it is remarkable that, like the dorsal processes of Busch's larva, they are immediately *behind* the circle of cilia, which, as is well known, is double in *Mesotrocha sexoculata*. It is possible therefore, that in the worms like *Chætopterus*, for a knowledge of the larval state of which we are indebted to Busch, four or more such appendages occur on each side instead of a single one; and it is also possible certainly, that the dorsal processes of the larva may really, as supposed by Busch, become gradually developed into branchiæ.

From the statements of M. Müller, it also appears that the characteristic distinctions between the two species of *Chætopterus* at present known are by no means of such a decided nature as one might perhaps have concluded from the difference in their size, and as was presupposed by me in the preceding analysis. This applies especially even to the structure of the bristles, which appear to be essentially similar in the two species, so that in my paper the name of *C. norvegicus* might be substituted throughout for *C. pergamentaceus* with equal right.

Under these circumstances I can of course only bespeak some consideration for my statements, in as far as they may place beyond a doubt the relations of the larva described by Busch to a (still unknown) form of the family of the Chætopteridæ.

XXV.—*Observations on the Genus* Assiminia. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Norfolk Crescent, Bath, Sept. 11, 1855.

In your September Number, 1855, p. 183, Dr. Gray has controverted my opinion, that the so-called genus *Assiminia*, embracing the single species *A. Grayana*, belongs to the *Truncatella* of Risso.

He says, "Mr. Clark's description proves the converse of his position;" and observes, "that *Truncatella* should have a subcylindrical shell with a slender tapering tip, which falls off when the shell approaches adult age; hence the name of the genus: *Assiminia* has a broad conic shell with an acute tip which does not fall off; if it is to be a species of the same genus, the name of the latter ought to be changed.

"The foot of *Truncatella* is small and peculiarly formed, and the eyes of all the species, according to Mr. Clark's observations, are large, with a white iris; now this is not the case with *Assiminia*, and yet Mr. Clark regards it as a *Truncatella*."

It appears by the first part of Dr. Gray's remarks, that he has adopted the old conchological generic base for *Truncatella* from a particular species: that definition has long been disused, and did not even conchologically satisfy the requirements of science when M. Philippi wrote;—as proof, that eminent naturalist, in the 2nd part, p. 133, of his 'Enumeratio Molluscorum Siciliæ,' thus remarks on the animal of *Truncatella*:—

"Tale animal testas tantopere diversas habitat, at vix ac ne vix quidem characteres illis communes invenire possumus, subcylindricas nempe, apice demum decollatas, globoso-conoideas, imo discoideas. Illi quibus hanc ob causam nomen *Truncatellæ* non placet, nomine *Choristoma* a De Cristophoris et Jan proposito utantur, ne novo nomine scientiam jam nominibus gravatam onerent."

And Philippi illustrates these views by four figures, tab. 24. f. 2, 3, 4, 5; three of them differ from Dr. Gray's definition by their contours and by their apices never becoming decollated: the 4th greatly resembles the outline of the so-called *A. Grayana*; indeed, so much so, that it might pass for it, if the description and size did not somewhat differ; but notwithstanding this discrepancy, I almost think the figure (the outline size having perhaps being accidentally omitted) may be intended to represent our *Truncatella Grayana*.

These extracts show that Dr. Gray's conchological generic character of *Truncatella* applies to only one species, and is therefore partial, untenable, and contrary to authorities.

We now come to a later epoch, when malacology has furnished an essential generic character for *Truncatella* which no other British mollusk has yet been found to possess, that is, the immersion of the eyes in the tissue (instead of being placed on pedicles as is usually stated) at the superior and nearly terminal points of the short, strong, divergent, almost rectangular tentacula: this structure stamps the so-called *A. Grayana* a *Truncatella,* and is that of every other British species of the genus.

Dr. Gray then terminates his reasoning with a malacological observation, that I have described the *Truncatellæ* of my work on the British Marine Testaceous Mollusca as having a white iris (? pupil), and that I had not observed in *A. Grayana* a similar appearance, on which account he seems to throw a doubt of its being a *Truncatella.* I do not understand the logic of this; the point in question is a mere specialty; one may with as much reason say that a man with a red iris or pupil, for example an *albino,* is not of the genus Man, because he has not the usual dark or grey iris; so, it is equally absurd to infer that *A. Grayana* is not a *Truncatella,* because the white iris or pupil was not detected.

Dr. Gray concludes by stating, that my notions are not those usually held by modern zoologists, and pronounces the whole of my logic unsound. I am not surprised that my logic should not find favour with one who considers that a genus must be restricted in the number of its species, however similar these may be in every essential character; and am sorry to learn, on Dr. Gray's authority, that such notions are held by modern zoologists, of which I was not before aware.

I am, Gentlemen,
Your most obedient Servant,
WILLIAM CLARK.

XXVI.—*On the Morphology of the Organs called Lenticels.* By M. E. GERMAIN DE SAINT-PIERRE*.

THE name of *lenticular glands* was given by Guettard, and that of *lenticels* by P. DeCandolle, to certain organs belonging to the bark of a great number of plants, which appear at the surface of the epidermis in the form of little brownish elevations or rugosities of an oval or elliptical form.

* From the Comptes Rendus, August 20, 1855, p. 305.

The opinion of Guettard (1734) that these organs formed an apparatus of secretion, was combated by DeCandolle (1826), who, as well as E. Meyer, believed that the lenticels were the rudiments of the adventitious roots. M. Hugo Mohl in his turn (1832–1836) has shown that DeCandolle's opinion was ill-founded, and ascertained that the production of the lenticels is analogous to that of cork, with this difference, that cork is the result of the hypertrophy of the suberose layer of the bark, and that the lenticels are produced by the hypertrophy of a deeper layer, the herbaceous layer. Lastly, M. Unger (1836) thought he recognized a sort of analogy between the lenticels and the *soridia* of the Cryptogamia, the utricles of cellular tissue which constitute the corky mass of the lenticel appearing to him to be analogous with the spores or propagula. The same observer regarded the lenticels as the result of a deformation of the *stomata*; and Du Petit-Thouars, who had given an analogous opinion, considered them to be intended for effecting a sort of communication between the external air and the cellular or amylaceous layer of the bark. The great diversity of opinion in so many distinguished observers, regarding a structure apparently so simple and so accessible to study, determined me to undertake some new researches, a summary of which I laid before the Société Philomatique in 1849; I have since continued my series of observations upon this subject, and now lay the results before the Academy. I have chosen for the subjects of my observations three trees in which the lenticels present essential differences of form,—namely the Birch (*Betula alba*), the Elder (*Sambucus nigra*), and the suberose variety of the Elm (*Ulmus campestris*).

In the Birch the first state of the lenticel is an epidermic gland of very simple structure. During its period of vitality (on the young branch) this gland secretes a gummy resinous matter; it then dries, splits up and becomes destroyed, leaving in its place a brownish fissure through which the subjacent cellular tissue protrudes. It is this cellular tissue which constitutes the adult lenticel, and M. Unger, who examined these glands, did not follow their development as far as the true lenticular period. In this particular case, it cannot be denied that the name of *lenticular glands* applied by Guettard to the lenticels is correct; but it can only apply at the period when the preparatory organ of the lenticel exists alone, and when the lenticellar mass does not yet exist.

On the epidermis of very young branches of the Elder, we may observe stomata and epidermic elevations or short hairs with broad bases. The stomata do not undergo any ulterior change of form; they are merely obliterated in proportion as the epidermis dries and grow old; but I have never seen them pass to the state of lenticels. On the other hand, in the short hairs already mentioned, and which are, properly speaking, elevations or pouches of the epidermis, the following facts may be observed: the upper part of the short hair, or the centre of the obtuse epidermic process, dries up and becomes destroyed at a certain time, and there soon remains nothing but the base, which is of an oval or elliptical form, and the margins of which are composed of a delicate membrane with lacerated edges; in place of the hair a narrow fissure only is then seen. It is through this fissure that the eruption of subepidermic cellular tissue of which the adult lenticel is composed, takes place; the quantity of cellular tissue protruded soon enlarges the original fissure by tearing it, and the origin of the lenticel is no longer recognizable; subsequently the increase in the length and diameter of the branch and the consequent distension of the epidermis become fresh causes of deformation, and the lenticel, after having been torn in a vertical direction, becomes enlarged horizontally. The cellular mass of suberose appearance which protrudes through the epidermic fissure in the form of a double cushion, and of which the outer layer becomes brownish by desiccation, appears to me to be composed, not of the herbaceous, or deep cellular layer, but of the suberose or subepidermic cellular layer.

In the suberose variety of the Elm, the first development of the lenticels takes place as in the Elder, but the excessive hypertrophy of the subepidermic cellular tissue soon disguises its lenticellar origin. In this tree I have followed all the transitions between the first elevation of the epidermis, the lenticellar hernia, and the corky masses which afterwards cover the bark with their anastomosing channels. In this tree, as in the preceding, numerous microscopic preparations have always showed me a perfect continuity between the lenticellar hernia and the suberose layer of the bark, with this difference, that in consequence of the direction of the expansion, the cells of the protruded portion are perpendicular to the bark instead of being parallel to it, as in the normal suberose layer.

From these observations it results that I regard the lenticels not only as a formation analogous to cork, but as one completely identical in origin and in tissue: the difference between the two productions consists only in the intensity of the hypertrophy, which is generally feeble in the production of lenticels and very intense in that of cork, which is nothing but exaggerated lenticellar production.

The maceration in water, or insertion in moist earth, of branches covered with lenticels, has convinced me, like M.

Mohl, that the adventitious roots are only accidentally produced on points occupied by lenticels, and that these roots commence their appearance externally by an elevation of the epidermis, which presents the appearance of a young lenticel and is converted into a coleorhiza by the passage of the root, but that this elevation, which never becomes a suberose lenticel, is without any analogy with the lenticular elevation.

True lenticels had only been noticed on woody stems, but I have ascertained their existence not only upon some herbaceous stems, and on rhizomes or underground stems, but even on the surface of roots, both of trees and herbaceous plants (*Betula alba, Dahlia variabilis, Mirabilis Jalapa*, &c.), and frequently on the petioles of leaves (as in the Elder). Finally, I have ascertained that the rugosities which are commonly seen on the surface of the epidermis of some fruits, on the bark of Melons for example, are merely lenticels more or less deformed, and that most of the punctures which exist on the surface of Apples and Pears are lenticels incompletely formed, by the destruction of an epidermic elevation and the desiccation of the subjacent cellular tissue.

The lenticel therefore is not an organ without analogy with other known organs; in its first state it passes by insensible gradations to the epidermic productions known under the names of hairs, thorns, and glands. During the following period, after the destruction of the epidermic elevation, it is formed by the hypertrophy of the superficial cortical cellular tissue, a hypertrophy which appears to be determined by the contact of the subepidermic cellular tissue with the external air. This hypertrophy differs neither organically nor physiologically from the suberose production of the Cork Oak. The form of the hernia or lenticellar cushion is determined by the epidermic fissure which serves it as a mould; its form is usually that of a buttonhole with thick edges which throw shreds of epidermis outwards: this form resembles that of the stomata, but it appears to me that the analogy between the stomata and the lenticels is confined to this resemblance.

The physiological function of the lenticels appears to me to consist simply in causing the commencement of fissures in the epidermis. In consequence of the growth of the tree in height and diameter these fissures become long clefts, extending either in a vertical or horizontal direction, and facilitate, by loosening the bark, the increase of the diameter of the tree.

BIBLIOGRAPHICAL NOTICES.

A Manual of Marine Zoology for the British Isles. By Philip Henry Gosse, A.L.S. Part I. London: Van Voorst. 1855. 12mo.

Amongst the host of blind guides that are continually making their appearance, professing to clear up the mysteries of nature to the uninitiated, it is some satisfaction to us to have to record the publication of the present little work,—a work written with a definite and intelligible purpose, which is carefully and intelligently carried out. Mr. Gosse states, and we can readily believe him, that he has often, in the course of his investigations, felt the want of a manual which should give, in a succinct form, the characters of the genera of British animals, so as to enable the student to determine on the spot something more than the general alliances of any animal that might occur to him. As nobody else appeared inclined to undertake the task, he has set to work himself, and we have here a portion of the result of his labours, embracing the invertebrate animals as far as the Annulosa; the Mollusca and Vertebrata being reserved for a second part.

It is not only to the beginner that such a work as this is of value; the more advanced student of nature will find it of the greatest advantage, as, from its very small bulk, he can easily carry it in his pocket in his rambles along the shore, so as to ascertain at once the nature of the objects he meets with, and thus probably refresh his memory as to what has been, or remains to be, observed with respect to their habits and economy.

Upon these latter subjects the work of course contains little beyond generalities; the author has contented himself with working out the characters of the groups down to the genera, referring in every case to the larger works which have served him as guides in the different branches of his subject, and to which the student is referred for more extended information. To each genus is appended a list of the known British species, accompanied by an excellent outline figure on wood of one species. To the eye, on a cursory inspection, these figures constitute one of the most refreshing features of the book,—accustomed as we are to the continual recurrence of the same woodcuts in almost every popular work on natural history. The present part contains figures of three hundred and forty species, of which a great majority are original, and more than half of these drawn from living specimens.

In the execution of the work Mr. Gosse appears to have laboured carefully and conscientiously; the characters are given in clear and intelligible language, and we should think that the merest tyro would have no difficulty in working out most of the animals which he is likely to meet with on our shores. The Infusoria and Entozoa, however, are entirely omitted; the former from the uncertainty existing as to what are really Infusoria, and what embryonic forms of higher animal forms, and the latter because, to use Mr. Gosse's words, "though some of them live in marine animals, their proper sphere is not the water or the land, but the living tissues of other creatures: they have a world of their own." It must be admitted that these excuses are plausible, but we think by no means satisfactory; and the omissions in question only add to our regret, that instead of devoting his book exclusively to the marine zoology of these Islands, Mr. Gosse has not given us a manual of British animals, a work which (at least if the Insects were omitted) would have occupied but little more space.

In the classification adopted there is, of course, nothing new; but Mr. Gosse has put the ordinary views on this subject into a very simple and intelligible form. The most objectionable point in this respect, the separation of the Cirrhopods from the Crustacea as a distinct class, may perhaps conduce somewhat to this simplicity; but we cannot agree with Mr. Gosse in "believing that the diversity between the groups is quite as great as that which subsists between the Crustacea and the Arachnida, or between the Arachnida and the Insecta."

For the explanation of the technical terms, Mr. Gosse has appended a glossary, which is certainly capable of great improvement. Thus, we are told that "Bilateral" means "having a right and a left side;" that "Capsules" are "bladder-like vessels;" that "Cirri" are "fleshy, unjointed threads;" that a "Sac" is "a bag;" and there are several other instances of the same kind, some positively incorrect, others unsatisfactory, and a few trivial and unnecessary.

On the whole, however, it is rarely that we meet with a book containing so little to find fault with, and we look forward with pleasure to the appearance of the second part.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 9, 1854.—Dr. Gray, Vice-President, in the Chair.

Description of a New Species of Humming Bird, from Quijos. By John Gould, F.R.S. etc.

Mr. Gould exhibited a Humming Bird, lately received from Quijos, which is very nearly allied to *Threnetes leucurus*, but which differs from that species in its larger size, and in having those parts of the tail-feathers of a deep fawn-coloured hue which are white in *T. leucurus*; precisely, in fact, the difference which occurs between *Lafresnaya flavicaudata* and *L. Gayi*. For this bird Mr. Gould proposed the name of

Threnetes cervinicauda.

Head, all the upper surface, upper wing-coverts, two central tail-feathers, sides of the neck, breast and flanks shining olive-green; wings purplish-brown; lateral tail-feathers deep fawn-colour, stained on the apical half of the outer margin and the tip of the outer feather with dark brown; a crescent of the same, but of a much paler hue, at the tip of the next; a still fainter mark of the same colour near the tip of the external web of the third; and a nearly obsolete mark, of a similar tint, in the same situation on the fourth; lores and ear-coverts brown; on the chin and throat a lengthened triangular mark of black, bounded on either side by a narrow line of greyish-white, and below by a broad band of deep sandy-buff crossing the throat; centre of the abdomen greyish-buff; under tail-coverts olive, narrowly edged with greyish-buff; bill black, with the cutting edge of the upper mandible and the basal three-fourths of the under one pearly-white; feet yellow.

Total length, $4\frac{5}{8}$ inches; bill, $1\frac{7}{16}$; wing, $2\frac{3}{8}$; tail, $1\frac{1}{2}$.

Hab. Quijos, in Ecuador.

List of a Collection of Birds received by Mr. Gould, from the province of Quijos in the Republic of Ecuador. By Philip Lutley Sclater, M.A.

Among the many novelties in ornithology lately received by Mr. Gould from different parts of the world, is a small but valuable collection of birds from the province of Quixos, or Quijos, in the republic of Ecuador. This country, which lies on the eastern slope of the Andes, where the Rio Napo and other adjoining tributaries of the mighty Amazon take their rise, is a very interesting locality to those who study South American ornithology, being intermediate between New Grenada—whence so many new forms have lately been sent to Europe—on the one side, and the wood regions of Peru and Bolivia, where Von Tschudi and D'Orbigny pursued their laborious researches in natural history, on the other.

Mr. Gould having most liberally placed this collection in my hands for examination, I have drawn up a complete list of the species as far as I can determine them satisfactorily, in order to show the character of the ornithology of this country—observing that Mr. Gould is expecting fresh consignments from the same quarter, which will doubtless much further increase our knowledge of the fauna of this highly interesting region.

Hirundinidæ.

1. *Acanthylis albicollis* (Vieill.).

Hirundo albicollis, Vieill. Nouv. Dict. xiv. 524 (1817).

Hirundo collaris, Wied, Reise nach Bras. i. p. 75 (1820), et Beit. z. Nat. iii. p. 344.

Acanthylis collaris, Gray's Gen. i. p. 55. sp. 6.

This fine spine-tailed Swift seems generally distributed over the northern portion of the continent. It was observed by Prince Max. of Neuwied in many provinces of Brazil, by Schomburgk in British Guiana, and Sir William Jardine has examples transmitted by Professor Jameson from the vicinity of Quito. Mr. Gosse has recorded its appearance in Jamaica.

Trogonidæ.

2. *Trogon melanopterus,* Sw. (Gould's Mon. pl. 10, 11).
3. *Calurus auriceps,* Gould.

Bucconidæ.

4. *Bucco macrorhynchus,* Gm.
5. *Bucco collaris,* Lath.
6. *Malacoptila fusca* (Gm.).

Galbulidæ.

7. Galbula chalcothorax, Sclater, sp. nov.

G. læte cupreo-viridis; capite cærulescente; pectore læte violaceo; macula gulari triangulari alba: ventris plumis basi nigricantibus, apice albis; rostro pedibusque nigris.

Long. tota 8·3, alæ 3·3, caudæ 3·5, rostri 1·5.

Obs. Similis *G. leucogastræ,* sed major et pectore violaceo-cuprescente.

This is an immature bird of a species closely resembling *G. leucogastra,* but of larger size and with a bright violet or purple tinge on the breast, which does not appear in examples of the older species.

Cœrebinæ.

8. *Dacnis cayana* (L.) (Pl. Enl. 669. fig. 1).
9. *Dacnis angelica,* De Fil. (Pl. Enl. 669. fig. 2).
10. *Dacnis atricapilla* (V.).

Trochilidæ.

Mr. Gould has himself determined the species of *Trochilidæ* that occur in the present collection, as also the Trogons and Toucans.

11. *Phaëthornis striigularis,* Gould (Mon. Trochil. viii. pl. 15).

A new species allied to *P. intermedia.*

12. *Phaëthornis superciliosus* (Linn.)?
13. *Threnetes cervinicauda,* Gould.

A new species resembling *T. leucurus,* but with the tail-feathers fawn-coloured where they are white in the other species (see p. 278).

14. *Thalurania viridipectus,* Gould.
15. *Chrysuronia œnone* (Lesson).
16. *Iolæma Schreibersi* (Bourc.).

Mr. Gould has made a new generic name for this bird, which has been placed by Prince Charles Bonaparte in his 'Conspectus Trochilorum' among the *Campylopteri.*

17. *Cœligena typica,* Bp.
18. *Gouldia Langsdorfi* (Vieill.).

Dendrocolaptinæ.

19. *Xiphorhynchus procurvus* (Temm.) (Pl. Col. 28. fig. 4).
20. *Dendrornis guttata* (Licht.).

Nasica guttatus, Lafr. Rev. Zool. 1850, p. 385.

These are both Brazilian forms.

Menurinæ.

21. *Scytalopus griseicollis* (Lafr.).
Merulaxis griseicollis, Lafr. Rev. Zool. 1840, p. 103.
A Bogota bird.

Mniotiltinæ.

22. *Setophaga ruticilla* (L.).
This North American species is one of the few Passeres of that country that extend all through Central America into the northern portions of the southern continent. It is included by Schomburgk among the birds of British Guiana.

23. *Myiodioctes canadensis* (L.).
Described from Bogota by the Baron de la Fresnaye as a new species under the name of *Setophaga nigrocincta* (Rev. Zool. 1843, p. 292), but, as afterwards acknowledged by the same author, quite identical with North American specimens.

24. *Sylvicola Blackburniæ*, juv.
Also a common U. S. species.

Turdinæ.

25. *Turdus minimus*, Lafr. (Rev. Zool. 1848, p. 5).
The Prince Charles Bonaparte has reunited this bird to the *minor* of the U. S., from which M. de la Fresnaye considered it distinct.

Formicariinæ.

26. *Thamnophilus stellaris*, Spix ? (Av. Bras. ii. p. 27. pl. 36. fig. 2).
♂ *cinereus : pileo dorsoque summo et medio nigris, hujus pennis basi niveis : alarum tectricibus apice maculis rotundis, albis.*
♀ *supra pallide cinerea : subtus brunnea, lateribus cinerascentibus : alis externe rufis.*
Long. tota 5·2, alæ 3·0, caudæ 1·6.
This is a typical *Thamnophilus* with a strong thick bill. There are several examples of it in the Paris Museum in different states of plumage, and it was from examining them that I was enabled to decide that the female above described (which is in my own collection) belongs to this species.

27. *Cymbilanius lineatus* (Leach), ♂ & ♀.

28. *Formicivora cærulescens* (Vieill.), Menetr. Mon. t. 6. fig. 1 & 2. p. 499 (?).

29. *Pyriglena quixensis* (Cornalia).
Thamnophilus quixensis, Corn. Vert. Syn. p. 12*.
P. atra, abdomine cinerascente : tectricibus alarum maculis rotun-

* Dr. Cornalia's paper, which is little known in this country, is entitled "Vertebratorum Synopsis in Museo Mediolanensi exstantium quæ per novum orbem Caietanus Osculati collegit annis 1846, 47, 48 speciebus novis vel minus cognitis adjectis necnon descriptionibus atque iconibus illustratis : Modoetiæ 1849."

dis, albis terminatis: dorsi plumis laxis, elongatis, basi albis: rectricibus apice albis.

Long. tota 4·5, alæ 2·1.

30. *Pyriglena rufiventris* (Cornalia).

Thamnophilus rufiventris, Corn. Vert. Syn. p. 12.

P. atra, abdomine læte castaneo: alarum tectricibus maculis rotundis, albis terminatis: dorsi plumis laxis, elongatis, basi albis: rectricibus graduatis, harum extimis apice albis; rostro pedibusque nigris.

Long. tota 4·5, alæ 2·1, caudæ 2·0.

I have little doubt that I have correctly referred these two birds to the species described by Dr. Cornalia, the types of which I had an opportunity of examining through his kindness when last at Milan. Although they closely resemble one another, except in the colouring of the belly, there is so much difference in the form of the bill in the two specimens in this collection, that I think it hardly possible that, as suggested by Dr. Cornalia, the variations between them can be due to age or sex, and I believe them distinct, though nearly allied species. I have placed them in the genus *Pyriglena*, with the type of which, *P. domicella*, they agree in several respects; particularly in the lax and elongated feathering of the lower back—a curious structure occurring in several groups of birds, *Pycnonotus*, *Philentoma*, &c., and which has not yet, as far as I am aware, been fully explained. In this same genus I should also place that peculiar form, the *Myiothera nudiceps* of Cassin (Proc. Ac. Sc. Phil. 1850, p. 106), *Pyriglena nudiceps*, mihi, of which Mr. Gould has a specimen from Panama, and the MM. Verreaux have lately received examples from Santa Martha in New Grenada.

There are several other birds of this family in the collection that I cannot make out. A modern monograph of the group would be a great addition to our knowledge of South American ornithology.

31. *Conopophaga aurita* (Linn.) (Pl. Enl. 822).

Agrees with Cayenne specimens.

Tyranninæ.

32. *Pyrocephalus rubineus* (Bodd.), Pl. Enl. 675. fig. 1.

33. *Todirostrum* ——?, ——.

34. Tyrannula phœnicura, Sclater, sp. nov.

T. flavo-olivacea: dorso imo et ventre flavissimis: capite nigro-cinerascente, crista media flava utrinque nigra: fronte lorisque albis: gula cinerea: alis nigricantibus, tectricibus majoribus et secondariis rufescente limbatis: cauda unicolore clare rufa.

Long. tota 4·0, alæ 2·5, caudæ 1·7.

Obs.—Similis *T. ornatæ*, Lafr. Rev. et Mag. de Zool. 1853, p. 57, sed cauda clare rufa et secondariis rufescente marginatis sane diversa.

35. *Elania cayennensis* (Linn.).

TÆNIOPTERINÆ.

36. *Copurus filicauda* (Spix).

TITYRINÆ.

37. *Tityra marginata* (Licht.).

AMPELIDÆ.

38. *Pipreola Sclateri* (Cornalia).

Euchlornis Sclateri, Corn. Jard. Cont. to Orn. 1852, p. 133. pl. 101; Rev. et Mag. de Zool. 1853, p. 104. pl. 4.

Dr. Cornalia, to whom I owe many thanks for the honour he has done me in calling this elegant bird after my name, rightly insists on the claims of priority of De Filippi's genus *Euchlornis* over Lafresnaye's *Pyrrhorhynchus*. But both these names must, I think, give way to Swainson's term *Pipreola*, established in 1838 (Animals in Menag. p. 357), the type of which, his *P. chlorolepidota*, seems closely allied to D'Orbigny's *Ampelis viridis*. I was rejoiced to see this bird in the present collection, as it clears up a mystery about its *habitat*, which Dr. Cornalia supposed to be Peru or Bolivia. But I have now no doubt that the type specimen in the Museo Civico at Milan, which is the only other I have seen, came, as the present, from the province of Quixos, and was probably collected there by the enterprising Italian traveller Osculati.

39. *Pipreola Riefferi* (Boiss.).

Ampelis Riefferi, Boiss. Rev. Zool. 1840, p. 3.

40. *Laniisoma arcuatum*, Swains.

This generic name of Swainson's must be used as prior by several years to *Ptilochloris* of the same author. M. de la Fresnaye has recently reunited his *Ptilochloris remigialis* to the type species *arcuata*, but I am sure that there are two birds confounded under this name, though I have not yet seen enough specimens to enable me to distinguish them accurately. The *P. rufo-olivaceus* and *virescens* of Lafresnaye, described in the Revue Zoologique, 1838, p. 238, do not, I think, belong strictly to this genus. They have both been previously named by Prince Maximilian of Neuwied, the first as *Muscicapa turdina*, Beit. iii. 817, the second as *Muscicapa virescens*, ib. p. 802.

41. *Pipra Isidori*, Sclater, Rev. et Mag. de Zool. 1852, p. 9; Cont. to Orn. 1852, pl. 100. fig. 1. p. 132.

42. *Pipra coronata*, Spix, Av. Bras. ii. pl. 7. fig. 1.

(*P. cyaneocapilla*, Hahn. *P. herbacea*, Spix, ii. pl. 8 *a*. fig. 1 ♀.)

I believe Spix's name is prior to Hahn's. The *Pipra herbacea* of the former (of which I have seen the type in the Munich Museum) is certainly a female of this species.

43. *Pipra leucocilla*, Linn.

44. *Chiromachæris gutturosa* (Desm.) Tang. & Man. pl. 58.

I have my doubts whether this bird is really separable from *Pipra manacus*, as made out in Bp.'s Consp. p. 171.

Garrulinæ.

45. *Cyanocorax yncas*, Bodd. (Pl. Enl. 625. *Corvus yncas*, Bodd., *Corvus peruvianus*, Gm.)

Sturnidæ.

46. *Cacicus persicus* (L.).
47. *Gymnomystax mexicanus* (Linn.) (Bp. Consp. p. 431).

Tanagrinæ.

48. Arremon spectabilis, Sclater, sp. nov.

A. supra aurescenti-olivaceus: capite nigro, vitta verticali cinerea: superciliis albis: axillis lætissime croceis: subtus albus; mento summo et torque gutturali nigris; lateribus cinerascentibus; rostro flavo.

Long. tota 5·8, alæ 2·8, caudæ 2·5.

This beautiful *Arremon* appears to me to be quite new. It comes nearest perhaps to the *A. aurantiirostris* of Lafr. (Des Murs, Icon. Orn. pl. 55), but that has a very broad pectoral band, this a narrow one. Besides, the deep saffron, almost chestnut colour of the bend of the wing is of itself sufficient to distinguish it from all the other species of the genus.

A second example of this bird is in a collection lately received by Sir William Jardine from the same locality.

49. *Pyranga* ——? —— ♀.
A bad skin of a female or immature bird.

50. *Ramphocelus* ——? ——.
A female of one of the species allied to *R. jacapa*.

51. *Tachyphonus luctuosus*, D'Orb. & Lafr.
52. *Tanagra cœlestis*, Spix, Av. Bras. ii. p. 42. pl. 55. fig. 2.

Readily distinguished from the other *Bishop* Tanagers by the silky white bar across the wing. A rare bird in collections. In the Paris museum are examples collected by MM. Castelnau and Deville at Pontobamba in June 1847.

53. *Calliste Parzudakii* (Lafr.).
54. *Calliste Schranki* (Spix).
55. *Calliste xanthogastra*, Sclater.
56. *Calliste gyroloides* (Lafr.) ♀.
57. *Calliste cyanicollis* (D'Orb. & Lafr.).
58. *Calliste thalassina* (Strickl.).
59. *Calliste xanthocephala* (Tsch.).
60. *Euphonia xanthogastra*, Sund.

Capitonidæ.

61. *Eubucco Bourcieri* (Lafr.).
62. *Eubucco Hartlaubi* (Lafr.).
63. *Capito peruvianus* (Cuv.).

CUCULIDÆ.

64. *Piaya cayana* (Linn.) (Pl. Enl. 211).

PSITTACIDÆ.

65. *Psittacula passerina,* Spix?
Agrees with Bogota specimens.

RAMPHASTIDÆ.

66. *Pteroglossus castanotis,* Gould.
67. *Pteroglossus flavirostris,* Fraser.
68. *Andigena nigrirostris,* Waterhouse.

RALLIDÆ.

69. *Corethrura cayennensis* (Gm.) (Pl. Enl. 368).

May 23, 1854.—Dr. Gray, Vice-President, in the Chair.

NOTICE OF ALL THE KNOWN SPECIES OF THE GENUS ACCENTOR, WITH THE DESCRIPTION OF AN UNCHARACTERIZED SPECIES FROM NEPAL. BY FREDERIC MOORE, ASSIST. MUS. EAST INDIA COMPANY.

Family SYLVIADÆ, Vigors.

Subfamily ACCENTORINA, Vigors.

Genus ACCENTOR, Bechstein.

1. ACCENTOR ALPINUS, Gmelin.

Motacilla alpina, Gmel. S. N. L. i. p. 957.
Sturnus moritanus, Gmel. S. N. L. i. p. 804.
Sturnus collaris, Scop. Ann. i. p. 131. no. 192. Gmel. S. N. L. i. p. 805. Lath. Ind. Orn. i. p. 323.
Accentor alpinus, Bechst. Naturg. Deutschl. iii. p. 700. Eyton, Cat. Brit. B. p. 13. Macgill. Hist. Brit. B. ii. p. 258. Gould, Birds of Eur. t. 99. G. R. Gray, Gen. of Birds, i. p. 187; Catal. Brit. B. in B. M. p. 64. Blyth, Cat. B. Mus. A. S. Beng. p. 130. Bonap. C. G. Av. p. 305.
Le Fauvette des Alpes, Buffon.
The Alpine *Accentor,* Eyton; Yarrell.
Hab. Europe.

2. ACCENTOR NIPALENSIS, Hodgson.

Accentor nipalensis, Hodgson, J. A. S. Beng. xii. p. 958 (1843); Gray's Zool. Misc. 1844, p. 83; P. Z. S. 1845, p. 34; Cat. B. of Nepal, p. 71. G. R. Gray, Gen. of Birds, i. p. 187. Blyth, J. A. S. Beng. xv. p. 42. Bonap. C. Gen. Av. p. 305.
Accentor cacharensis, Hodgs. P. Z. S. 1845, p. 34.
The Nepal *Accentor,* Gray.
Hab. Nepal.

A. nipalensis.—"Newly-moulted adults have the upper parts nearly as in *A. modularis*, but the dark colour predominating, and the striation of the head and neck obsolete, or nearly so, these parts, with the ear-coverts and breast, being of an almost uniform dark brownish-grey; throat white, spotted with dusky-black, which forms two cross-bars on each feather, their extreme tips being greyish; belly and flanks bright dark ferruginous, mingled with the hue of the breast along the middle of the former; under tail-coverts dusky, tinged with ferruginous, and laterally margined with white; the feathers of the back are greyish-brown, with broad dark centres, or they may be described as blackish, with brown lateral margins, tinged with ferruginous towards and upon the scapularies; wings dusky-black, the tertiaries broadly margined with ferruginous, the other large alars slightly so, and all having a spot of this colour at the extremity of their outer edge; wing-coverts having a white spot at the tip of their exterior webs, and the small feathers near the bend of the wing coloured like the head; tail brownish-black, tipped with brown, the terminal spot of the inner web of each feather successively more albescent to the outermost; upper tail-coverts long, and brown with a dark central streak; bill dusky, the lower mandible yellow except at tip; legs reddish-brown. In worn plumage, the margins of all the feathers have more or less disappeared, and what remains of them is faded in hue; the conspicuous white spots on the wing-coverts, and ferruginous margins of the tertiaries, being completely abraded, the former leaving a semicircular sinus, as if artificially cut away. The young have the clothing plumage of the usual flimsy texture, the under parts coloured like the back, with no ferruginous on the belly, the spots on the wing-coverts are larger and less purely white; and the ferruginous on the scapularies and wing-coverts dingy."

Length about 7 inches; of wing $3\frac{3}{4}$ inches; tail $2\frac{3}{4}$; bill to gape $\frac{5}{8}$ths; and tarse $\frac{15}{16}$ths of an inch.

This species appears to represent *A. alpinus* on the Kachar region of Nepal.

3. Accentor variegatus, Blyth.

*Accentor himalayanus**, Blyth, J. A. S. Beng. xi. p. 187.

Accentor variegatus, Blyth, J. A. S. Beng. xii. p. 958 (1843); Cat. B. Mus. A. S. Beng. p. 131. G. R. Gray, Gen. of Birds, i. p. 187. Bonap. C. G. Av. p. 305.

Accentor alpinus, Vieill. Gal. des Ois. t. 156 (nec Gmel.).

The Variegated *Accentor*.

Hab. Sikim; Kasouli; Nepal (No. 964, Hodgson's Catalogue).

A. variegatus.—"Forehead, crown, occiput, neck, shoulder of the wings, and rump dingy grey-brown, with an inconspicuous lighter greyish eye-streak; throat and fore-neck white, with small round spots disposed as in *alpinus*; ear-coverts streaked with fulvescent, and

* This name was changed to *variegatus* by Mr. Blyth, as the other Indian species of this genus are also found in the Himalayas.

small loral and infra-orbital feathers tipped with fulvous-white; gorget brown, more or less tinged with rufous, which latter brightens on the lower breast, flanks, and sides of the belly, the feathers being laterally edged with white, and some having dark streaks on the flanks posteriorly; lower tail-coverts white, with lanceolate central dusky spots; wings intricately mottled, having the anterior range of coverts dusky-black with white tips, the next or great range fulvescent-grey exteriorly at base, and dusky-black for the remainder with slight whitish tips; primaries edged with grey, secondaries with brown, and tertiaries with fulvous; scapularies and interscapularies rufous-brown, mottled with large black terminal spots on the middle of each feather; tail dusky, having a large white spot at the tip of the inner web of each feather; bill black; legs pale reddish."

4. Accentor modularis, Linn.

Motacilla modularis, Linn. S. N. i. p. 329.

Accentor modularis, Bechst. Naturg. Deutschl. iii. p. 617. Eyton, Cat. Brit. B. p. 13. Macgill. Hist. Brit. B. ii. p. 251. Gould, B. of Eur. t. 100. G. R. Gray, Gen. of Birds, i. p. 187; Catal. Brit. B. in B. M. p. 65.

Sylvia modularis, Lath. Ind. Orn. ii. p. 511; Gen. Hist. vii. p. 20.

Tharrhaleus modularis, Kaup, Naturl. Syst. i. p. 137.

The Hedge *Accentor*. Selby. Yarrell.

Hab. Europe.

5. Accentor rubidus, Temm. et Schlegel.

Accentor rubidus, Temm. et Schleg. Faun. Japon. Av. p. 69. t. 32. Bonap. C. G. Av. p. 305.

The Japan *Accentor*.

Hab. Japan.

This species is closely allied to the common *A. modularis*, Linn.

6. Accentor montanellus, Pallas.

Motacilla montanella, Pallas, It. iii. p. 695. Gmel. S. N. L. i. p. 968.

Accentor montanellus, Bechst. Naturg. Deutschl. iii. Temm. Man. d'Orn. ed. 2. p. 251. Lath. Gen. Hist. vii. p. 15. Eyton, Cat. Brit. B. p. 13. Macgill. Hist. Brit. B. ii. p. 251. Gould, Birds of Eur. t. 101. G. R. Gray, Gen. of Birds, i. p. 187.

Sylvia montanella, Lath. Ind. Orn. ii. p. 526; Gen. Hist. vii. p. 90.

Spermolegus montanellus, Kaup, Naturl. Syst. i. p. 152.

?*Accentor Temminckii*, Brandt, Bull. Sci. Acad. Imp. St. Petersb.

The Mountain *Accentor*. Gould.

Hab. Eastern portions of Europe and Asia.

7. Accentor rubeculoides, Hodgson, n. sp.

Accentor rubeculoides.—Forehead, crown, nape, ear-coverts and chin brown; infra-orbital feathers tipped with whitish; throat, sides of neck, and shoulder of wings dingy grey-brown, the feathers of the throat blackish at base; back and rump ferruginous, centred with dusky; wings dusky, margined exteriorly with ferruginous; lesser and greater wing-coverts tipped with white; tail dusky, margined exteriorly with pale ferruginous; breast and fore part of flanks ferruginous, the latter streaked with dusky; belly white, tinged with ferruginous on the flanks posteriorly, vent, and margins of the under tail-coverts; the latter centred dusky. Bill blackish; feet pale reddish.

Length 6 inches; of wing 3; tail $2\frac{1}{2}$; bill to front $\frac{4}{10}$ths; to gape $\frac{1}{2}$ inch; tarse $\frac{3}{4}$.

The Robin *Accentor*.

Hab. Nepal (No. 970, Hodgson's Catalogue).

This fine undescribed species was lately presented by B. H. Hodgson, Esq., to the Museum of the Hon. East India Company.

8. Accentor strophiatus, Hodgson.

Accentor strophiatus, Hodgs. J. A. S. Beng. xii. p. 959; Gray's Zool. Misc. 1844, p. 83; P. Z. S. 1845, p. 34; Cat. B. of Nepal, p. 72. G. R. Gray, Gen. of Birds, i. p. 187. t. 51. Blyth, Cat. B. Mus. A. S. Beng. p. 131. Bonap. C. G. Av. p. 305.

The rufous-breasted *Accentor*, Gray.

Hab. Himalayas.

A. strophiatus.—"Upper parts much as in *A. modularis*, but the colours brighter and more contrasted, and the crown and neck uniform with the back; a broad eye-streak, the first of which is white to beyond the eye, surmounting a ferruginous streak continued backward to the occiput; a semicircle of the same surrounds the dusky ear-coverts, and the entire breast is also ferruginous; throat white, with dusky spots, forming a line descending from each angle of the lower mandible; belly and lower tail-coverts white with dusky streaks; wing-feathers dusky, margined with ferruginous, with an albescent spot at the tip of each covert; tail brownish, with dull rufous outer margins; bill black; legs reddish-brown."

Length about $5\frac{1}{2}$ inches; of wing $2\frac{1}{4}$ to $2\frac{1}{2}$; tail $2\frac{1}{8}$ to $2\frac{1}{4}$; bill to gape $\frac{5}{8}$ths; and tarse $\frac{13}{16}$ths of an inch.

9. Accentor immaculatus, Hodgson.

Accentor immaculatus, v. *nipalensis*, Hodgs. Gray's Zool. Misc. 1844, p. 83; P. Z. S. 1845, p. 34; Cat. B. of Nepal, p. 71 et App. p. 153.

Accentor mollis, Blyth, J. A. S. Beng. xiv. p. 581 (1845); Cat. B. Mus. A. S. Beng. p. 131. G. R. Gray, Gen. of Birds, iii. App. p. 8. Bonap. C. G. Av. p. 306.

The unspotted *Accentor*.

Hab. Nepal; Sikim.

A. immaculatus.—"Upper parts a rich brown, passing into pure dark ash-colour on the head and neck, and into maroon on the scapularies and tertiaries, and less deeply on the hind part of the back; coverts of the secondaries pure dark-grey, those of the primaries, with the winglet black, as also the primaries, these last having their unemarginated portion externally bordered with pale-grey; tail greyish dusky; frontal feathers to above the eyes margined with white, the lores blackish, and the entire under parts slightly embrowned deep ash-colour as far as the vent, which is pale and tinged with ferruginous, the under tail-coverts being deeper ferruginous, and the hind portion of the flanks dark ferruginous; bill blackish; feet fleshy grey; iris straw-colour."

Length about 6 inches; tail $2\frac{1}{2}$; wing $3\frac{1}{4}$; bill to frontal feathers $\frac{5}{16}$ths; and tarse $\frac{3}{4}$ of an inch.

10. Accentor Huttoni, Moore.

Accentor atrogularis, Hutton (nec Brandt?), J. A. S. Beng. xviii. p. 811 (1849). Blyth, Cat. B. Mus. A. S. Beng. p. 131. Bonap. C. G. Av. p. 305.

Hutton's *Accentor*.

Hab. Simla; Afghanistan. In Mus. East Ind. Company.

A. Huttoni.—"General colour above brown, the feathers centred dusky, more rufescent on the back, greyer on the nape, rump and upper tail-coverts; crown darker; a broad line above the superciliar streak, with the ear-coverts and throat dusky-black, the latter divided from the ear-coverts by a pale line proceeding from the base of the lower mandible, and this with the entire supercilium and the breast, of a uniform light rufescent sandy hue; belly whitish, the flanks streaked with dusky; wing-coverts slightly tipped albescent, forming slight cross-bands. Bill dusky, yellowish towards gape, and feet pale." "Irides brown."

Length 6 inches; of wing $2\frac{7}{8}$ths; tail $2\frac{1}{2}$; bill to gape $\frac{9}{16}$ths; and tarse $\frac{3}{4}$ths of an inch.

11. Accentor Altaicus, Brandt *.

Accentor Altaicus, Brandt, Bull. Sci. Acad. Imp. St. Petersb. (1841?). G. R. Gray, Gen. of Birds, i. p. 187. Bonap. C. G. Av. p. 306.

The Altaic *Accentor*.

Hab. Siberia.

12. Accentor atrogularis, Brandt.

Accentor atrogularis, Brandt, (nec Hutton?), Bull. Sci. Acad. Imp. S. Petersb. (1841?). G. R. Gray, Gen. of Birds, i. p. 187.

The Black-throated *Accentor*.

Hab. Siberia.

"The species of this genus," remarks Mr. Yarrell, in his admirable work on British Birds, "are very limited in number, only five, I believe, being at present known; two are figured in this work as belonging to England, two others are found in the north and east

* Not having been so fortunate as to examine the descriptions of Dr. Brandt's species, I am unable to describe them in this notice.

of Europe*, and a fifth has been received from the Himalaya mountains." The discovery of six distinct species in India, which have mostly been collected in Nepal by B. H. Hodgson, Esq., one from Japan, and the two described by Dr. Brandt, making in all twelve species, is accordingly no small accession to the known species of this interesting genus.

June 13, 1854.—Dr. Gray, Vice-President, in the Chair.

On the Genus Mulleria, Sowerby, or Acostæa, d'Orbigny.

By Dr. John Edward Gray, F.R.S., P.B.S., V.P.Z.S.

M. d'Orbigny has very kindly transferred to me the specimens of the shells which he described, in the 'Rev. et Mag. Zool.' 1851, under the name of *Acostæa Guaduasana*, and which he had received from Rio Sero near Guadual (Rio Magdalena) in Bogota. The examination of the specimens proves the truth of the supposition which I formerly expressed, that Mr. Sowerby's genus *Mülleria* was described from an imperfect specimen of this shell which had lost its umbones, with the young free state of the shell attached to them, in the manner so characteristic of this genus.

The series of specimens consists of a pair, not in a very perfect condition, and without the produced umbo of the attached valve, like the specimen described by Mr. Sowerby, but in a less worn condition, four specimens of the attached valve, and several of the free upper one.

The series of attached valves is curious, as showing the very different state of the umbo, the manner in which the free valves are modified before one of the valves becomes fixed; also the manner in which the upper free valves separate from the free part by a natural crack, when the free valves become united together by their edges, forming a shelly tube. In two of the specimens this crack takes place almost immediately behind the posterior end of the symmetrical free shell; in two of the others, the hinder part of the free shell is dilated into a triangular irregular portion before the hinder older part of the upper valve separates from the young one; in one of these the triangular tube thus formed is narrow and elongate; in the other, broad, forming a nearly equilateral triangular cavity under the umbo of the attached valve.

In three of the five specimens the shell is attached by the outer surface of the right valve, and in the other two by that of the left valve; the three specimens attached by the right valve exhibit all the three variations in the form of the umbo, viz. the absence of the free shell, the small, and the large and much dilated state of it.

There can be no doubt, as far as one can undertake to determine from the examination of the shell alone, of the affinity of this genus

* One of which species is in all probability the so-called *Accentor Calliope* of Temm. v. *Calliope Camtschatkensis*, Gmel., which, certainly, has no affinity to *Accentor*.

with *Etheria*, from which it appears only to differ in the very small size, or indeed in the total absence of the anterior adductor muscle. Like *Etheria*, the lower valve is rather attached to the stones and shells to which it is affixed, by inequalities in the form and surface of the shell, than by any real attachment of the substance of the shell itself, for the attached valves are covered with a continuous periostraca.

As all attached shells have a free young state, as may be seen by examining the umbones of *Arcinella*, *Chama*, and other attached bivalves, the young of *Etheria* are doubtless free, and there is nothing peculiar in the young of *Mülleria* being free; but there is a great peculiarity in the young shell becoming united into a tubular case, and one of the valves, after the other has become attached, separating itself from its younger part by a natural caries or crack.

LINNÆAN SOCIETY.

February 6, 1855.—Thomas Bell, Esq., President, in the Chair.

Mr. Westwood, F.L.S., exhibited some cocoons and living chrysalides of the Eria Silk-worm of India, which feeds on the castor-oil plant, which he had received from the Governor of Malta through Dr. Templeton; this being the species, the introduction and cultivation of which in Malta, Italy, and the South of Europe was now attracting so much attention in those countries, as proved by the numerous communications presented within the last few months to the Académie des Sciences at Paris by Marshal Vaillant, French Minister of War, and by MM. Milne-Edwards, Guérin-Méneville, Isidore Geoffroy Saint-Hilaire, Duméril, Montagne, &c. An extract was read, communicated by Major-General Hearsey, from the "Journal of the Asiatic Society," on the peculiarities of the silk of this species, the natural history of which, as well as of the Tusseh Silk-moth of India, formed the subject of an excellent memoir by Dr. Roxburgh in the "Transactions of the Linnæan Society," vol. vii. On examining the cocoons, Mr. Westwood had observed, that, unlike those of the common Silk-worm and most other moths which were of an entire, oval form, these cocoons were open at one end, which was protected by a series of converging elastic threads (like the mouth of a rat-trap), a peculiarity which had been long observed in the cocoons of the common Emperor Moth, *Saturnia pavonia minor*. This peculiarity, which had also been noticed by M. Duméril, had been supposed to have for its object the introduction of air to the interior of the cocoon, and also the prevention of the ingress of parasitic *Ichneumonidæ*, &c. Neither of these hypotheses were however considered by Mr. Westwood as conclusive; he thought rather that it was connected with the discharge of the fluid which most insects emit immediately after arriving at the perfect state. The circumstance is however of some practical importance in the Eria Moth, as it allows the egress of the perfect insect without injuring the thread of the cocoon, as is the case when the common Silk-worm Moth of the mulberry is allowed to escape from its cocoon. It is not, however, of so great a practical importance as might be at first supposed, as the silk-growers never allow the cocoons intended for winding to produce the moth; still those cocoons, which were set aside in order to obtain the perfect insects for breeding from, would also remain uninjured after the escape of the moths.

March 6.—Thomas Bell, Esq., President, in the Chair.

Mr. Syme, F.L.S., exhibited specimens of *Ophioglossum vulgatum*, L., from Swanbister, Orkney, together with a large series of specimens from other localities; and comparing them with an extensive series of specimens of *Oph. Lusitanicum* from various distant localities, came to the conclusion, in common with several recent botanical writers, that these two supposed species are in reality merely varieties of one and the same specific type.

Mr. N. B. Ward, F.L.S., exhibited on the part of Mr. Maxwell T. Masters, Sub-Curator of the Fielding Herbarium at Oxford, an abnormal stem of a species of *Dipsacus*, on which the following observations, by Mr. Masters, were read:—

"The specimen was received from Mr Smith of Witney in Oxfordshire, to whom it had been given by a blanket manufacturer of that town. From the presence of some small prickles on the remains of the leaves, Mr. Baxter, jun., the Curator of the Oxford Botanic Garden, suggested that it might be the stem of a *Dipsacus*. Great as is the dissimilarity between this abnormal specimen and the natural appearance of a Teazel-stem, the subsequent testimony of the donor confirms Mr. Baxter's opinion. Moreover, if the explanation here offered be correct, there is little difficulty in supposing it really to have been a Teazel-stem. It has unfortunately been broken, but its general appearance, when it came into our possession, is shown in the accompanying sketch. It then measured about 21 inches in length, and as the specimen seems to have been broken off pretty close to the ground, its original height must have been much less than that of an ordinary Teazel. At the base it is of a cylindrical form; soon, however, the stem becomes, as it were, twisted on itself, and is then flattened out laterally. A cross section of it at this point would therefore be ovoidal in outline. This portion of the stem is hollow: traces of the pith adhere to its inner surface. The greatest breadth is about 2½ inches; the breadth, however, gradually diminishes towards the upper part, where the cylindrical form is resumed. The branches, or flower-stalks, are placed one over the other in a line following the spiral curvature of the stem. Some of the branches have been broken off, and indications of several abortive branches are plainly visible. Remains of leaves occur at the base of one or two of the upper branches, and on these are small prickles, such as are found on a Teazel-leaf. The epidermis has for the most part peeled off, showing the course of the woody fibres in a spiral direction all the way up the main stem, but taking an opposite direction from that formed by the line of branches. In the lateral branches the course of the fibres is straight. The obliquity of the spiral is greatest in the lower part of the stem, diminishing as the stem expands laterally, and again increasing towards the upper part, where the stem resumes its cylindrical form. When the course of the fibres is traced from the base of any of the branches, the spiral will be found to terminate about the base of the second branch above that from which the line started. If each turn of the spiral, in this abnormal specimen, be considered to represent an internode, then the opposite and alternate arrangement of the branches of a *Dipsacus* would seem to be indicated. Should this view be correct, it would have an important bearing on that theory which ascribes the opposition of leaves to the absence or non-development of internodes, for here, where the internodes are developed, the arrangement is alternate. The position of all the branches in a line one over the other is accounted for by the spiral course of the fibres of the stem. And thus, if we conceive the fibres of this specimen untwisted and made to assume a vertical direction, and at the same time imagine the absence of internodes, the result will be the opposition of the branches and the alternate position of the pairs of branches as regards the side of the axis from which they proceed. At the dilated portion of the stem the growth was probably much more rapid than at the lower part, which, from its more solid and firmer structure, may be conceived to have offered some resistance to the lateral expansion of the stem. In so doing it may have been the cause of that twisting of the stem upon itself, which, it will be observed, begins at the point where the change of form also commences."

The communication was accompanied by a sketch of the monstrosity described in it.

March 20.—Thomas Bell, Esq., President, in the Chair.

Read a "Description of *Peachia hastata*, a new genus and species of the Class *Zoophyta*; with observations on the Family *Actiniadæ*." By Philip Henry Gosse, Esq., A.L.S.

The specimens on which Mr. Gosse founds his new genus, *Peachia*, were discovered by the Rev. Charles Kingsley in the months of January and March 1854, in the vicinity of Torquay. Mr. Gosse gives an elaborate description of the animal, both in reference to its external and internal structure, together with a particular account of its habits, derived from the communications of Mr. Kingsley as well as from his own observations. He considers that the possession of an excretory orifice to the body is a character of sufficient importance to separate it from *Actinia*, and to constitute a new genus, for which he proposes the name of *Peachia*, as a tribute to the zeal, industry and success with which marine zoology has been studied by Mr. Charles W. Peach. He is also led to this selection of a name, because he thinks it probable that a minute species, described by Mr. Peach under the name of *Actinia chrysanthellum*, may belong to the same genus. The following are the characters, generic and specific, of the animals in question:—

PEACHIA, *Gosse.*

Corpus elongatum, subcylindricum, pyriforme, v. fusiforme, ditrematum, liberum ; *tentaculis* paucis, brevibus (disci diametrum haud superantibus), crassis, conicis, uniseriatis ; *oviductu* in tuberculum papillosum desinente.

1. PEACHIA HASTATA, corpore roseo lineis æqualibus pallidis, tentaculis 12 albo-hyalinis seriebus 2 parallelis macularum sagittatarum brunnearum notatis, disco circulis duobus macularum brunnearum V-formium cincto, oviductûs papillis numerosis aggregatis.

2? P.? CHRYSANTHELLUM, corpore cylindrico albido lineis inæqualiter latis, tentaculis brunneo-annulatis.

Mr. Gosse considers the principal interest of this form to consist in the decided approach which it makes to a higher type than that of *Actinodermata*, assisting, together with the genus *Edwardsia* of M. Quatrefages, to diminish the interval between the *Actiniæ* and *Holothuridæ*. Of the genus *Edwardsia* he observes that there are two British species, one of which was described and figured by himself, in the 'Annals of Natural History' for Sept. 1853, under the name of *Scolanthus callimorphus*, which genus he is now convinced ought to be abolished ; and the other, described in a letter from Mr. Kingsley, appears to be identical with *Edwardsia Beautempsii*, Quatr.

The author then proceeds to remark on the importance of still further dividing the large remainder of species, which, even after the separation of the genera already constructed from it, still remain united under the name of *Actinia*. After discussing the principles on which he conceives that this division may be most properly founded, he goes on to establish the following generic types, adding after each the names of the British, and of some of the exotic species belonging to it.

SAGARTIA, *Gosse.*

Actiniæ basi adhærentes ; *tentaculis* conicis facilè retractilibus ; *sphærulis* marginalibus nullis. *Corpus* everrucosum, *filamenta capsulifera* e poris emittens ; *filis urticantibus* brevibus, pilorum fasciculo densè armatis.

Sp. Brit.—Act. viduata (=anguicoma, *Price*), *Troglodytes, Aurora, candida, rosea, nivea, venusta, parasitica, Bellis, Dianthus* ; fortè etiam *A. aurantiaca* et *pulchella,* Jord.

The following exotic species, figured by Mr. Dana in the Zoophytes of the American Exploring Expedition, seem to be referable to this genus, viz. *A. Primula* ; the beautiful *decorata* and *Fuegensis,* both allied to our *Bellis* ; and *Achates, reticulata* and *Paumotensis,* which are evidently allied to *Dianthus.*

BUNODES, *Gosse.*

Actiniæ sphærulis marginalibus nullis ; *corpus* verrucosum ; *cute* coriaceâ, *filamentis* missilibus nullis ; *filis urticantibus* longis simplicibus ; *tentaculis* plerumque crassis, conicis, obtusis.

Sp. Brit.—A. gemmacea, Thallia, clavata, crassicornis, monile (fortè *crassicornis* junior) ? *Chrysoplenium* ?, *alba* ?, *miniata* ?

Of exotic species, *A. Diadema, pluvia, Gemma, Artemisia* of Dana's Zoophytes, probably belong to this genus.

ACTINIA, *L.* (*pars*).

Sphærulæ capsuliferæ ad disci marginem seriatæ; *corpus* everrucosum, *poris filamentisque missilibus* destitutum ; *cute* lævi.

Sp. Brit.—*A. Mesembryanthemum, margaritifera, Chiococca.*

Of exotic species, *A. Tabella* and *graminea* of Dana are here referable.

The following British species are of doubtful position, viz. *A. coccinea, intestinalis, biserialis* and *vermicularis*. The very curious *A. biserialis* has a close parallel in Dana's *Rhodora*; and these may perhaps form together another genus when more is known about them. *A. intestinalis* and *Vermiculum* show, in their slender lengthened form, an approach to the free condition of *Peachia*, &c.

Mr. Gosse next exhibits in a tabular manner one of the modes in which the British non-coralligenous *Actiniadæ* may be artificially distributed; and under the head of each genus comments on its structure, limits, and affinities, concluding his paper with a diagram intended to express, as nearly as such a representation can, the varied consanguinities and cross-alliances of the group.

The paper was illustrated by figures of *Peachia hastata*; and by magnified representations of the thread-cells and threads of several species of *Sagartia*.

April 3.—T. Bell, Esq., President, in the Chair.

The following letters were read :—

"12 South Frederick Street, Glasgow,
22nd March, 1855.

"DEAR SIR,

"At Dr. Hooker's suggestion I send you, for the herbarium, two specimens of a rare British plant (*Hierochloë borealis*), which, after having been erased from the list, was rediscovered near Thurso by Mr. Robert Dick, who states that it flowers so early in the year as May and the beginning of June, disappearing soon afterwards; so that there was no wonder I and others could not find it in Don's station, Glen Kella, Angusshire, as botanists seldom go there before the end of July.

"I am, dear Sir, yours truly,
"WM. GOURLIE."

"*R. Kippist, Esq.*"

The specimens forwarded with this letter were marked as gathered by Mr. Robert Dick, at "Thurso, Caithness, May 1854."

"Cedar Terrace, Henwick, Worcester,
March 21st, 1855.

"MY DEAR SIR,

"In the account of the Meetings of the Linnean Society which have met my view, I have seen no notice of a very interesting addition to the British Flora which was made in 1854 in this neighbourhood, on the confines of Worcestershire and Herefordshire, though strictly within the latter county. The plant I allude to (a specimen of which I enclose for the inspection of the Society) is the pretty little Orchid, *Epipogium aphyllum*, which was never before, that I am aware of, met with in England, and has not been alluded to as a probable native in any of our local or general floras.

"It was first noticed in July of last year (1854), by Mrs. Anderton Smith, then staying at Tedstone Rectory, and other specimens were afterwards gathered by her husband, who communicated with me on the subject, and indicated the place where Mrs. Smith first gathered the plant. The locality has quite a subalpine aspect, the Sapey brook there running in a deep glen shadowed on all sides by lofty trees, and near the spot a little water-fall gurgles over the massive sandstone rocks. It was the felling of some of these trees that brought the plant to light. I have also to mention another locality for the *Neottia* or *Spiranthes æstivalis*, hitherto, I believe, only found in England in the New Forest, Hampshire; but the last autumn a specimen of the *Spiranthes æstivalis* was shown to me, which was gathered by Mr. George Jordan of Bewdley, on the confines of the great bog in Wyne Forest, Worcestershire. I have been careful to examine the plant gathered by Mr. Jordan, and to visit the spot where it was found, so that the information may be relied on, and thus the range of the *Spiranthes æstivalis* is extended in England. This it may be interesting to note.

"The enclosed specimen can be exhibited at the next Meeting of the Society, if the plant has not been previously brought before their notice as a native of Britain. It is the only one I at present possess; but if the Linnean Society has not a British specimen in their collection and you think it may be any way advantageous to botanical science, or be useful for metropolitan botanists to examine, I will with pleasure permit the retention of it for the Society. Otherwise please return it to me at your leisure after it has been examined.

"I remain, my dear Sir, yours very truly.

"*R. Kippist, Esq.*" "Edwin Lees."

The specimen of *Epipogium*, which (in compliance with Mr. Lees' kind permission) has been placed in the herbarium of the Society, is stated on the ticket to have been "gathered in a woody dingle on the banks of Sapey Brook, Tedstone, Herefordshire, about a mile and a half south of Clifton-on-Teme, Worcestershire; July 1854."

MISCELLANEOUS.

Sibbald's Drawings of Scottish Animals.
By the late Dr. George Johnston.

There is a small quarto volume of original drawings with the title "*Piscium et Aquatilium Icones, a Joanne Alexandro ad vivum depictæ.* Anno Domini M.DCC.VII," preserved in the Library of the Royal College of Physicians of Edinburgh. The drawings were undoubtedly made for Sir Robert Sibbald, and a few of them have been engraved to illustrate his book on Whales, and his Natural History of Scotland. On the inside of the board of the volume there is written—"Hic liber olim viri docti D. Roberti Sibbaldi Eq. Aur. fuit, et multorum variorum apud nos piscium icones continet." The title is written within a square border, very neatly ornamented. In the centre of the top there is a clam-shell with a figure of Neptune, his trident, and horses; and on each side a classical Dolphin. To the right, a figure of the Sepia is suspended over an upright figure of the Loligo sagittata, with a Crab between; and on the left, the Sturgeon and the Tusk make the border, with the Turritella terebra as a piece of separation.

Folio i. A characteristic figure of the Scad or Horse-Mackerel.—Fol. ii. "Piscis in lacu Mabano seu vandosus;" and "a Whale cast in at Rosyth castle." The Vendace is very unlike the figure of that fish in Yarrell; nor can I identify the whale with any figured in Bell's work on the Mammalia. It appears to be a species of Beluga.—Fol. iii. Balænoptera Physalus.—Fol. iv. "A Sperma Ceti Whale." Two figures, viz. a side and a back view. There is written on the paper—"Whale at Moryfurth, Feb. 23, 1703. Side, but it did lay halfe vpon the side that one Ey and a little of the bellie was sanded. 57 foots long, and 56 round. booth under and all the skin blackish blew werie smooth and as thick as a bull's and all white fat within and nixt the skin."—Fol. iv. A rude figure of Coronula diadema: a better figure of the Vendace: and "a horse markrett"—which is something I cannot decipher.—Fol. v. A whale cast in at a place which is illegible. The whale is Balænoptera Physalus, and is about 50 feet long.—Fol. vi. Probably a species of Hyperoodon. It is called a North-Caper.—Fol. vii. Fig. sup. Scorpio marinus nostras = the long-spined Cottus, Yarrell. Fig. med. Galeus lævis = Acanthias vulgaris or Dog-Fish. Fig. inf. Cataphractus nostras = Aspidophorus europæus.—Fol. viii. A repetition of the figure of the Beluga?—Fol. ix. Fig. 1. The Cat-fish. (2) Gymnetrus Banksii! (3) Galeus nostras = The Dog-fish. (4) Gobius maculis undatis nostras = the unctuous Sucker. (5) Aculeatus marinus major nostras = the Fifteen-spined Stickleback.—Fol. x. A good figure, and appears to represent the Cook Wrasse of Yarrell.—Fol. xi. The Hiatula = the Ballan Wrasse. —Fol. xii. The Bonnet Flooke. This is the Holibut.—Fol. xiii. A very rude and unfinished figure of a "Salmon Stour"? "taken in Sanda in Orkney." The figure is one of the Tunny. There is, on the same folio, the figure of a Tusk without the head, as it is salted. —Fol. xiv. Teeth of the Spermaceti Whale—"Dentes Balenæ macrocephalæ."—Fol. xv. "Loligo," viz. L. media; and Raia vulgaris = the Common Skate.—Fol. xvi. "Polypus nostras," viz. = Eledone ventricosa.—Fol. xvii. "Sepia nostras" = Sepia officinalis. Both this and the preceding are excellent figures.—Fol. xviii. Loligo sagittata: good.—Fol. xix. A Fossil Nautilus.—Fol. xx. Fossil Nautilus, two species.—Fol. xxi. "Vulva marina, supina fascies" = an Ascidia. "Favus marinus"—The ovisacs of the Fusus antiquus on a stone covered with a Serpula.—Fol. xxii. "The Harper Crab" = Hyas araneus. "A shore Crab," but it is really Portunus depurator.—Fol. xxiii. Fig. sup. Perhaps Nymphon giganteum. Fig. med. "Cancer araneus" = Stenorynchus Phalangium. Fig. inf. The Common Crab.—Fol. xxiv. "Scolopendra marina nostras" = Aphrodite aculeata.—Fol. xxv. "Loligo nostras" = L. sagittata.—Fol. xxvi. "The Lugg" = Arenicola piscatorum. "Urtica rarior sphæricus," a species of Medusa unknown to me.—Fol. xxvii. Four unfinished sketches of a Medusa, probably the M. cruciata; and three equally rude figures of Lobularia digitata.—Fol. xxviii. The claws of the Norway Lobster (Nephrops norvegicus); and a "chela Astaci monstrosa."—Fol. xxix. "Canis carchariæ Icon rudior"—so rude as to be beyond specific identification—"Stella echinata" = Ophiocoma rosula.—Fol. xxx. "Gurnadus griseus" = the Grey Gurnard.—Fol. xxxi. The Tunny: a good figure.—Fol. xxxii. The Tusk: a finished drawing.—Fol. xxxiii. "Gurnardus griseus"—the Grey Gurnard again.—Fol. xxxiv. "Trachurus"—viz. the Horse-Mackerel.—Fol. xxxv. A figure probably of the Cook Wrasse.

The only other figures are copies of those which have been engraved for the Scotiæ Prod. Nat. Hist. and for Sibbald's other works, more especially his little volume on Whales.

CLAUSILIA ROLPHII.

Some of the "new localities" for British plants and shells, discovered by the Rev. W. H. Hawker and given in the last Number of the 'Annals' (p. 212), are so remarkable, that I was glad to see one which I could confirm from personal observation; viz. the station for *Clausilia Rolphii* (*plicatula*, Drap.) in Ashford Woods, where I met with it fifteen years ago, when collecting with Mr. Wm. Harris, F.G.S., of Charing.—S. P. Woodward.

HELIX ASPERSA.

A curious specimen of the common Garden Snail has been sent me by Miss A. Hodgson of Ulverstone. It is an adult shell with a second, half-grown individual, fixed to its spire and partly imbedded in the suture of the body-whorl. The winter door (*epiphragm*) remains in the exposed part of the small shell's aperture, showing that it had died during the first hybernation, whilst its neighbour had survived, and not getting free from the incubus of the empty house of the deceased, had partially enveloped it in the course of its growth to maturity.—S. P. Woodward.

Descriptions of some New Species of Birds.
By the Viscount Du Bus de Gisignies.

1. *Vireosylvia frenata.* V. supra flavido-cinerea; pileo pure cinereo; superciliis ad nucham productis et genis dilute fulvescentibus; subtus albida; hypochondriis dilute flavido-cinerascentibus; gula utrinque stria atra a basi mandibulæ descendente marginata; remigibus

et rectricibus fusco-cinereis, flavicante extus limbatis; tectricibus alarum inferioribus et crisso flavidis. Rostro et pedibus fuscis.

Total length 19½ centim. (nearly 8 inches).

Hab. Ocaña, New Granada.

A typical species, with the bill rather long, straight, and compressed; it presents a close resemblance to *V. olivacea*, Linn., but is easily recognizable by the blackish streak which passes down each side of the throat from the base of the mandible.

2. *Cyanoloxia concreta.* Mas. C. cærulescenti-nigra; fronte, superciliis et genis paulo dilutioribus; humeris cyaneis; alis et cauda nigris; tectricibus alarum superioribus et remigibus secundariis cærulescente limbatis. Rostro et pedibus nigricantibus.

Total length 15½ centim. (about 6 inches).

This bird was killed at Playa-Vicenti in Mexico. In its coloration it approaches *Loxia cyanea*, Linn., and is nearly of the same length, but is more robust, and the bill and feet are much stronger. It also appears to be distinct from *Coccoborus cyanoïdes*, which I only know from the short description published by Lafresnaye in the 'Revue Zoologique' for 1847.

3. *Pyrenestes personatus.* Mas. P. saturate fuscus; capite, absque occipite, et tectricibus caudæ superioribus coccineis, nitentibus; pectore coccineo tincto; rectricibus duabus intermediis supra, cæterarum pogonio externo obsolete coccineis. Rostro nigro; pedibus fuscis.

Total length 14 centim. (about 5½ inches).

Hab. Senegal.

This is the second species of the genus, supposing *P. coccineus*, Cass., to be the same as *P. ostrinus*; it is still more typical than the latter. It has the bill thicker in proportion, and the tooth of the lower mandible more developed.

4. *Poliospiza canicapilla.* P. supra, cum lateribus capitis, fusco-cinerea; pileo fusco-nigricante et albido vario; subtus cinerea; superciliis, gutture, ventre et crisso albidis; remigibus et rectricibus obscure fuscis, cinerascente extus limbatis. Rostro et pedibus cinereo-fulvis.

Total length 12 centim. (about 4¾ inches).

It closely approaches *Serinus tristriatus* and *xanthopygius*, Rüpp., which inhabit Abyssinia. This new species inhabits Senegal.

5. *Quelea capitata.* Q. supra brunnea, plumis singulis albido-fuscescente marginatis; capite pure sanguineo, mento et gutture nigris, sanguineo maculatis; subtus dilute fuscescens; hypochondriis brunneo variis; ventre albido; remigibus et rectricibus flavicante extus limbatis. Rostro brunneo, mandibulæ basi dilutiore; pedibus rubro-fuscis.

Total length 11½ centim. (about 4½ inches).

Hab. Senegal.

If the colours of the head were not sufficient to distinguish this species, I should have considered it identical with *Euplectes erythrops*, Hartl., with which I am not acquainted in nature, but which is described and figured with care in the second volume of the 'Abhandlungen' of the Natural History Society of Hamburg, 1852. This bird has only a little red round the base of the bill and above the eyes, whilst the new species has the whole of the head of a fine uniform blood-red, and the throat and front of the neck are spotted with red and black.

Nor is it likely that the difference between these birds is sexual, as Hartlaub gives descriptions of both sexes of his *E. erythrops*, and states that the female is yellow where the male is red.

6. *Chrysomitris xanthogastra.* Mas. C. nigerrima subnitens; speculo lato alarum, rectricum basi, exceptis duabus intermediis, et abdomine cum hypochondriis et crisso aureo-flavis. Rostro cærulescenti-nigro; pedibus brunneo-nigris.

Total length 9 centim. (about $3\frac{1}{2}$ inches).

Hab. Ocaña, New Granada.

This is one of the smallest species of the genus. In its colour it resembles the *Carduelis atratus*, D'Orb., but differs in its size, which is about one-fourth less.—*Bull. de l'Acad. Roy. de Belgique*, xxii. p. 150–152, 1855.

The Operculum of Diplommatina. By Capt. Thomas Hutton.

The operculum of *Diplommatina folliculus* having been overlooked, from its small size and hidden position, in the original description, Mr. Benson was inclined to doubt its existence, but afterwards corrected his former opinion. Captain Hutton formerly believed it might be a *clausium*, attached to the shell by an elastic ligament: he has recently most kindly written me a note, in which occurs the following passage, setting this question at rest: "Having placed my specimens upon some wet and withered oak leaves (*Q. incana*), which the animal prefers to anything else, I waited, magnifier in hand, to decide the knotty point of operculum or no operculum, and lo! when the animal came forth, I saw the little shield-like operculum *carried horizontally upon the back of the animal*, and not attached to the shell. When the animal is just coming out of the shell, the appendage is plain with the aid of a glass, but not so easily seen when in full motion, as it lies upon the back of the animal, just under the shell, and is thus in a measure hidden."—J. E. Gray.

Note on the Aphyllanthes monspeliensis, *and the new Family of the* Aphyllanthaceæ. By M. Parlatore.

The *Aphyllanthes monspeliensis* is a plant which has the aspect of a little rush, or rather that of the *Dianthus prolifer*; it grows abundantly in the stony, sterile parts of the basin of the Mediterranean, in the south of France as far as Nice, in Spain, Portugal and Algeria. This plant was first described and figured by Pena and Lobel, who did not fail to notice a certain resemblance between its flowers and those of a *Dianthus,* and who described them as borne within a glumaceous involucre. From this same resemblance, G. Bauhin placed the *Aphyllanthes* in his section *Caryophyllus sylvestris,* under the name of *Caryophyllus cæruleus monspeliensis.*

Tournefort established the genus *Aphyllanthes,* placing it in the class of *Liliaceæ,* and considering the involucre as a scaly and nearly tubular calyx ; he gave a plate containing an analysis of the flower and even of the capsule. Linnæus retained the genus *Aphyllanthes,* and in the first editions of his 'Genera Plantarum,' it is placed beside the genus *Juncus* ; for Linnæus regarded the *Aphyllanthes* as nearly a rush, saying in the observations upon this plant, "*Juncus esset si corollâ careret.*"

In the 'Genera Plantarum' of Antoine-Laurent de Jussieu, *Aphyllanthes* is arranged in the first section of the order of *Junci,* in which we also find the genera *Eriocaulon, Restio, Xyris,* and *Juncus,* each of which has since been raised to the rank of a family.

DeCandolle continued to regard the *Aphyllanthes* as a plant belonging to the family *Junceæ,* although with him this family had not the same limits as with Jussieu. This opinion has been followed by several recent botanists,—as by Ventenat, Bartling, Reichenbach, and others.

Labillardière having discovered the genus *Borya* in New Holland, arranged it also amongst the *Junceæ,* as it is allied to *Aphyllanthes*; but Mr. Robert Brown, in his celebrated 'Prodromus,' whilst remarking that the aspect of *Borya* is that of a rush, indicated the differences existing between the *testa* and *albumen* of the seeds and those of the *Junceæ* ; this led him to arrange *Borya* in the family of the *Asphodeleæ,* which, with him, includes a great part of the Asphodeli and Asparagi of Jussieu.

Endlicher, in his 'Genera Plantarum,' placed *Aphyllanthes, Borya, Johnsonia, Laxmannia,* and a new genus which he calls *Alania,* at the end of the *Liliaceæ,* considering them as genera allied to the Asphodels (*genera Asphodeleis affinia*) ; this has been followed by Kunth and Schnitzlein ; and the latter has formed for these plants a tribe of *Liliaceæ* which he calls *Juncopsideæ.* Thus, three different opinions now exist as to the family in which the *Aphyllanthes* should be placed : according to one of these it is a rush ; according to another, an Asphodel ; and the third approximates it to the Asphodels or the Lilies, according to the extension given to the limits of the great family *Liliaceæ.*

Few have, however, carefully studied the *Aphyllanthes monspeliensis* in the living state, at least to judge from the published figures and descriptions, which are partially false. In the researches upon the monocotyledonous plants, which I have followed for several years, I have examined the *Aphyllanthes,* which presents a singular structure, especially in the parts of the flower. The most remarkable characters of the plant are the following :—

1. A rhizome with branches in the form of leafless stems.

2. Solitary flowers, or flowers united two or three together, borne at the apex of the branches, and accompanied by scale-like bracts.

3. A scaly involucre proper to each flower, composed of five bracts united together to a great extent so as to form a tubular calyx, and persistent after flowering, when it envelopes the capsule.

4. A pedunculated flower in the interior of this involucre; its perigonium is formed of six membranous, petaloid leaflets, arranged in two rows, and furnished with a pretty long claw, as in the *Silenaceæ*.

5. The æstivation of these leaflets of the perigonium is imbricated, and they cover each other at the tips.

6. Six stamina arranged in two rows, of which the external are the shortest; they are inserted by filiform filaments upon the throat of the perigonium, and the anthers are bilocular and introrse.

7. Ovary stipitate, trilocular, with a single ovule in each cell.

8. Ovules amphitropal, reversed, inserted towards the middle of the inner angle of the cell.

9. Stigmata trifid; each division furnished with a large lobe below.

10. Capsule rostrated, splitting into three valves (loculicido-trivalve), with a single seed, furnished with a crustaceous testa and a fleshy perisperm, and containing an axile embryo, half the length of the perisperm.

From these characters it appears to me that we must regard this plant as the type of a new family, to which I propose to give the name of *Aphyllanthaceæ*.

This family approaches the *Junceæ* in the characters of the organs of vegetation, and the *Liliaceæ* in those of the organs of reproduction, so that it appears to form the passage between these two natural families of plants. Nevertheless it differs essentially from both, in the presence of an involucre which persists after inflorescence, and in the imbricated æstivation of the leaflets of the perigonium, even of those of the outer row, which is valvate in the *Junceæ* and *Liliaceæ*, the leaflets of which have the apices perfectly free, even in those species in which the leaflets cover each other slightly at the margins. In *Aphyllanthes*, on the contrary, the leaflets of the perigonium cover each other at the tips, so that a form of bud is produced different from that of the *Liliaceæ* and *Junceæ*.

In other respects the *Aphyllanthaceæ* differ principally from the *Junceæ* in the membranous and petaloid nature of the leaflets of the perigonium, which wither and fall after inflorescence; in the crustaceous testa of the seed, and especially in the embryo, which is situated in the axis of a fleshy perisperm of double its length. In the *Junceæ* the leaflets of the perigonium are glumaceous and rarely subpetaloid, but always persistent; their seeds have a membranous testa and enclose a small embryo, which only occupies the base of the perisperm.

Besides the characters already indicated, the *Aphyllanthaceæ* also differ from the *Liliaceæ* in the characters of the vegetation, and in the singular structure of the flower, which presents a distinct resemblance to that of a Silenaceous plant, whence is partly derived that resemblance to a *Dianthus* noticed even by the older writers.

The establishment of this family appears to me to acquire greater importance, as some at least of the genera *Borya*, *Alania*, *Johnsonia*, and *Laxmannia*, must be referred to it; these are genera allied to *Aphyllanthes*, which, in the characters of their vegetation, resemble either the *Junceæ* or the *Cyperaceæ*, and which have their petaloid flowers accompanied by scale-like persistent bracts, the two superior of which are opposite, almost like the glumes of the *Gramineæ*, and are sometimes bifid or trifid, bidentate or tridentate at the apex. These flowers are also disposed in groups or heads, which, after flowering, present a great resemblance to the heads of *Chætospora* or *Xyris* after their petals have fallen.—*Comptes Rendus*, 27th August 1855, p. 344.

METEOROLOGICAL OBSERVATIONS FOR AUG. 1855.

Chiswick.—August 1. Very fine. 2. Very fine: heavy rain. 3—5. Very fine. 6. Overcast. 7. Very fine. 8. Rain: thunder: heavy rain. 9. Cloudy and fine: clear at night. 10. Foggy, with heavy dew: very fine: slight haze: very fine. 11. Slight haze: very fine. 12. Overcast: fine: clear. 13. Very fine. 14. Cloudy and fine. 15, 16. Very fine. 17. Slight fog: very fine. 18. Very fine. 19. Very fine: slight rain at night. 20. Slight rain: cloudy and boisterous. 21. Fine: clear and windy. 22. Very fine. 23. Very fine: much sheet and forked lightning at night. 24—26. Very fine. 27. Very fine: cloudy at night. 28, 29. Very fine. 30. Very fine: clear at night. 31. Very fine.

Mean temperature of the month	61°·63
Mean temperature of Aug. 1854	60 ·55
Mean temperature of Aug. for the last twenty-nine years ...	61 ·98
Average amount of rain in Aug.	2·446 inches.

Boston.—Aug. 1. Fine: rain A.M. 2—4. Fine. 5, 6. Cloudy. 7. Cloudy: rain A.M. and P.M., with thunder. 8. Cloudy: rain A.M and P.M. 9. Rain A.M. 10. Fine. 11. Cloudy. 12. Cloudy: rain A.M. 13. Fine. 14. Cloudy. 15—18. Fine. 19. Fine: rain A.M. 20. Cloudy: rain A.M. 21, 22. Cloudy. 23. Cloudy: rain A.M. and P.M. 24. Fine. 25. Fine: rain P.M. 26—28. Fine. 29. Cloudy. 30, 31. Fine.

Sandwick Manse, Orkney.—Aug. 1. Cloudy A.M.: fine, fog P.M. 2. Rain A.M.: fine, cloudy P.M. 3. Clear A.M.: fine, drops, thunder and lightning P.M. 4. Rain A.M.: drizzle, showery P.M. 5. Bright A.M.: cloudy P.M. 6. Clear A.M. and P.M. 7. Rain A.M.: showers P.M. 8. Rain A.M.: drizzle P.M. 9. Drizzle A.M.: clear, vapour P.M. 10. Hazy A.M.: damp P.M. 11. Cloudy A.M.: showers P.M. 12. Cloudy A.M.: damp P.M. 13. Showers A.M.: cloudy P.M. 14. Bright A.M.: cloudy P.M. 15. Drizzle A.M.: cloudy P.M. 16. Cloudy A.M.: rain P.M. 17. Cloudy A.M. and P.M. 18, 19. Cloudy A.M.: cloudy, thunder and lightning P.M. 20. Showers A.M.: rain P.M. 21. Bright A.M.: cloudy P.M. 22. Showers A.M. and P.M. 23. Showers, bright A.M.: clear P.M. 24. Cloudy A.M.: rain P.M. 25. Clear A.M. and P.M. 26, 27. Rain A.M.: cloudy P.M. 28. Clear A.M.: showers P.M. 29. Bright A.M.: clear P.M. 30. Drops A.M.: clear, drops P.M. 31. Cloudy A.M. and P.M.

Mean temperature of Aug. for twenty-eight previous years ...	54°·99
Mean temperature of this month	56 ·10
Mean temperature of Aug. 1854	55 ·06
Average quantity of rain in Aug. for fifteen previous years ...	2·95 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.
1855. Aug.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·853	29·773	29·32	29·65	29·58	74	54	61·5	61	56	sw.	sw.	e.	·02	·04	....
2.	29·824	29·728	29·27	29·52	29·49	76	50	63	59	58	sw.	sw.	e.	·17	·02	·11
3.	29·780	29·639	29·23	29·43	29·44	74	52	63	65	57	sw.	sw.	ne.	....	....	·29
☾ 4.	29·713	29·664	29·08	29·48	29·69	72	53	64·5	55	50½	sw.	sw.	n.	·01	....	·64
5.	30·022	29·929	29·43	29·90	30·05	73	41	61	53½	50½	sw.	nw.	n.	....	....	·05
6.	30·062	29·866	29·58	30·06	30·01	73	55	65	54½	50	s.	nw.	e.	·11	....	....
7.	29·755	29·664	29·28	29·82	29·74	75	56	66	52½	52½	sw.	s.	ne.	·44	·04	·10
8.	29·650	29·626	29·12	29·63	29·65	72	54	63	58	57	sw.	nw.	ese.	·50	·37	·20
9.	29·918	29·828	29·30	29·71	29·85	71	38	59	56½	54	w.	wnw.	calm	....	·35	·23
10.	30·151	30·043	29·57	29·89	29·99	76	49	57	61	58½	w.	wnw.	s.	....	....	....
11.	30·201	30·145	29·68	30·02	30·07	80	56	66	65	54½	w.	wnw.	w.	....	....	·05
● 12.	30·205	30·181	29·65	30·07	30·03	70	42	65	59	55	w.	n.	sw.	·01	·20	·44
13.	30·223	30·213	29·73	29·96	29·99	72	41	60	57	55	n.	wnw.	w.	....	....	·04
14.	30·189	30·174	29·66	30·06	30·12	73	57	63	57	54	nw.	w.	nw.	....	....	·01
15.	30·231	30·224	29·70	30·01	30·10	76	47	65	58	56	n.	nw.	w.	....	....	....
16.	30·297	30·274	29·75	30·14	30·18	79	45	63	58	56	nw.	nw.	sw.	....	....	·08
17.	30·282	30·244	29·78	30·14	30·09	83	45	61	59	58	n.	wnw.	wsw.	....	....	·06
18.	30·232	29·760	29·60	29·94	29·74	79	53	65	68	60	se.	s.	sse.	....	....	....
19.	29·791	29·689	29·10	29·40	29·35	76	56	70	61½	54	w.	ssw.	wsw.	·02	·02	....
☽ 20.	29·929	29·809	29·34	29·42	29·38	66	58	65	54½	52	sw.	w.	ese.	·05	·08	·07
21.	29·878	29·817	29·23	29·38	29·54	74	42	64	54	52	w.	sw.	w.	....	....	·14
22.	29·994	29·961	29·46	29·55	29·62	76	52	63	54½	51½	w.	w.	w.	....	....	·15
23.	29·898	29·691	29·44	29·74	29·83	81	56	63	55	48	se.	s.	calm	·12	....	·11
24.	29·876	29·725	29·20	29·76	29·47	74	40	68	53	56	sw.	ssw.	se.	....	·12	....
25.	30·006	29·969	29·47	29·53	29·50	73	49	59	57	55½	sw.	ssw.	s.	....	....	·61
26.	30·047	29·775	29·52	29·50	29·68	74	39	58·5	55½	53	n.	sw.	w.	....	·06	·30
○ 27.	29·983	29·878	29·43	29·44	29·46	77	49	63	55	56½	sw.	s.	wsw.	....	....	·06
28.	29·858	29·777	29·24	29·48	29·53	81	44	64	61	55	sw.	ssw.	calm	....	....	·08
29.	30·025	29·991	29·46	29·78	29·97	75	42	63	56	52½	w.	sw.	wsw.	....	....	·13
30.	30·257	30·250	29·58	30·13	30·08	72	40	60	56	55	ne.	s.	sse.	....	....	·03
31.	30·210	30·181	29·75	29·95	30·18	78	41	59	62	53½	e.	ssw.	sw.	....	....	....
Mean.	30·011	29·919	29·45	29·757	29·787	75·00	48·26	63·0	57·80	54·41				1·45	1·30	3·98

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XXVII.—*Notes on some new or little-known Marine Animals.* By Philip Henry Gosse, A.L.S.

[With a Plate.]

(Fascis III.)

Class ARACHNIDA.

Order Acarina. Fam. Trombidiadæ.

Genus Pachygnathus (Dugès).

P. notops (mihi). Pl. VIII. figs. 1–4.

Body flat, sinuated, pointed behind, black; one eye on the back; legs equal, the first and second remote from the third and fourth, hairy; the last joint the longest.

Description.—Length $\frac{1}{87}$th of an inch. Body lozenge-shaped or somewhat 7-sided, with sinuations at the origin of the limbs; it is hyaline and colourless at the margins, but the interior is almost filled with a flesh of deep blue-black hue, perfectly opaque, and of defined, subregularly-sinuous outline. In the centre of the back, just behind the head, is a bright ruby-like round eye, placed in front of the opacity, and between the first legs (fig. 1). The head, formed by a great lip, projects in front and carries two small palpi, thick at the base, conical, and pointed. Below, the lip is divided longitudinally (fig. 2), each half being slightly incurved and pointed, the two divisions approaching in a pincer-like manner. Under slight pressure, there were projected between the palpi two slender styles (fig. 3), which doubtless represent the mandibles; and hence I am not sure whether the species should not range under the genus *Raphignathus* of Dugès.

The legs are about equal and alike; the fourth and sixth joints are large and swollen; the seventh is the largest and tapers abruptly at the middle, like a claret bottle; the tip forms a little round disk, whence diverge a pair of curved hooks, with plain edges, but two-toothed at the tip, or rather having a prominent tooth over the tip (fig. 4). All the joints are well furnished with straight bristles, the sixth having one much longer and stouter than the rest. The limbs are set in two series, the first and second originating close together, but remote from the third and fourth, which are also contiguous to each other.

Several specimens of this little Mite, I have found in one of my older vessels of sea-water. They climb up the glass sides, among the flocculent vegetable matter that is deposited on the glass. I afterwards found it among bushy sea-weed at Ilfracombe, in August.

The specific name is from *νῶτος*, the back, and *ὤψ*, the eye.

Fam. Oribatadæ.

Genus Halacarus (mihi).

H. ctenopus (mihi)*.

I found another specimen of this marine Mite in one of my aquaria, among weed from Ilfracombe. It was $\frac{1}{55}$th of an inch in length, the body opaque or only subpellucid white, tinged internally with pale red; the median white line very conspicuous. Strongly conspicuous also were two lateral black eyes, which exactly agreed with those of *H. rhodostigma*, and a third orbicular eye also black, close behind the rostrum. Neither of these eyes was visible in the specimen I before examined. The shape of the body agreed more with that of *H. rhodostigma*, and, as in that species, the anus here was papillary and terminal. This specimen appeared to be a male.

A single *Vorticella* of a rather shallow bell was attached to the body, and the limbs carried several *Acinetæ*, perhaps of the same species. They had a cylindrical body set on a very slender stem; the body cut into very distinct annuli, and bearing on its two anterior angles pencils of short capitate setæ (Pl. VIII. fig. 6). Total length $\frac{1}{390}$th of an inch.

* See Ann. and Mag. Nat. Hist. for July 1855.

Class CRUSTACEA.

Order Podophthalma. Fam. Palæmonidæ.

Genus Hippolyte (Leach).

H. spinus (Sowerby).

A single specimen of this interesting Æsop Prawn, obtained by me while dredging on the oyster-bank off Ilfracombe, in August last, enables me to mention its colours in a living state. It was about $\frac{3}{4}$ths of an inch long.

The carapace, with the rostrum, and all the organs of the head are opaque white; the abdomen is dull purplish-red, except the summit of the third segment, which is white; the swimming-plates of the tail and half of the penultimate segment are white; the legs ringed with white and red. The surface of the abdomen is beset with a few scattered erect hairs.

Order Edriophthalma. Fam. Corophiadæ.

Genus Unciola (Say).

U. irrorata (Say).

Of this rare American Crustacean, which has not hitherto been recognized in Europe, I obtained a specimen at Weymouth between tide-marks in April last. Its colour was wholly white. It lived in one of my small vases for a week or two, manifesting no noticeable peculiarity of manners, except that it delighted to hide among the bushy sea-weeds.

Fam. Asellidæ.

Genus Tanais (M.-Edw.).

T. Savignyi (Kroyer).

This minute species, now first recognized as British, I obtained also at Weymouth, in coralline from tide-marks. Both this and the preceding I have figured in my 'Manual of Marine Zoology,' figs. 246 & 256.

Fam. Pranizadæ.

Genus Praniza (Leach).

P. cœruleata (Montagu).

I took a specimen parasitic on a young *Cottus bubalis* in a rock-pool at Ilfracombe, in August. The mouth of the Crustacean was so firmly imbedded in the cheek of the fish, that it could not be detached without considerable effort; at length I picked it off with a needle, and observed that the muzzle of the *Praniza* was furnished with minute divergent filaments. The colours during life were frecklings of umber-brown on a pellucid ground, except the whole of the enormous penult segment of the thorax, which was filled with a core (so to speak) of rich grass-green, appearing bluish in some aspects, set in a pellucid-white exterior. The eyes, which were black, were remarkable for the fewness and great size of their facets; which, notwithstanding the minuteness of the insect, were distinctly visible with a low-powered pocket-lens.

The animal was sluggish, though apparently unhurt, when detached from its victim.

Otto obtained *P. branchialis* (Nov. Act. xiv. 348) from the branchiæ of *Phycis furcatus*; and this is the only instance that I know of in which this genus has been proved to be parasitic. Mr. Westwood, however, suspected it (Ann. Sci. Nat. xxvii. 326), from his having found *P. Montagui* among *Caligidæ* from Shetland.

Fam. Sphæromadæ.

Genus Næsea (Leach).

N. bidentata (Leach).

When alive its ground colour is dark chocolate-brown, produced by a pattern of lines on a pellucid body, studded with symmetrical spots and dashes of pale "king's yellow;" the contrast of hues producing a handsome result. This species I have obtained both at Weymouth and at Ilfracombe.

The following Crustacea are perhaps worthy of being mentioned as occurring to me at Weymouth. *Corophium longicorne* is numerous in the shallow salt-water ditches at the upper end of the Backwater. *Anthura gracilis* occurred in sea-weed; and *Nebalia bipes* I found in a hollow beneath a stone off the jetty at a low spring tide.

Class ANNELIDA.

Order Chætopoda. Fam. Nereidæ.

Genus Crithida (mihi).

Antennæ five, very large, viz. a frontal pair which are bulbous at base, and two-branched, and three occipital ones, which are very thick, tapering to a blunt point, and long: a pair of tentacular cirri on the head; two large eyes: feet ovate, very moveable, each with a filiform cirrus above, a pencil of short bristles, and a second pencil of long straight convergent bristles.

C. thalassina (mihi). Pl. VIII. fig. 5.

Length $\frac{1}{6}$th of an inch; colour of some specimens a lively pellucid sea-green, of others pale orange or fawn-brown: all the members colourless.

The head is distinct, with two large conspicuous eyes, of a very dark red hue. The front of the head, which is slightly two-lobed, bears a pair of porrected antennæ, the basal portions of which are large and bulb-like, giving rise to two diverging filaments, of which the interior is the shorter, and is often much convoluted. Between these antennæ and the eyes are two minute horn-like processes, which may perhaps be considered a supplementary pair of antennæ, in which case the total number is *seven*. Immediately behind the eyes are three large antennæ (two lateral and one medial), which taper to a blunt point, and are more than half as long as the body; they are directed backwards, and are generally more or less curled and convoluted. A tentacular cirrus springs from the base of each lateral antenna.

Segments twenty-five, exclusive of the head. Each is furnished with a pair of feet, of which the first three are smaller than the rest, and stand out transversely. All the rest point backwards (but are very free and mobile), and are of a long-oval shape, diminishing regularly to the tail. Both these and the anterior series carry a superior cirrus, which is filiform, wrinkled, but not moniliform, and a little longer than the foot itself. Both series have also a pencil of short bristles, and the posterior series have in addition a second pencil, which is straight, convergent, twice as long as the foot, and directed obliquely backwards. The ovate feet in regular distichous arrangement, with these long pencils, have a very striking resemblance to an ear of barley with its grains and awns; a resemblance which I have commemorated in the generic appellation, from κριθὴ, barley, and εἶδος, likeness. The ultimate and penultimate segments are minute, and are destitute of cirri and bristles.

Some half-dozen of these little worms were dipped from the surface of the Bristol Channel near Ilfracombe, on a calm afternoon in August last. They swam with excessive agility by a rapid horizontal undulation of the body, in which the long pencils reflected prismatic rays. The moment this undulatory movement ceased, they usually bent themselves into a crescent or circle.

The genus reminds one of *Ioida* of the late Dr. Johnston, but is widely remote from it; the bifid antennæ are very peculiar.

The minuteness of the animal forbade my determining the nature of the proboscis, or the form of the bristles.

Fam. Auricomadæ?

Genus Crossostoma (mihi).

No distinct head; no eyes; upper margin of mouth set with numerous cirri; segments thirty, of which the anterior ones are furnished with bristles, feet, and superior cirri; inferior cirri from the fourth segment to the tail ear-like, cleft; eight tentacles on the second and third segments; tail furnished with a pair of minute styles.

C. Midas (mihi). Pl. VIII. figs. 7–12.

Body $1\frac{1}{2}$ inch long, $\frac{1}{6}$th of an inch wide in front, tapering to tail, subcylindrical, flattened beneath, plump and glossy (fig. 7). Mouth opening somewhat beneath, with a retractile lip, the upper margin of which is fringed with numerous radiating cirri, which are curled, white, slender, ciliated, and apparently tactile, as they are frequently applied to the ground in an exploring manner (figs. 7, 8). Immediately above this fringe are two oval or reniform disks, which appear to occupy the place of eyes, but are not coloured.

The body is composed of thirty segments, which are very distinct beneath, but, from the plumpness of the body above, the annulation is almost obsolete there. Each segment, as far as the eighteenth, is furnished, on each side, with a small cylindrical foot (fig. 10), which bears, above, a minute superior cirrus, and is perforated at the tip to project a pencil of bristles, which are long, slender, straight blades, drawn off to a fine point, slightly curved (fig. 12). The pencil of the first segment is much graduated, and is of the colour and appearance of burnished gold; those of the second and third segments are minute, and these segments themselves are as it were fused together. They give origin above to eight tentacles, which form a group of four on each side, comparatively short, but graduated in length, thick, cylindrico-conical, obtuse, with a dark core; these organs are suberect, projecting and diverging (figs. 8, 9).

At the fourth segment commences a series of organs, which continues to the tail. They appear to be the inferior cirri of the feet, but are separated by a distinct interval from the bristle-bearing tubercles (fig. 10). In form they resemble the human ear, at least as far as the middle of the body, whence they gradually become more and more wart-like. They have a longitudinal fissure near the tip, the orifice of which is protected by a series of minute, close-set, transverse bristles, which impart to these organs under the microscope some resemblance to the lips of a Cowry shell. I could detect no cilia on these ear-like organs, but the tentacles and the fringing cirri of the mouth are richly ciliated.

The ultimate segment is furnished with a pair of slender diverging fleshy filaments (fig. 11).

The colours of this worm are beautiful. The back is purplish-red, passing into lilac, with a fine pearly gloss, the whole thickly studded with white specks. The head, the mouth-fringe, and the whole under-parts are white. The tentacles are translucent yellow-olive, with a black core at the base, gradually lost, the surface marked with transverse lines and dashes of opake white. The first pencil of bristles (as has been said above) is golden.

The animal inhabits a tube about twice its own length and thickness; but its diameter appears greater than it is, from its manner of construction. It is made of small fragments of shell, minute bits of slate, &c., affixed, not by their surfaces, but edgewise, so that the whole presents a peculiarly rugged bristling appearance, yet not devoid of neatness. Slender filaments of sea-weed, coralline, &c. project here and there;—and while a large flat stone ballasts the posterior extremity, the anterior is protected by a small limpet shell, which has been seized entire, and most ingeniously fastened so as to form a dome over the animal's head when partly protruded (fig. 8). Somewhat similar porticoes I have seen in the tubes of Caddis worms, which indeed this structure closely resembles; and the same object is attained by a large species of *Sabellaria* common on the Devonshire coast, which constructs a flat portico of the common substance of the tube. In all cases it is a beautiful instance of animal providence, as well as architecture.

I did not, however, find that, with all this attention to comfort, the worm was particular as to which end of his dwelling he made his sally-port; for after having used the porticoed extremity awhile, which of course was the front door, he suddenly appeared (having turned himself meanwhile in some mysterious manner) at the back-door, which thenceforth he persisted in using all the while I had him. He was not at all shy; he would retreat, indeed, if touched, but was presently out again. His habit was to protrude a fourth, or even half of his body from the tube, and remain curling and twining the mouth-fringe of cirri, every instant twitching one or other of the tentacles, and as it were striking the water with them, as a crab does with its inner antennæ.

The specimen was taken at Ilfracombe, under a stone at low water, in August; and lived some days in captivity.

The generic name is from κροσσὸς, a fringe, and στόμα, the mouth; the specific alludes to the fable of the long-eared Phrygian king.

Fam. SABELLADÆ.

Genus PROTULA (Grübe).

P. Dysteri (Huxley).

I obtained this beautiful and interesting species at Ilfracombe, both from deep water, and from the sides of perpendicular rocks at extreme low tide. I had prepared drawings and a memoir of it for publication, supposing it to be new; but I find that my friend Mr. Huxley has described it far better than I could, in the 'Edinb. New Phil. Journ.' for January of the present year. I had the pleasure of repeating most of his observations, and in particular that of the fissiparous increase of the species.

Class TURBELLARIA.

Order PLANARIEA. Tribe RHABDOCŒLA.

Genus CONVOLUTA (Oersted).

C. paradoxa (Oersted).

This little worm I met with in April of the present year at Weymouth, crawling out of tufted weeds from low water. But at Ilfracombe in July it occurred in far greater abundance, crowding the branches of the common Coralline and Ceramium. The manner in which the lateral edges of the body are rolled over, so as to form an imperfect cylinder, with an oblique orifice anteriorly, renders it a highly curious form. In their movements the little creatures were very active; crawling swiftly along the branches, and especially about the terminal filaments, frequently two or three on the same tip, with a smooth gliding progress, much like that of an *Eolis* or *Doris*, but more nimble. They frequently raise the fore parts, and occasionally almost the whole body, adhering only by the posterior portion, and then explore the surrounding water, as a caterpillar throws its head about at the tip of a twig. Then they often glide off into the free water, and swim with exactly the same sort of motion as they used on the weed.

Having immersed several of them in fresh water, with a view to killing them before placing them in spirit of wine for preservation, I found that in a very few moments they were dissolving, by the commingling of their exterior surface with the water, so as to present only undefined and incoherent masses of mucus.

Class ZOOPHYTA.

Order Actinoida. Fam. Lucernariadæ.

Genus Lucernaria (Müller).

L. campanulata (Lamx.).

A specimen of this species was obtained at Ilfracombe in August, by the Rev. Sir Christopher Lighton, who kindly gave it to me. It was about $1\frac{1}{4}$ inch in height, of a dull chocolate hue, in parts tinged with olive; in form a deep goblet with the cup slightly bell-shaped, the stalk slender, and the foot wide and thick: the groups of tentacles were contracted while I had it, the globose heads being crowded together, with no appearance of their slender pedicels. Between the tentacled eminences the spaces were rounded, and seemed as if the integument were a little turned over like a rim.

It was found attached to a sea-weed, but soon detached itself, and never afterwards adhered to anything: the only motion I observed in it was an occasional spasmodic bending-in of one or other of the tentacle-groups. After a day or two it became offensive, without losing its form, and was evidently dead and decaying.

EXPLANATION OF PLATE VIII.

Fig. 1. *Pachygnathus notops*, magnified, dorsal surface.
— 2. *Ibid.* the lip viewed from beneath.
— 3. *Ibid.* the palpi and styliform mandibles.
— 4. *Ibid.* an unguis.
— 5. *Crithida thalassina*, magnified.
— 6. *Acineta*, parasitic upon a marine Mite, magnified.
— 7. *Crossostoma Midas*, nat. size, out of its tube.
— 8. *Ibid.* magnified, viewed laterally, with a portion of its tube.
— 9. *Ibid.* magnified, viewed dorsally, anterior portion.
— 10. *Ibid.* a foot from near the middle.
— 11. *Ibid.* the posterior extremity, and caudal styles.
— 12. *Ibid.* a pencil of bristles.

XXVIII.—*On the Injurious Effects of an excess or want of Heat and Light on the Aquarium.* By Robert Warington, Esq.

Temperature is a point requiring great attention in carrying out successfully the principles of a permanent aquarium. The mean temperature of the ocean is estimated to be about 56° Fahr., and this, under ordinary circumstances, does not vary more than about 12° throughout the different seasons of the year. The causes of this equilibrium will be readily understood when we take into consideration the effects that must be produced by the continued flux and reflux of the tides, and by the enormous streams of water which must be flowing from the Arctic regions from year's end to year's end in one constant current, and which, by their movement, must necessarily cause other currents to flow in and take their place, thus forcing, as it were, the heated surface-water of the tropical seas towards the colder regions of the globe. Again, the whole surface of the earth, submersed below the ocean, is protected by this fluid coating from the effects of the cooling influences of radiation on the one hand, and from contact with the currents of the atmosphere on the other; and hence we perceive an always existent cause for the maintenance of a steady, equable temperature by the waters of the ocean throughout the year.

Many of the inhabitants of the sea are very sensitive to changes of temperature, and we find that a few degrees of variation will cause them rapidly to move their position and seek some cooler or warmer spot as the case may be. In the ocean it will be evident that the creatures have the power readily to effect this under ordinary circumstances, by seeking deeper water not liable to be affected by atmospheric influences, by partially or entirely burying themselves in the sand or shingle, or by shielding their bodies under the protecting shadow of the rocks or growing vegetation. In arranging the rock-work in the interior of the aquarium, therefore, great care should be taken to keep these points in view, and to afford as much protection as possible to the creatures from the cooling influences of radiation on the one hand, and from the heat of the sun's rays on the other.

From my own experience I find that the range of temperature should not be below 50° Fahr., nor above 70°; within these limits all appears to progress healthily, but beyond these points many of the creatures are rapidly affected. During the last long-continued and severe winter, it was found very difficult, in an ordinary sitting-room having a south aspect and a good fire maintained throughout the day—the tanks being also screened at night by a blind,—to prevent the powerful cooling effects from radiation on a clear frosty night; and on three several occasions, marking exactly the three severest frosts that we experienced during the winter, the thermometer, immersed in an aquarium containing about thirty gallons of water, fell as low as 45° Fahr. The Shrimp and Crab tribes, and the Crustaceans generally, are especially affected by these changes, and on each of the three occasions alluded to, one or two individuals perished; the larger-sized Prawns, as *Palæmon serratus*, appeared to suffer more readily than the *P. squilla*, although this might arise from the smaller ones being able to find a shelter from the radiation by concealing themselves more completely among the rock-work or vegetation. *Anthea cereus* is also very sensitive to considerable variations of temperature, falling from its foot-hold to the bottom of the tank apparently dead.

Excess of heat and also strong sunlight are likewise to be as carefully guarded against, and I may state as an evidence of this, that on a particularly hot day during the summer of 1854, being absent from home, the servant omitted to screen a small case from the sun's rays during the hottest period of the day, and on my return I found every creature dead. It contained an *Anthea cereus, Actinia dianthus*, two specimens of *Athanas nitescens*, and several others.

Too much light has also the effect of rapidly propagating several of the minute animalcules of a green colour, as the *Euglena* and its congeners, which under this influence multiply so rapidly as to render the whole water of a grass-green hue; this will at times subside to the lower part of the tank as evening approaches and disappear in the shingle bottom, but immediately the morning light shines strong upon the aquarium it will rise like a thin green cloud and diffuse itself throughout the whole of the water. Although this animalcular growth is not unhealthy, yet it causes the aquarium to present a very unsightly appearance, and prevents all observation on the habits of the inmates. The want of light, I need hardly observe, causes the rapid decay of the vegetation, and the products arising from this change are highly poisonous to animal life, the whole contents of the aquarium becoming of a black colour, and very soon of an offensive odour.

Apothecaries' Hall, Sept. 11, 1855.

XXIX.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[With a Plate.]

[Continued from vol. xiv. p. 262.]

Gasteropoda.

It is now proposed to inquire into the structure of the organs of breathing in that multitudinous group of mollusks which lies above the Lamellibranchiata, constituting literally a great subkingdom; it will be impossible within the limits of this memoir to do more than to illustrate types and plans of structure by special reference to a few familiar examples. Little account will be rendered of those classes with reference to which no personal opportunities have occurred to the author for instituting original investigations.

The Pteropoda are thus first excluded.

In proceeding to the study of the respiratory system of the Gasteropod mollusks, there present themselves a few questions which must be preliminarily considered.

In the conchiferous orders of this class, the shell is not simply and exclusively intended to shield and protect from external violence the soft body of the animal: it is a means by which the animal maintains between itself and the surrounding medium a certain fixed and important relation. The soft parts are tied to the shell only at certain limited points (Pl. IX. fig. 2 *b*). The mode of connexion differs in different orders, but not in families and genera. The point or line of attachment (*b*) is the pivot upon which the motions of the body of the animal are performed. Locomotion, in which the animal as well as the shell effect a change of place, is accomplished by means of the foot. The movements of the animal within the shell, the latter being fixed, considered with respect to its immediate well-being, assume a far greater importance than that of progression. In all shelled Gasteropods, the shell, whatever be its figure, whether univalve or multivalve, spiral, tubular or conical, circumscribes a chamber which is larger in size than the body of the animal which it serves to lodge. The difference in sectional area in the case of the spiral Univalves between the solid coil of the contained body and the hollow coil (fig. 2 *a*, *a*, *a*, *a*) of the containing shell, indicates a space which in all instances is filled with water: it is water which occupies this space even in the land Helicidæ. In the Patelloid and Chitonoid families (fig. 1 *a*, *b*) a chamber corresponding to this space is bounded above by the hollow apex of the shell, below by the dorsal surface of the animal; it is closed behind and open anteriorly. When the occupant extrudes itself from this coned chamber, a spacious open cavity is generated at the apex of the shell, into which through an opening in the edge of the mantle (*b*), situated above the head of the animal, water or air rushes. In the Fissurellidæ, in which the apex of the shell is perforated, the surrounding element in part enters into, and escapes from, according as the inmate emerges from or retires into its shell, the space at this orifice, the edge of the mantle consequently being adherent nearly all round. This is a point of generic difference between the Patellidæ and Fissurellidæ. The layer of water intervening between the animal and the shell is in direct contact with that region of the body in which the viscera are enclosed. The interior surface of the chamber of the shell is so nacreous and polished, and the corresponding portion of the animal is so serous and smooth, that every condition which can affect the facile motion of the one surface upon the other is thus secured. From this circumstance the mind is led forcibly to the idea, that this arrangement has really nothing more than this mechanical purpose for its object. It might be supposed, from the intimate contact thus effected between the external element and the visceral cavity, that the former might incidentally enter in considerable quantities by endosmosis into the latter, and thus replenish the diminishing volume of the nutritive fluids. In order to determine this latter point, and whether the water in the chamber of the shell (fig. 2 *a*, *a*) were capable of fulfilling an accessory part in the office of respiration, it became necessary to ascertain by actual observation two doubtful points of structure, viz. whether the membrane covering that portion of the body of the animal which is enclosed within the shell be ciliated, or otherwise favourably organized with a view to such an office; and secondly, whether the circulating fluids beneath this membrane were disposed conformably with such an intention.

The great bulk of the soft parts, the abdomen proper (fig. 6 *d*, *d*; fig. 4 *b*, *c*), by which the coil of the shell is filled, consists of the liver, a portion of the stomach and intestinal canal, and the reproductive organs. They are invested by a membrane which is the continuation of the mantle. The membrane here becomes thinner and smoother, assuming the characters of a serous structure; it is not adherent at any point to the shell. On the inferior aspect of the body it is drawn up into a *frenum*, in the layers of which are enclosed muscular fascicles. It is by means of this contrivance that the animal is enabled to coil itself firmly round and to grasp the columella (fig. 2 *c*). Although this coat has a serous aspect, it is the continuation of the fibrous mantle which forms the vault of the respiratory chamber (fig. 3 A–*a*, & fig. 3 B–*a*). If by a very careful dissection this covering be removed from the viscera underneath, the nature of its connexions with the latter will be readily seen. It nowhere leaves an open space between it and the solid organs which it invests. It is, on the contrary, so intimately united to them, that numerous fibrous threads and bands descend from its internal surface, penetrating into the substance of the viscera and becoming continuous with their stromatous fibrous structure. It is inseparably identified with the serous *tunica propria* of each viscus. The latter cannot be said to exist as an independent structure. In no single species of the Prosobranchiata (M.-Edw.), or the shelled Pulmonifera, is it provided with ciliary epithelium. This is actually the case in the freshwater Limneids, the most highly ciliated of this order. In no single species is there discoverable a *space* of any description, or a layer of channels or vessels of any sort between it and the invested abdominal organs. It is therefore certain that the abdominal segment of the body in the conchiferous Gasteropods can lend no aid whatever in the function of breathing. The porcellaneous interior surface of the shell is totally devoid of all organic covering; its polished surface is well adapted for the ready motion of the soft abdomen, covered also by its finely polished membrane, in its coiled chamber. The nacreous internal layers of the shell answer another important end: they render the shell water-proof; that is, the water which is drawn into the abdominal cavity, through the space at the mouth of the shell between the thoracic chamber and the edge of the latter, cannot escape by exosmosis or evaporation through the texture of the shell. The aperture of the shell being closed, by the operculum and thoracic expansion of the mantle, the water in the spire cannot escape. It constitutes a permanent reservoir. In this position it answers important purposes. It prevents the drying of the delicate abdominal membrane. It preserves the vital organs underneath in the required condition of moistness. It obviates the exhaustion of the nutritive fluids by evaporation. But more than all, it is capable, by a slight movement backwards of the animal, of being pushed forward into the cavity of the anterior shell-coil, and thence it may be drawn into the branchial chamber. In the littoral families of Univalves this is not a useless function when they are left on the dry rock by the recession of the tide. In the land Helicidæ it subserves also a similar end. This fluid in the Cyclobranchiata is lodged in the hollow of the apex or vault of the shell (fig. 1 *a*) resting on the back of the animal. In this order the border of the mantle is deficient at the point (*b*), which corresponds with the back of the neck of the animal. It is by this orifice or passage that the water is drawn into the cavity (*a*). The character, the extreme dilatability and uses of this cavity may be advantageously studied in the common Patella. It is capable under certain circumstances of receiving and retaining a large volume of fluid. But the furthest limits (*c*) to which it may be distended without rupture are best shown by the injection of coloured size. By steadily continued force, the fluid thrown in will slowly thrust the mollusk out of its shell (*i*). It forms a fulcral point upon which the animal bears, in the act of fixing its shell to the rock. This dorsal chamber in the Chitonidæ is very small. In the Fissurellidæ the perforation at the apex of the shell opens into the cavity; the latter cannot therefore act on the mechanical principle above explained. But since these mollusks are seldom out of the water, this mode of action can scarcely at any time be put in request. They fix themselves by the action of the foot alone. By the undulating motion of this organ, the water between it and the surface of the stone is pressed out. The soft parts within the shell are then subject to the uncounterbalanced pressure of the superincumbent column of water which operates through the orifice at the apex of the shell. In the case of the Patella, it is by the shell that the atmospheric pressure is borne. The vacuum is formed, not by the extrusion of the water from the roof of the shell, but by the adaptation of the foot to the surface of contact. Hydrostatic or atmospheric pressure, as the case may be, becomes thus a considerable assistant force, but it does not, as commonly supposed, constitute the only and exclusive mechanism by which these mollusks cling to the rock.

These observations therefore justify the total and unconditional exclusion of the abdominal region of the body in the Conchiferous Univalves from the office of aërating the fluids. Neither the investing membrane nor the distribution of the blood underneath sanctions this idea.

This conclusion is not opposed to the views first stated by Milne-Edwards, in his celebrated essay "Sur la Circulation chez les Mollusques *."

* Annales des Sciences, 3 Sér. tom. viii. 1847. Nowhere does this distinguished observer describe an *abdominal* cavity in the Mollusca. Nothing in this class in the adult state exists which can be compared to the free, undivided visceral cavity of the Echinoderms and Annelids. Here this space is occupied by an independent fluid, the chylaqueous. In Mollusca such a fluid does not exist. The cavity therefore is not required. Milne-Edwards chiefly insists upon the fact, that the *venous* system is deficient or imperfectly developed in this class. "Dans tous les Mollusques dont la structure nous est connue, les vaisseaux sanguins manquent en partie, et une portion plus ou moins considérable du cercle circulatoire se trouve constituée par de simples lacunes." In another place he observes—"Mais dans la tête, je voyais toujours l'injection s'extravaser et remplir une grande cavité où se trouvent logés le cerveau, les glandes salivaires, le pharynx, et tous les muscles de la bouche." Again, he speaks in *Haliotis* of "une communication libre et normale entre la grande artère du corps et la cavité céphalique où se trouvent logés les principaux centres nerveux et toute la portion antérieure de l'appareil digestif." He then states that this "cavité céphalique" is filled with arterial blood. In a still more definite manner he thus describes the *only* "*cavity*" for the reception of fluid which exists in the Molluscan organism:—"Effectivement, je me suis assuré que, chez ce grand Mollusque Gastéropode, l'artère aorte, parvenue au point où le canal digestif se recourbe pour descendre de la face supérieure du bulbe pharyngien dans la cavité abdominale, debouche directement dans une vaste lacune, dont les parois sont formées en partie par les téguments communs de la tête, et en partie par les muscles et les tuniques du pharynx jointes à des lames de tissu connectif étendues transversalement au devant de la cavité abdominale, lacune dont l'intérieur est occupé,

The spacious sinuses and lacunæ developed in the course of the venous half of the circulation are not said by this author to

comme je l'ai déjà dit, par la masse charnue de la bouche, les glandes salivaires, les principaux ganglions du système nerveux, et un grand nombre de brides musculaires et fibreuses." . . . . . "Mais un fait qui, au premier abord, paraîtra plus singulier encore, c'est que, tandis qu'une portion de la cavité générale vient compléter l'appareil vasculaire, l'artère aorte remplit des fonctions analogues à celles de la *cavité abdominale*, car elle loge dans son intérieur une portion de l'appareil digestif." It does not clearly appear from the observations of M. Quatrefages, in his memoir "Sur la Cavité générale du Corps des Invertébrés" (Ann. des Sci. 3 Sér. tom. xiv. 1850), that he has specially considered this point. He does indeed in one place positively state, that the "abdominal cavity in the Acephalan and Gasteropod Mollusks is a part or segment of the circulatory system":—"Chez les Mollusques Acéphales, proprement dit, l'existence de la cavité générale est encore plus complètement déguisée. . . . . . . Les Mollusques Gastéropodes présentent souvent quelque chose de semblable. Toutefois, chez ces derniers la cavité générale est presque toujours très reconnaissable, surtout dans la partie qui correspond au pied." Here no distinction is attempted between the true *peritoneal* cavity, such as it exists in the Radiated aad Annulose classes, and those lacunæ or vascular dilatations such as Milne-Edwards first described in the structure of the Mollusca. This point is one of great zoological as well as homological interest. If in the Mollusca the circulatory system is peripherically nothing but a ramification of the *peritoneal* cavity, it is only a *chylaqueous* system plus a heart. But if it can be proved that the peritoneal space is obliterated in these mollusks, and that the venous lacunæ of Milne-Edwards are *parieted*, contractile, dilated vessels, that is, *segments* of the fluid system, situated in the interstices of the solid organs, every reason will have been overthrown for supposing that the apparatus of the circulation in the mollusks is *nothing but a ramified development of the peritoneal cavity*. In all animals below the Mollusca, the system of the perivisceral chamber is dedicated to a distinct and separate system of nutritive fluids. Its parietes in all cases are non-contractile—almost always ciliated at some point or other of its extent—while the fluid contents are invariably circulated by the action of externally situated muscles. These are peculiarities which appear to isolate this system almost completely from the circulatory apparatus of the Mollusca; in other words, they seem to prove that it partakes more fully of the characters which belong to the maturely developed circulation of the Vertebrated animal, than of those of the rudimentary chylaqueous system of the Radiate and Annulose classes. If the *arterial* half of the circulation of Mollusks be likened to the blood-proper system of Annelids, and the venous half of the former be taken as the representative of the perivisceral cavity in the latter, the homology of the molluscan fluid-system would be established! Siebold observes—"In Nudibranchs, Cyclobranchs, Scutibranchs, Tectibranchs, Pectinibranchs, and Pulmonata, &c., these venous canals are only lacunæ excavated in the *muscular* walls of the body, and are without proper walls, as Meckel has pretended is the case with those of *Aplysia*;" and Souleyet (Comptes Rendus, xx. p. 81, note 3) remarks, "que le système veineux des Mollusques n'est pas toujours formé par des vaisseaux distincts, mais qu'il se compose en grande partie de ces canaux creusés dans l'épaisseur ou dans l'interstice des organes." And it has been supposed by Prof. Owen and others, that the heart-like dilatations which occur at various points in the circulation of the Cephalopods, are lined consist of the *abdominal cavity*, portioned off in order to aid in the circulation of the fluids. Whatever may be the embryonic significance of these roomy dilatations of the blood-channels in this class, it is quite certain that in very few instances are they situated external to and *around* the viscera (a position invariably occupied by the chylaqueous fluid), and therefore in the space bounded by the peritoneum and immediately underneath the external covering *. By the fact of their situation, these parts are then excluded from all participation in the office of breathing.

The preceding facts affect the present inquiry in the following manner:—They prove that the organization of the posterior or abdominal portion of the body in the Conchiferous Gasteropods, that part which is lodged within the shell, is not adapted for the admission of water into the interior of the animal, either for the supply of an aquiferous system or for the replenishing of the nutritive fluids. They prove, independently of other evidence, that the water with which the spire of the shell is filled, and in which floats the corresponding portion of the animal, cannot penetrate in any manner into the body; that it cannot be viewed as a reservoir whence is drawn the contents of a water-vascular system—if such a system has a real existence in these animals; that, in fact, it can only act in a mechanical sense by enabling the tenant to vary the specific weight of his house, to move

internally with a *mucous* membrane, like that which invests the branchial chamber. These and other facts drawn from the *adult* anatomy of the Mollusca, prove that, whatever argument may be drawn from embryonic development, that the open spaces, lacunæ, &c., which arise in the venous segment of the system, ought not too readily to be explained as merely cut-off portions of the perivisceral or peritoneal cavity.

If the spacious cephalic and pharyngeal lacunæ, first defined by Milne-Edwards, be not, in an embryonic sense, spaces cut off from the general cavity of the body, they must *ab origine* be parts of the vascular system. For the present this subject must remain an open question; that is, it cannot at present be confidently stated whether the circulating system of Mollusca form a distinct and independent system in the organism, or whether it be only a modified adaptation of the peritoneal cavity, or whether it be a fusion of both. To solve such doubts by an easy reference to the embryological relations of the parts were unsatisfactory. Two parts may have a common point of departure in the process of development, and yet they may stand very remotely apart in their ultimate structure and purpose. How little explanative it is, for instance, to remark, that the 'blood-proper' system of the Annelids and the tracheal system of Insects, being developments of the tegumentary, epidermal layer, are *therefore* homologous anatomically, and analogous in office! This, however, is not the occasion for the full discussion of this subject.

* It should be stated, however, that in the lowest Mollusca, as exemplified by *Firoloïdes* and *Atlanta*, the space between the integuments and the viscera is described by some observers as forming a constituent arc of the fluid-system.

readily to and fro in his chamber, and to shield the soft segment of the body from injury. It is not improbable that the layer of water thus placed between the body of the mollusk and the shell, may materially assist in the excretionary process as described by Mr. Huxley, by which the latter is formed. It may add fluid to, or dissolve the excreted material furnished by the surface of the mantle, and adapt it to the internal surface of the shell. The limited ligament (fig. 2 *b*) by which the animal is *organically* united to its shell, places it beyond doubt that the latter can be formed by no other process.

By a few general observations, one department of the subject has been thus disposed of. No reference will hereafter be made to this subject, namely to the relation which subsists between the abdominal segment of the body in Gasteropods and external circumstances. It is extraordinary how in this class of mollusks the *most active* forces of life are developed and specialized in the thoracic region, and how comparatively passive are those parts which are bounded by the limits of the abdomen! Circulation and respiration are functions which belong to the former division. Large chylopoietic viscera are a resultant phænomenon. Thoracic development is a dynamic expression of an organic power. Without it, other results could not follow. It is the sign of power—without which the vegetative processes could not be sustained. Between the Acephala and Cephalophora there is this striking difference:—In the former the *mouth* is placed in the respiratory cavity, in the latter it is the anal orifice. In the former the alimentary and respiratory chambers are confounded, in the latter the breathing and the cloacal cavities are identified. This is a wide mark between the Lamellibranchs and the Gasteropoda.

The higher the animal in the scale of life, the more vigorous are the dynamic *active* powers. Thus, in the Gasteropod mollusks as compared with the Acephala, the physiologist expects an increment of vivifying force. How is it accomplished? By a more fully developed heart, impelled by the vital battery of a more highly organized cephalic ganglion, by a more actively endowed thoracic apparatus, by respiratory movements of a higher muscular character, and by branchial or pulmonary systems of incomparably more intricate workmanship.

In looking upwards along the line of the Cephalophora, it will be seen that the head as a detached member, as a distinct classificatory character, appears long before the respiratory organs—ex. Pteropoda, Heteropoda, Apneusta, and many Nudibranchs. Though the Encephala discover several marked signs of superiority as measured by the standard of the Acephala, it is well determined that in the scale stretching between the Patellidæ and Cephalopods, the nervous and circulatory systems display few evidences of advancement.

In the lowest Gasteropod the heart is as perfect in structure as in the highest Cephalopod. When the branchial organ is symmetrically developed, the heart has two auricles. This is the case in *Chiton, Fissurella, Emarginula, Haliotis, Tethys* and *Janus,* and less completely in the Eolidæ. In all other Gasteropods the auricle is single. The position of the heart depends upon that of the respiratory organs. It is situated on the right side of the back in the Pulmonata, most Tectibranchiata, and the dextral Pectinibranchiata, and in all the Limacidæ; it is on the opposite side in the sinistral Gasteropods, *Ancylus* and *Haliotis*; it is to the left of the dorsal median line in *Carinaria, Clio, Hyalæa* and *Cleodora*; and near the hinder end of the body in *Firola* and *Atlanta.* In *Dentalium, Tritonia, Scyllæa, Phyllidea,* it is on the dorsal median line. The heart is furnished with a distinct pericardium in all Gasteropods, save the Apneusta, where it is not clearly defined. In all those genera whose branchial organs are symmetrical, the ventricle and aorta are directed forwards, but in the turbinated genera they are directed backwards.

Between the heart and respiratory organs in this class two relationships are discernible. In the first the heart is placed between the head and the branchiæ—Prosobranchiata (M.-Edw.); in the latter, between the tail and the branchiæ—Opisthobranchiata.

In all, there is between the branchiæ and the heart a most intimate juxtaposition. In all families the heart is *systemic.* In no single species is it pulmonic or branchial. In all, the auricle or auricles receive the blood immediately from the respiratory organ. The heart in the testaceous Gasteropods, spiral and otherwise, is always placed at the posterior end of the branchial cavity, or in other words, is fixed at that extremity of the branchiæ *farthest* from the entry of the aërating fluid. In *Dentalium* this rule is not broken, because here the water enters at the posterior instead of at the anterior orifice of the mantle.

The same general observations apply to the nervous system. Souleyet first explained that the parts which by their constancy and fixity constitute the essential centre of this system in the Mollusca, are always grouped around the œsophagus. The others should only be regarded as different degrees of development of these central portions, and this is proved by their degradation or disappearance in proportion as we descend in animals of this series*. The primary ganglia always exist; many of the local parieto-splanchnic may be absent. The latter in size bear relation to the organ or part to which they furnish nerves. Those connected with the branchiæ vary with the latter organs. In the Mollusca, therefore, a part of the peripheric structures may acquire increased development, while the central systems remain unchanged.

Physics of the Respiratory Chamber in the Cephalophora.

In the Cephalophora the organs of respiration assume variable positions as regards the rest of the body. They lack the topographical constancy of these organs in the Lamellibranchs. As in the latter class, in the Cephalophora they consist essentially of developments of the tegumentary system. They are elaborated productions of the mantle. Although they may vary in structure and position, this relationship to the mantle is never radically affected. A brief review of the space or chamber in which the branchiæ are enclosed, will enable us to enter more detailedly into the regional anatomy of these organs.

The respiratory chamber (fig. 1 *f*) in the Cyclobranchiata is but imperfectly defined. It is for the most part a grooved circular fossa between the edge of the foot and the border of the mantle (fig. 1 *h*); but the branchiæ are not the less a development of this structure. If in the Patelloid and Chitonoid forms the edge of the mantle were prolonged and introverted, a channel would be defined in which the branchiæ would be enclosed. Wherever these organs are placed, some provision, such as a groove, is made for the efficient play of the *physics* of the branchial process.

The direction of the main aërating currents is from before backwards, and transversely on the branchial leaflets. The cavity which circumscribes the branchiæ in the Fissurellidæ commences at the neck and extends some distance backwards along the sides. It receives water though the vertical fissure, placed between the pedicles of the branchiæ; it escapes expiratorily at the lower and posterior border. In *Emarginula* the respiratory cavity of the mantle is situated at the back of the neck. In the Haliotidæ this cavity is similarly formed. *Patella, Acmæa, Pileopsis* and *Calyptræa* are the cervico-branchiate patelloid forms with a single non-symmetrical branchia. *Fissurella, Emarginula, Puncturella* and *Haliotis* are in the same cervicobranchiate category, but having two branchial leaves. (*Clark.*)

Thus in the same family how striking are the generic varia-

* Comptes Rendus, 1843.

tions in this one particular! The structure of the organs contained in these variously located chambers will be found to differ no less remarkably.

In the Pleurobranchiata the furrow for the branchia is situated between the foot and the lateral free border of the mantle. It differs in no essential respect in character and locality from that of the Patellidæ. This crypt or fossa has a higher position on the side in the Aplysiadæ. The *mechanics* of this cavity follow the same principle in all. The water-currents bear in an inward and backward direction under muscular and ciliary agency.

In the Pectinibranchiata (fig. 3 A, 3 B) a distinct and well-defined thoracic chamber exists (*a*, *a*). It is situated on the antero-dorsal region of the animal, and fills the anterior coil of the shell. It is overvaulted by the mantle. It does not form a closed cavity as in the Pulmonifera (figs. 4, 5, 6). It opens in front by a fissure extending from the right angle to the left. Behind, it is closed by the adhesion of the mantle to the edge of the diaphragm-like (fig. 4 *b*) partition between this chamber and the abdomen, thence the mantle is prolonged in a thinner form over the latter region. In this water-breathing order of mollusks this chamber is not exclusively specialized to the office of respiration. In every family it contains the termination of the intestine. It is thus at once respiratory and cloacal. In its walls, at a point differing in different families, is situated the heart, and a system of glands of complex formation. The branchiæ form only a small integral constituent. In the physics of this cavity one plan prevails throughout the Pectinibranchiate order. The branchiæ occupy a point in the chamber opposite to that taken up by the rectum. The former are to the left, the latter lies on the extreme right. It is on this side also that all the other excretory ducts terminate. The water-currents are excited and sustained by the muscular action of the parietes of the chamber. This force, which repeats itself in a regulated order, constrains the water to move in a fixed and determinate direction. It enters first at the left side, through the siphon (fig. 3 B, arrows), if this appendage be present—through the fissure directly, if it be absent. This *pure stream* impinges immediately upon the branchiæ. At this point, by means of an exquisite concert of muscular and ciliary forces, the mass of water thus received is divided into as many vertical sheets or secondary columns as there are spaces between the branchial leaflets. As the cartilaginous edges of these laminæ are provided with muscles, and the flat surfaces of each are strewn with cilia (as will be afterwards described), the water is subdivided again into myriads of invisible streamlets. Issuing from the interlaminar spaces where its course is slow, the dispersed columns reunite, assume a more rapid course, passing over the surface and between the folds of the "mucous glands," under the character of effete and deoxygenated water, and sweeping the termination of the intestine, and finally escape at the extreme right cleft (*b*) of the respiratory chamber, mechanically bearing on its current all the refuse products of the cavity. It will be anticipating, what will afterwards be studied more minutely, to enter further at this place into the details of this most beautiful arrangement.

The thoracic cavity of the aquatic and terrestrial Pulmonifera (figs. 4, 5 & 6) is mechanically arranged on the plan of that of the Pectinibranchiata. Though in some genera, as in *Parmacella*, *Testacella* and *Onchidium*, it may assume a posterior position on the back, it is not changed in mechanism or in anatomical structure. In all other families of this order it occurs on the back near the head. In those species whose shell is sinistral the orifice is situated on the left side, in all others on the right. Under the former circumstances the respiratory movements of the parietes of the cavity are reversed. The pulmonary cavity of the air-breathing Gasteropods, relatively to the bulk of the body (fig. 4 *a*, *b*), is larger in dimensions than the branchial chamber of the Pectinibranchs. This difference is explained by the difference between air and water, but, as will hereafter be shown, it is due in reality to the comparatively rude and imperfect provision which has been made in the instance of the Pulmonata for the necessities of breathing. Here, the anterior fissure of the branchial cavity, so characteristic of this part in water-breathing Gasteropods, is accurately closed. The cavity communicates with the exterior by means only of a single orifice, which, for the most part, is situated on the right side. This orifice, in families of aquatic habits, is prolonged into an infundibulum (figs. 4 & 6 *a*, *a*).

The acts of inspiration and respiration are remarkably slowly performed. So spacious is this chamber in the Planorbidæ (fig. 6 *c*), Limneadæ (fig. 4 *a*, *b*), and Helicidæ, that a supply of air capable of sustaining life for a considerable time under water, or in an irrespirable medium, can be stored.

The normal muscular movements of respiration are most satisfactorily studied in *Helix aspersa*, previously carefully, and without injury to the soft parts, removed from its shell. It will be seen that the volume of air drawn in by the inspiratory act is driven by the slow vermicular movement of the parietes (arrows in fig. 4) from right to left, chiefly along the roof. If the air is long retained, it repeats the same orbit. During the act of expiration the walls of the whole of the dorsal and lateral regions of the body simultaneously contract, and the breathing-chamber collapses in a most remarkable manner. It is during the expiratory act that the fæcal excreta are expelled, and this takes place through one and the same orifice. In this character the Pulmonata are strikingly distinguished from the Pectinibranchiata. In the latter, the pure current entering the breathing-chamber is scrupulously separated from that which is about to be expelled. When water and not air is the medium of respiration, this is a constant feature in the history of the Cephalophora.

This circumstance is still more beautifully and perfectly observed in the physics of breathing as exemplified in the Cephalopod mollusks (fig. 7). It has already been explained, that so completely and intimately is the body of every Invertebrate animal surrounded and *apparently penetrated* by the external element, that not only is it profusely admitted into the digestive and respiratory organs, but, as for example in tubicolous Worms and testaceous Cephalophora, its contact with the entire exterior of the body is secured by express provisions.

In the Cyclobranchiata, as formerly described, a water-reservoir occupies the concave apex of the shell: the abdominal coils of the shells of all Univalves constitute a similar receptacle. The same rule is recognized in the organization of the Cephalopods. In this class, in a given time, a considerable volume of water traverses the branchial chamber. The respiratory actions of the mantle and the funnel are rapid and powerful.

In the Nautilus, Ammonite, and other testaceous Cephalopods, the base of the branchial recess of the mantle is continuous with the siphuncle. In this manner the external element is admitted directly into the abdominal segments of the shell, therein chiefly to subserve mechanical purposes. If the respiratory chamber in the shelled Gasteropods were perforated at its posterior border, opening thus into the spiral spaces of the shell, the water occupying this portion in these families would stand in the same relation to that of the branchial cavity as it does in the case of the Nautilus.

In those orders, chiefly the Dibranchiata, which are devoid of an external shell, the respiratory chamber is larger and more prolonged into the spaces between the vital organs than in those in which this appendage is present. *Octopus, Loligo,* or *Sepia,* afford the best opportunity for witnessing the mechanical actions of breathing. The anterior edge of the mantle is separated from the side of the body by a broad open fissure (fig. 7 *b,* and ingoing arrows). This fissure within the mantle assumes the character of a canal which leads back *along the floor* (*c*) of the branchial chamber as far as the attached or cardiac base of the gills (*d*). Along this canal up to this point the water enters as a broad single column (fig. 7, arrows). It is then suddenly deflected forwards into the *interior of the gills* (*e*), which, in *Octopus* and *Sepia*, form *hollow conical organs*, in *Loligo* and the Calamary a hollow *semicylinder*. In the former during the moment of inspiration a copious column of water rushes up the hollow axis of the gill; in the latter families, along the inferior concavity. These currents are directed by a most complexly coordinated series of muscular actions. From the interior of the branchiæ the water is compressed by a muscular power resident in the branchiæ themselves. It issues in as many streams as there are perforations between the ultimate *pinnæ* of the organ. These streams regather themselves and flow backwards again in the direction of the base of the gills, leaving the branchial hearts and other large blood-channels situated in that region; then driven forwards by the expiratory collapse of the entire mantle, the water in form of a single column enters the base of the funnel (*f*), through which it finally leaves the cavity as an excretory and expiratory current (*a*).

The author will explain on another occasion how much that is old and how much that is new is contained in these observations. In succeeding papers they will be supported by a large mass of anatomical details of great interest, and hitherto, he believes, unknown to naturalists.

EXPLANATION OF PLATE IX.

Fig. 1. An imaginary vertical section through the shell and body of *Patella athletica*. *a*, water-cavity in the roof of the shell, capable of being enlarged to the dimensions of *b* and *c*. *e*, gills; *f*, fringed edge of the mantle; *g*, *g*, edge of shell; *i*, foot; *j*, anus, terminating in the chamber above the mouth.

Fig. 2. A longitudinal section of the shell of *Buccinum undatum*, showing the abdominal spires, *a*, *a*, *a*, *a*, which are filled with water and with the abdomen of the animal. *b*. denotes the ligament by which the animal is attached to the columella, *c*.

Fig. 3 A. Male animal of *Buccinum undatum* taken out of its shell. At *b*. is shown the mode in which the penis is carried in the branchial chamber *a*.

Fig. 3 B. The same animal with the penis withdrawn from the branchial chamber. On the left is the siphon through which, as indicated by the arrows, the water enters the chamber (*a*), describing therein a circuit marked by the arrows; it escapes at the right cleft *b*.

Fig. 4. The animal of *Lymneus stagnalis* taken out of its shell. The arrows define the pulmonary chamber and the circulation performed by the air under the vermicular action of the walls. *b*. is the posterior limit of the thoracic chamber; *c*. marks the solid abdominal portion of the body, and *a*. the respiratory and defecatory siphon.

Fig. 5. *Limax maximus* in outline. *a*. denotes the respiratory and defecatory orifice. The arrows define the position and the boundaries of the breathing-chamber.

Fig. 6. *Planorbis corneus,* Lamk., taken out of its shell. *a,* respiratory siphon; *b,* space embracing the mantle; *c,* outline of pulmonary chamber; *d, d,* abdominal segment of the body.

Fig. 7. Plan of branchial chamber of *Sepia officinalis. a,* expiratory siphon; *b.* and arrows, inspiratory fissure; *c,* bottom of the branchial cavity; *d,* plan of the hollow cones of the branchiæ; *e,* the open hollow bases of the branchiæ by which the water enters the interior of the organ.

[To be continued.]

XXX.—*Notice and Description of a New Species of Spider.* By the Rev. Hamlet Clark, M.A., Curate of All Saints, Northampton.

To the Editors of the Annals of Natural History.

Gentlemen, Northampton, Oct. 16, 1855.

Mr. Blackwall has for many years selected your Magazine as the medium for communicating to the public his many discoveries in British arachnology; this is my reason for applying for admission into the same pages of an additional species which appears to be new to our lists.

I am, Gentlemen, faithfully yours,

Hamlet Clark.

Salticus Blackwallii.

Length 4 lines; length of cephalothorax $1\frac{1}{3}$; greatest breadth 1; length of posterior legs $2\frac{3}{4}$; of second pair $2\frac{1}{4}$.

Legs, especially the anterior pair, robust, setaceous; on the inferior surface of tibiæ and metatarsi of first and second pairs two rows of sessile spines; legs ochraceous, on the upper surfaces an irregular row of black spots; the fourth pair is longest; the second pair slightly shorter than the third. *Tarsi* terminated by two black curved claws. *Palpi* ochraceous. *Cephalothorax* large, convex, somewhat quadrate, rounded at the sides and base, slightly pubescent; the anterior part, where the eyes are seated, black; the sides and posterior part ochraceous, with black spots and radiating irregular lines converging to the centre; lateral and posterior margins narrow and black; frontal margin clothed with longish yellow hairs. *Falces* short, vertical, subconical, marked with a short black streak on the outer side. *Maxillæ* straight, short, enlarged and rounded at the extremity, marked with dark spots on the inner margin. *Lip* oval, base and sides black. *Sternum* oval, narrower at anterior than at posterior extremity, ochraceous, with broad black margin. *Abdomen* elongate, oval, slightly pubescent, pale dull ochraceous, with numerous blackish short lines or spots; on the sides these spots range themselves in longitudinal lines; on each side of the upper medial line is a broad longitudinal band composed of confluent black spots, approximating to each other towards each extremity, where they meet; the spots on the under surface are fewer and more minute; down the medial line extends a narrow band composed of more distinct spots, some of which are confluent. *Sexual organs* black. *Branchial opercula* pale yellow.

I found a single adult female of this large and handsome species at Southport, Lancashire, during the last week of September; it was sunning itself on a gate close to the shore on the south side of the town: it appears to be new to science. The name by which I have designated it will commend itself to all your readers. My esteemed relative and friend Mr. Blackwall has for many years devoted himself to the study of this Order, and the result of his unassisted labours is simply this:—twenty-five years ago I suppose from forty to fifty species were all that were known as recorded indigenous representatives of this Order; we can now boast of a catalogue comprising TWO HUNDRED AND FORTY-SEVEN. I rejoice to find that others are ac-actively following where he has so long led; for there is little doubt but that this our present list, however in itself creditable to science and honourable to him, will be still further increased.

XXXI.—*Observations on the Habits of the Stickleback* (being a continuation of a previous paper). By ROBERT WARINGTON, Esq.

DURING the early part of the last summer I had the good fortune to observe the whole progress of the various stages in the breeding of the Three-spined Stickleback, *Gasterosteus leiurus*, which will therefore enable me to complete the notice already published on this subject in the 'Annals and Magazine of Natural History' for October 1852.

In the account there given, the observations extended to the completion of the nest by the male fish, and it is my intention in the present communication to carry on the details of the progress from that point, premising that the water was the same which had been employed for the original experiments of 1849, and that the fish contained in the aquarium consisted of three Stickleback, one male and two females, two Tench, and a Goldfish.

The position selected by the male fish for the construction of the nest was between two plants of *Vallisneria spiralis*, at the point where the leaves spring from the root, and directly in front of a fragment of limestone which rose behind the plants and acted as a protecting background to the position. The nest being all prepared, exactly as before described, although by another individual, the eggs were deposited, I presume, during the night of May 8th: this was judged of, not from observance of the act of spawning, but from the altered appearance of the female fish evidencing that she had shed her spawn, from the immediate change made by the male fish in the arrangement of the materials forming the nest, and, likewise, the violent repulsion of the female from the neighbourhood of its position, to which previously he had been as assiduous in driving her.

From this period the nest was opened more to the action of the water, and the vibratory motion of the body of the male fish, while hovering over its surface, caused, as before described, a current of water to be propelled across the surface of the ova; this action was repeated almost continuously. The apparent luminosity of the body, if I may so term it, also decreased, and in this state all continued without change until the 18th of May, making a period of ten days. After this date the whole nest was destroyed, and the materials of which it had been composed thrown aside, with the exception of a few wiry stems of a decayed water moss, and a space cleared around the spot of about 3 inches in diameter; the mud or sand at the bottom being carefully removed with its mouth and carried in this manner to some distance, leaving the rounded stones of the gravel clean and free from any obstruction around them.

Watching carefully for a short time, to understand what all this busy alteration indicated, I at last had the pleasure of observing, by the aid of a long-focused pocket-lens, some of the young fry,—of course most minute creatures, fluttering upwards here and there, by a movement half swimming, half leaping, and then falling rapidly again upon or between the clean pebbles of the shingle bottom. This arose from their having the remainder of the yelk still attached to their body, which, acting as a weight, caused them to sink the moment the swimming effort had ceased.

Around all this space above mentioned, and across it in every direction, the male fish, as the guardian, continually moved. And now his labours became still more arduous than they had been before, and his vigilance was taxed to the utmost extreme, for the other fish, three of them some twenty times larger than himself, as soon as they perceived that the young fry were in motion, used their utmost endeavours, continuously, to pounce upon the nest and snap them up. The courage of this little creature was certainly now put to its severest test, but nothing daunted he drove them all off, seizing their fins, and striking with all his strength at their heads and at their eyes most furiously. All the assistance that could possibly be afforded him was of course rendered, short of actual interference, by keeping them pretty well fed, in order to allay, if possible, their voracity. Another circumstance, which appeared to add greatly to the excitement that he was constantly subjected to, arose from the second female fish, being in spawn, endeavouring most pertinaciously to deposit her ova in the same locality, and hence rushing frequently down towards the spot; but the male fish was ever on the alert, and although he did not strike at her in the furious way he attacked the larger ones, yet, he kept continually under her, with the formidable back spines all raised erect, so that it was impossible for her to effect her apparent object.

The care of the young brood, while encumbered with the yelk, was very extraordinary, and as this was gradually absorbed and they gained strength, their attempts to swim carried them to a greater distance from the parent fish; his vigilance, however, seemed everywhere, and if they rose by the action of their fins above a certain height from the shingle bottom, or flitted beyond a certain distance from the nest, they were immediately seized in his mouth, brought back, and gently puffed or jetted into their place again. This was constantly occurring, the other fish being continually on the watch to devour these stragglers, and make a savoury morsel of these Lilliputian truants. Indeed, the greater number of the whole brood must have fallen a prey to their voracity, as it was only some three or four that reached a size to place them beyond the power of these destroyers.

As soon as the young fry could swim strongly the parent fish gradually relinquished his duties, although a constant watch appeared to be still quietly maintained on their motions as they swam about near the surface of the water and among the floating leaves of the *Vallisneria* and *Lemna*. It is a curious circumstance, that, very soon after these young Stickleback were left unmolested by their companions, both the parent fish disappeared, and I presume have died in some hiding-place among the rock-work; as though, their allotted functions, namely the propagation of their species, having been completed, their period of existence must terminate.

Apothecaries' Hall, Sept. 11, 1855.

XXXII.—*The Vegetable Individual, in its relation to Species.* By Dr. Alexander Braun, Professor of Botany in the University of Berlin, &c.* Translated by Chas. Francis Stone.

[Continued from p. 256.]

Part II.

As I attempted to show in Part I., whatever seems arbitrary and indefinite in the existing views of what constitutes the Vegetable Individual has its ground in the nature of plants themselves, which in their realization are resolved into a plurality which they are not capable of reducing to as complete a unity as animals are. As we ascend in the natural kingdoms, individuals increase in importance, until they reach their most perfect independence in Man. Hence, if we would appreciate them justly in the lower departments, in which their character is less definite, we must try to comprehend the less perfect structures by starting from the more perfect ones: to appreciate vegetable individuals we must start from a comparison of animal individuals. From this point of view we perceive at once that the cell cannot be regarded as the proper individual in plants, otherwise it would have to be considered in the same manner in animals. Cell-formation is a property common to plants and animals: but in animals it appears far more obviously as a subordinate element in the organization of the whole body, than it does in plants; since the animal cell, in most cases, is not so independent, nor so determinate, nor so permanently isolated as the vegetable cell. For this reason, too, it is rarer to find the animal cell considered as the proper animal individual, although Schwann has shown that animal cells are analogous to vegetable cells, and may be as justly considered individual organisms as they. Yet as mere *curiosa* we might adduce the somewhat similar assertion of Gaillon, that "men and animals are properly masses of Infusoria;" and Oken's doctrine of generation, "a synthesis of Infusoria," might, perhaps, be interpreted in the same sense. The "stories" of the axes, the internodes with their leaves, might claim to be compared with the animal individual with more justice than the cell, especially if leaf-formation really took place, as the defenders of such doctrines have represented; that is, if every successive leaf were produced as a *new* structure out of the old one (out of its base which becomes the internode), and if the whole stem were thus merely a concatenation of leaves shooting out of and growing above each other. But this is not so: the rudiment of the stem as an uninterrupted growth ("conti-

* Reprinted from Silliman's American Journal for September 1855.

nuance") is formed *before* the leaves, while the latter, emerging as developments of the upper surface of the stem, are evidently members dependent upon and belonging to the axis, and forming with it one whole. Hence the structure of the internodes may be more aptly compared with the lateral structure of the animal body, and that of the leaves with its terminal structure. Thus we arrive at the shoot; and we must investigate the question, whether it should be considered as what corresponds best with the animal individual, or whether we must ascend still farther, up to the whole plant-stock.

The Shoot as the Vegetable Individual.

The first and most common view is that which considers the individual in plants, as in animals, to be merely each single specimen, *i. e.* each representative of the species which appears to be one whole from the connexion of its parts. To some extent this view is correct, for in a forest of trees of the same genus and species, in a meadow, or in a corn-field, each single tree, each stock of grass or of grain, appears as a single member of its species, as each single beast does in a flock of animals forming a community. But the question arises whether these individual beings, regarded as such in this superficial way, can each be considered individuals in the same sense. When the flocks or societies of animals are numerous, as in an apiary, each hive or swarm will appear as an individual member of its species, and the more so in proportion to the closeness of the connexion between the members of such a community. Many flocks of animals whose members are organically connected during life, have until lately been considered to be individual animals; and even when the separation of the individuals is more complete, such conceptions are to a certain extent justified as long as the community is really a natural growth—when in fact it consists of members of one single stock—and we are not surprised to find that the oldest history of the human race describes the family itself, and the tribe which springs from it, as one person, named after its patriarch. As regards the plant-stock, even a superficial examination shows us peculiarities which will hardly allow us to consider it as an individual in the precise meaning of the term, and which calls upon us carefully to consider whether it is to be regarded as such an individual, or merely as an individual in the broader sense,—as one united family. Even our feelings aroused by the sight of the most ramified plant-stocks,—especially by a tree with its numerous branches, with the thousands of blossoms and fruits which it bears, and the numberless buds through which it will deck itself again in the following year with leaves and flowers—excite the presentiment that this is not one single being, one single life, comparable with the animal or the human individual, but rather a world of united individuals which have sprung from each other in a succession of generations, and although they do not separate, going through their particular cycles of existence,—here dying off, there reproduced, and thus building themselves up in uninterrupted succession into a family-tree, perennially laden with an increasing posterity. That such a view, so consistent with our healthy natural feelings, is corroborated by scientific investigation, I hope to show in the following observations.

Comparing plants with animal individuals, it is at once evident that the tree loses annually flowers and fruit,—the highest and noblest structures which vegetable life produces,—to generate them again in the following period of vegetation. Even the whole dress of the tree, even its foliage when compared with the trunk and branches, is only a superficial growth periodically dying off, and reproduced by the succeeding generation: in the paradoxical words of Schleiden *, "No tree has leaves." The leaves, in fact, never grow out of the woody portions of the tree, but only on its herbaceous extremities, which grow upon the woody stem as upon a ground formed by the process of vegetation. This common ground, namely the woody stem, which is almost lifeless in comparison with the herbaceous parts engaged in active growth, is annually covered with a vigorous sheath under the protecting bark, and this sheath is the ground of the nourishment of all the vegetating herbaceous extremities. This sheath is the so-called *cambium*, a layer of active, living tissue, which, contemporaneously with the lignification of the herbaceous extremities of the branches, becomes a new woody layer, united to the old trunk in the form of an annual ring—to be covered in its turn in the following period of vegetation with a new layer, which, again, will be the immediate supporter of the new generations. The history of the grand development of nature on the surface of our globe presents an analogy which may perhaps serve to set this relation in a clearer light. The successive geological formations superposed during the course of countless ages, present, buried in their depths, the traces of as many formations of the organic world, each of which carpeted the then superior stratum of the earth with a new life, until it found its own grave in the succeeding formation, when a new

* Beitr., p. 152, where the following view of the arboraceous stem, as a common ground bearing many individuals, is developed; but this whole view, after all, needs to be corrected by a precise limitation of its meaning by what follows it.

uprising of organic life took its place. In the same way the stem of a tree is a multistratified ground, in whose layers the history of earlier growths is legibly preserved. The number of the woody layers indicates the number of the generations which have perished, *i. e.* the age of the whole tree: a distinct annual ring is the monument of a vigorous season, an indistinct one of a bad season, a sickly one (which is often found among healthy ones) indicates the unhealthiness of the foliage of that particular year. The practised woodman can decipher many facts of the past in the layers of the trunk, *e. g.* a good season for foliage or for seed, damage by frost or by insects, &c.

Essentially the same relations as those seen in the tree, or the shrub, are to be found in the subterranean perennial growth of *plantæ redivivæ* (herbaceous perennials), whose subterranean stem (rhizoma), like the stem above the surface, emits annually a new generation of herbaceous growths; whose stalks however, unlike those of the tree, do not lignify and form a part of the common supporter, but die off wholly, or mostly, at the close of the season of vegetation.

The relations indicated above compel us to recognize a succession of generations in trees, shrubs, and perennial herbs; and thus our first idea of them as individuals is necessarily modified. Another remark may be made here which confirms our idea thus modified. Natural *death* closes the life of the individual*. The development of the life of individuals in organic nature has a goal, an acme; after it has attained this goal its course draws to an end. This is not the case in the tree and the perennial herb. True, the tree is destroyed by time; but this seems to result more from external, and in part mechanical causes, than from any internal decrepitude. The more numerous the generations which the tree builds up, one above the other, the greater is the distance of the growing extremities from the source of their nourishment: the thicker the supporting trunk, the thinner is the layer of cambium which connects the new shoots with the extremities of the root by which the nourishment is absorbed. This increased

* Cf. Schleiden, Beitr. p. 151. "The idea of individual life necessarily implies as its distinguishing characteristic individual death, preconditioned in the organization itself." Although this remark is not universally true in many respects, yet I have adopted it for the light it is calculated to throw on the nature of the tree. For the very reason that natural death is the result of a determinate conclusion of the development, those shoots (vegetable individuals) which have no such conclusion frequently undergo no death at all except that of some of their parts: but this is a concomitant of animal life itself (casting the skin, moulting, and the organic changes in the body). Cf. on this point Roeper, Linnæa, 1826, p. 439, and the following remarks on *Paris, Lysimachia nummularia, Adoxa,* &c., and the preceding ones on *Caulerpa.*

difficulty of communication between the upper and lower extremities is probably the cause of the decrease of vigorous growth after the plant has arrived at a certain age. But in most cases external casualties are superinduced, which accelerate the termination of the tree's life. It is injured by wind and weather, the decay of the injured part spreads through the whole organism, various fungi fix themselves upon the tree, and are especially fatal when they attack the roots. Oftentimes the tree breaks down under the weight of the productions of its own vital powers, the luxuriance of its fruit. These statements are corroborated by the cases of trees of unusual age, now so well known through DeCandolle's investigations. One of the examples adduced by him shows in particular, that those trees whose branches have been prevented from breaking down by props or supports attain to a great age. I refer to the celebrated Linden in Neustadt on the Kocher, which, as early as 1229, was the cause of the town being called "Neustadt an der grossen Linde" (Neustadt of the great Linden), whose wide-spreading branches were supported already in 1408 by sixty-seven stone pillars, and this number was afterwards increased up to more than one hundred*. The hoary tree still flourishes, having survived its many scientific admirers, among whom was my predecessor, to whom botany is so greatly indebted, who visited and described it a few years ago (in 1849†). Natural supports are more efficacious in preserving trees than even artificial ones; since they not only prop the branches, but conduct nourishment to them by a shorter road, as is actually found to be the case in *Rhizophora Mangle*, in various species of figs [Banyan, &c.], and other tropical trees, whose branches high in air send down strong roots into the earth. A similar example nearer home, though indeed on a much smaller scale, is found in the *Juniperus Sabina*. Its branches, which spring from a low stem, curve down to the earth, strike numerous roots, and raise themselves again, so that the comparatively feeble stem may carry a creeping crown of considerable extent, like a thick wood continually spreading, and which may continue to flourish in its parts, even when the communication between the original supporter and nourisher of the whole colony and the succeeding new growths, which are constantly receding from it, has finally ceased. A remarkable specimen of this tree stands in the Royal Botanical Garden at Schöneberg, which, if not as old as the garden itself, which was laid out in 1679 under the great Elector, Frederic William, cer-

* DeCandolle, Physiol. Veg. ii. p. 988.

† Link, Erinnerungen an die grosse Linde bei Neustadt am Kocher (Flora, 1850, no. 8).

tainly dates as far back as Gleditsch's time, and his directorship commenced in 1744. The main stem is not more than 33 inches in circumference at eight inches above the ground, close under the place where the first branches originate: the centre-piece of the crown which belongs immediately to the stem is only 9 feet high, and has been dying off during several years, while the maximum diameter, from S.W. to N.E., of the hundred-rooted crown, which has spread out over the ground by the declination of the branches, measures 35 feet: the entire circumference of the crown, which amounts to about 100 feet, would be still more considerable if it had been permitted to spread on every side, and if the branches on the N.E. side had not been removed at an early day.

What has just been said of trees admits of no doubt as regards perennial herbs (*plantæ redivivæ*) with subterranean creeping stems or stolons. Such plant-stocks as those of the well-known *Paris, Anemone nemorosa, Convallaria majalis, Asperula odorata,* are undoubtedly exposed to none but a casual death *. All plants which renew the cycle of vegetative life repeatedly and without any determinate limits to their existence, and which I would hence call *anabiotic,* cannot therefore be considered *simple* individuals †.

At first sight the case seems to be different in the *haplobiotic* ‡

* The same relations of great unlimited age are found in polyps which form stocks. Cf. Ehrenberg, Abh. d. Akad. for 1832, p. 382, 420, where, among others, stocks of Mæandriæ and Faviæ are referred to, larger than a cord of wood—which may readily be supposed to have been seen by Pharaoh.

† I pass over the further question, intimately connected with this subject, whether the composite plant-stock itself, with all its subordinate generations, with all its possible divisions,—viz. the individual in the most comprehensive sense (in which Gallesio conceived it),—has not a determinate term of life, though not easy to be ascertained, on account of the narrow space of time accessible to our direct experience.

‡ DeCandolle calls *anabiotic* growths *polycarpic,* and *haplobiotic* growths *monocarpic,* terms which are useless from their ambiguity. With an equally inappropriate choice of terms, he divides the first (Phys. Veg. ii. p. 73) into *caulocarpic* and *rhizocarpic,* according as the stem which produces the fruit is permanent, or dies off down to the root; but the latter in fact never takes place in perennial growths; for in such cases the life of the plant-stock is preserved, not by the mere root alone, but by a subterranean portion of the stem. It is one of the most remarkable confusions which a want of true biological ideas has engendered, that DeCandolle should have regarded the simplest and most natural circumstance in the plant's life,—its death after having attained the goal of its development,—as an unnatural, and to some extent casual occurrence,—as a kind of sickness comparable to the succumbing of the mother in childbed, which he accounts for by the rapaciousness of the flowers and seeds. Roeper, however, in a note to his translation of the above work, justly remarks that there are annuals with double flowers which die off to the ground although they

plants, which terminate their existence at the end of the simple process of development, with the formation of flowers and fruit; and this they do whether they exist one year, as *Adonis æstivalis* and *autumnalis, Nigella, Papaver Rhœas, Erigeron Canadensis**, or for two years, as *Œnothera* and *Verbascum,* or for many years†, as *Agave* (Century-plant), the East Indian *Corypha,* and the Mexican *Fourcroya*‡, which suddenly puts forth its flowers only after 400 years of extremely slow growth, and ends its life with the formation of its first and long-deferred fruit. The development of these plants, when compared with that of the first-mentioned anabiotic plants, seems at first to comprise only *one* generation, and to depend upon the development of *one* individual. But here, too, a closer examination shows conditions incompatible with the nature of the simple plant (the individual). One constituent element in the idea of an individual is, that the parts of the organism are *essentially* connected; yet the stock of annuals themselves presents a multitude of parts which bear no essential relation to the whole plant. This is true of a large part of the ramifications, of branches which may exist in one case and not in others, and which are proved to be unessential by the plant's losing no essential function when deprived of them. For even when the plant does not produce them, it can fully consummate the object of its individual life: it can produce flowers and fruit. A glance at the examples just now adduced, *Nigella, Papaver Rhœas, Adonis,* &c., will make these statements obvious. The branches of these plants, each of which, like the stem, is crowned with flowers and fruit, are evidently only *unessential repetitions of the simple plant,* absolutely identical with the main stem, and

produce no seeds. We may convince ourselves beyond a doubt that the flowers, on the contrary, are much less rapacious than the vegetative parts of the plant,—that they even shut themselves off from the afflux of too copious nourishment; for many plants develope vegetative branches close under the terminal flower, as *e. g. Stellaria media, Datura, Mirabilis,* &c. In such cases the flower-stalk, which cuts itself off from almost all farther afflux of nourishment, remains slender, while the portions of the stem directly beneath, and the branches which spring from it, gorged with succulent matter, enlarge more and more, and attain a most disproportionate size.

* These plants, like other annuals which germinate in the autumn, are usually reckoned among biennials; but this is a mistake, for, like our winter corn, they are *plantæ annuæ hiemales.* So, too, many vernal plants, as *Teesdalia, Erophila, Cardamine hirsuta, Spergula Morisonii,* and many weeds of the winter corn, *e. g.* several species of tares, *Bromus secalinus et aff.*

† *Corypha umbraculifera.* Cf. Rheede, Hort. Mal. iii. pl. 1–12. This is also the case in the palm genera *Metroxylon* and *Eugeissona,* according to Martius (Hist. Palm. i. p. 108).

‡ On *Fourcroya longæva,* cf. Zuccarini in the Nov. Act. Nat. Cur. xvi. 2. p. 666, and pl. 48.

hence to be ranked as equal to it in importance, *i. e.* equally to be viewed as particular individuals, and with as much reason as in zoology we concede individuality to the branches of the coral-stock (polypidom), which are now universally acknowledged to be individuals, and which offer an analogy of decisive importance for ascertaining the nature of the branch in vegetables. In view of this analogy, Ehrenberg regarded plants as aggregations of individuals*.

We can now turn back, and apply what has been shown to be the case in the annual herb, to the shrub and the tree, each of whose annual generations now appears, more distinctly than before, to be, in their peculiar connexion, not one individual, but a world of individuals developing in the same period of vegetation and upon the same stem. To this intent many of the early botanists have expressed themselves, as I stated in the introduction. Thus, B. Batsch, *e. g.*, says of branches, that they shoot forth from the stem "as if they were so many plants rooted in it†;" and Goethe‡: "Lateral branches may be regarded as particular plantlets which are rooted upon the maternal stem, just as this stem is upon the earth." Among moderns, Unger, at the close of his investigations into dicotyledonous stems, says, ". . . . Buds and the branches they develope are individual plants, which live by preying upon the maternal stem§." Similar expressions are used by Schleiden‖; they are most definite in

* Abh. d. Akad. 1835, p. 247. ". . . . Hence a polyp-stock is a mass of animals. We have no satisfactory comprehensive expression for our idea of a plant. What an individual is, remains still unknown; most of them are evidently aggregates of individuals which may be compared with coral-stocks." The origin of coral-stocks is minutely described by Ehrenberg in the Abhandl. for 1832, where he makes the following remarks:—"The coral structure is neither a mere structure composed of many animals arbitrarily conjoined, as Ellis supposed; nor one single animal with many heads, or with simple furcations, as Cavolini maintained; nor a vegetable stem with animal flowers, as Linnæus expressed it; it is a body of families, a *living* tree of consanguinity; the single animals belonging to it, and continually developing upon the primary ancestor, are entirely isolated within themselves, and capable of complete independence, although unable to achieve it."

† Bot. für Frauenzimmer, pp. 15, 16.

‡ Versuch d. Metam. d. Pfl. zu erklären, p. 59. The words "just as" in the passage quoted imply too much, and remind us of Du Petit-Thouars' unfounded doctrine of the formation of the woody layers of the stem by the 'roots' of the buds which penetrate it.

§ Ueber d. Bau u. Wachsthum des Dicotyledonenstammes, p. 177. Here, too, "preying" is too strong a term.

‖ Grundz. ii. p. 4. "New identical individuals develope upon the maternal stem by continuing the growth," &c. Here the expression "continuing the growth" is improper, for the shoot does not "continue" the growth at all, but is a new growth from a new rudiment.

Roeper's works*. Linnæus expressed the same thought in the words "*gemmæ totidem herbæ.*" And I am thus led to make a particular remark, which is intended at the same time to modify in some degree what I said before in relation to the annually renewed generations of trees. It is indeed true that branches of trees and perennial herbs, especially in temperate climates, first appear as buds; and in a more extended sense we call in general every young branch a bud, even if its parts are not, as they usually are, compactly arranged and folded together; still, all buds are not the rudiments of branches. *Lateral* buds are the only ones from which branches originate, and therefore they alone are to be regarded as new lines of development,—as individuals. Terminal buds, on the contrary, are nothing but still-undeveloped parts of the (relative) principal axis: they are mere continuations and augmentations of the individual already existing, and are not to be regarded as commencements of a new one†. Hence, only those trees which produce no terminal buds, as the Linden, Willow and Elm, develope new individuals and nothing else at each renewal of vegetation; while, on the contrary, those which do produce terminal buds also, as for example the Oak and Poplar, bear a mixed annual generation, which consists partly of new individuals, partly of old ones reawakening and continuing their development with renewed vigour.

I have already remarked how unessential the presence of branches is in many plants. A comparison of stocks grown on a rich soil with those of a poor one shows what license is given to plants in regard to producing branches, and how different the appearance of specimens of the same species thus becomes. Plants grown on a poor soil are often called dwarfs; but

* "Omnis gemma solitaria aut ejusdem continuatio immediata et perpendicularis (caulis, ramus, ramulus, flos) individuum vegetabile vocatur." This is the most definite description I know of; for in this passage not only the branches so called, but also every arbitrary shoot, even when it is merely a flower, is acknowledged to be a particular individual. Besides what I have stated in the text in regard to the appearance of terminal buds, I have only to remark, against the word "gemma," that in its growth every shoot does not enjoy a perceptible state of gemmation, *i. e.* a state of rest in which its parts are folded together. The term 'bud' is applicable to but one state of a shoot or of its parts, and therefore cannot be a suitable expression for what is to be regarded as the vegetable individual.

† Kützing (Phil. Bot. ii. p. 146) aptly expresses these relations by calling the terminal bud the continuation of the "series of formations;" lateral buds, beginnings of a new "series of generations." In contradiction with these terms, however, he calls the bud an "organ" as long as it is connected with the natural individual,—a term inapplicable to the bud as it is to the developed branch, of which it is the adolescent state.

unjustly, for they present the most normal development of all essential parts, dispensing with everything that is unessential, and are much less inclined to malformations than the lusty giants of the rich soils. Not unfrequently we find diminutive specimens of *Erythræa pulchella s. ramosissima* which are branchless and perfectly simple, as they terminate with a flower after four or five pairs of leaves. More vigorous specimens produce two branches out of the axils of the highest pair of leaves, which after a single pair of leaves terminate in the same manner with a flower; and branches of the second order may be also emitted from the axils of the two leaves preceding this flower; and so on. In the first order of ramification the number of flowers amounts to three, in the second to seven, and so on; in the seventh, which is not unfrequently attained, it amounts to 127! Here, if we would consider the stock or specimen as the individual, and the flower as the superior termination of the vegetable organism, comparable, say, to the head of the animal, this variation in the number of the flowers would be as astounding as if we were to learn that an animal might have 3, 7, 15, 31, 73, or 127 heads, according to circumstances. The same thing occurs in *Radiola linoides*. *Erigeron Canadensis*, which often grows to the height of a man and bears as many branches as a tree, presents dwarfed specimens scarcely two inches high and of a perfectly simple form*. After developing two early deciduous cotyledons it presents about 13 leaves on the stem, which are followed by a terminal capitulum of 21 involucral bracts and about 34 flowers. One middle-sized specimen about three feet high presented nearly 100 branches of the first order, out of which branches of the succeeding orders proceeded, together bearing about 2000 heads, and hence (reckoning the head at 34 flowers) 68,000 flowers†.

I may here remark, that such unessential branches may be separated and reared independent of their parent stem; on which fact depends propagation by artificial divisions, which is so variously employed in horticulture. The most remarkable case of this artificial division is recorded by Miller: in the year 1766–67, he obtained 500 stocks of winter rye, by dividing one stock and repeating the operation three times; these 500 stocks emitted 21,109 spikes, bearing together 576,840 grains. Nature

* Not counting the florets, which also are properly so many branches.

† Similar cases occur in most annuals. The forms of *Bromus mollis* and *racemosus* with simple spikelets instead of rich panicles are well known; less known and less remarkable are the depauperate specimens of *Umbelliferæ* with one single unifloral umbel, some of which of *Scandix Pecten* are in my possession. I have also specimens of *Solanum nigrum*, one and a half inch high, with a solitary terminal flower.

herself, as well as art, in various ways may effect such an independent separation of developed branches or of undeveloped buds, and this too either above or beneath the ground. Propagation of the Strawberry by its runners; of the Potato and the *Helianthus tuberosus* by their tubers; of bulbous plants by their bulbs; of the Garlic by the bulblets formed in the process of flowering, and falling off like seeds; of the varieties of the beautiful *Achimenes* by the amentaceous or the strobilaceous deciduous shootlets, are well-known examples of this process; and thousands of others might be adduced*.

The gardener can not only separate individuals, but unite them upon one stem. This is true not only of individuals of the same species, but even of those of different species; sometimes even of different genera of the same family. The Lilac is not unfrequently grafted upon the Privet (*Ligustrum*), the Pear upon the Mountain Ash (*Sorbus Aucuparia*), the Peach upon the Almond. By the insertion of a bud (inoculation), or of a developed sproutlet (grafting), we are thus enabled to pluck different kinds of roses from the same bush, to gather different kinds of fruit from the same tree. It would evidently be a contradiction in this case to consider the whole tree, or the whole bush, as the individual; for we should then give the name to a compound of several species, or even of several genera.

In attempting to comprehend the vegetable individual in its simplest form, we have thus far spoken of unessential branches only, and have endeavoured to show that they cannot be regarded as mere parts of the individual. But there is another kind of branches, those which are essentially requisite for the attainment of the end of vegetation,—for the formation of flowers and fruit. These occur in all plants which possess no terminal buds, and

* I will only adduce a few more of these examples, which might be multiplied indefinitely. Besides the Garlic (*Allium sativum*), in many other species of *Allium*, e. g. *A. oleraceum, carinatum, vineale*; *Lilium bulbiferum, tigrinum, humile*, and other species; *Gagea fistulosa, Ficaria ranunculoides, Dentaria bulbifera, Saxifraga bulbifera* and *cernua, Cicuta bulbifera, Polygonum viviparum, Begonia bulbifera, diversifolia*, and other species, *Remusatia vivipara, Cystopteris bulbifera*—buds fall off above the ground (as bulblets). In *Stratiotes aloides* rosette-like developed axillary shoots separate close to the base. The separation of lateral shoots in *Lemna* is well known; and it occurs in a similar manner in *Pistia*, by the separation of thin-stalked lateral rosettes, and in *Hydrocharis* in the separation of peculiar winter-buds. When the inferior leaf-formation is gorged with sap, bulblet-like buds form from the axils of the root-leaves (frondes fundi) in *Saxifraga granulata* and many exotic species of *Oxalis*, in the same way as the bulb-brood of monocotyledonous bulbous plants. Inferior leaf-buds which are placed on the ends of their stolons become free by the death of the runners in *Epilobium palustre, Lycopus Virginicus*, &c., and swell out and form little lumps. Cf. on this subject Wydler (Flora, 1853, p. 17–24).

which must hence necessarily have some branches in order to attain the end of their existence. This is the case with the Evening Primrose, Larkspur, *Orchideæ*, &c., whose lateral flowers are just such essential branches. If we demand that the individual should be a complete representative of the characters of the species, as is implied in the usual view, then we must add to the principal axis such branches as these,—without which the process of vegetation is not concluded, and on which, in fact, the most essential and characteristic parts of the plant make their appearance,—and call these, parts of the same individual. In this sense Schleiden's view of the simple plant might perhaps be justified, although, as he starts from different premises, he does not consider mere floral branches as particular individuals. He says, "If nothing but organs of reproduction, or flowers, spring from the bud, we still call the plant a simple one*."

Here, however, we arrive at a contradiction, which shows us that we cannot carry out the idea of the vegetable individual with the requisite definiteness in this way, since we thus regard essentially similar branches, now as individuals in themselves, now as mere parts of individuals. As I have already remarked, Schleiden allows individual importance to branches which are identical † with the main axis; those on the contrary which produce flowers alone, and in this respect differ from the main axis, he regards as mere parts of the simple individual. This distinction when analysed is perfectly nugatory; since it only lays down two extremes, between which there is an infinite number of gradations. Strictly speaking, there are no branches which are perfectly identical with the main stem, as is evident from the fact that no branch begins with cotyledons, as the main axis does ‡. Besides, the foliaceous leaves on the branch are almost always fewer than those on the main axis, and generally fewer in proportion as the point is higher where the branch originates. The arrangement of the leaves on the branches, also, often differs from the arrangement on the main axis, as *e. g.* in most of our broad-leaved trees,—in the Elm, Hazel, Chestnut, Linden, &c., in which the phyllotaxis on the main axis, and often at a later period in the so-called "water-shoots" (Wasserschossen), is spiral or decussate, while on the branches it is, on the contrary, distichous. In *Alnus viridis* the phyllotaxis is tristichous on the main axis, and distichous on the

* Grundz. ii. p. 4. † *Ibid.*

‡ The basilary cotyledons of the branches, indeed, have been compared to cotyledons. This comparison is partly justified in view of the commencement of phyllotaxis on the branch; which often resembles that on the main axis, while in regard to form and consistency almost all resemblance disappears.

branches. On the main axis of Cypresses and *Thuja* there are three- to four-leaved whorls; on the branches the pairs of leaves are nearly decussate; this is also the case in *Lysimachia vulgaris.* In the same way in *Equisetum,* the number of the rameal verticillate leaves is always inferior to that of the cauline ones. While thus on the one hand the vegetative branches are nowhere entirely similar to the stem from which they spring, on the other hand it appears that those branchlets which seem to bear flowers only are usually more numerous than they seem to be; since in most cases one, two, or even more small leaves (bractlets) are present beneath the flower, which may easily escape notice on account of their diminutive size, although their existence may be often ascertained with certainty even in those cases in which they are not visible when the flower has reached its complete development*. If we are to deny individuality to those buds (branches) only which are composed of a flower alone, as a strict

* In fact, all the constant lateral flowers of *Primulaceæ, Cruciferæ, Capparideæ, Resedaceæ, Balsamineæ, Orchideæ,* never have any bractlets. Among monocotyledonous plants in many cases there is only one bractlet; among the dicotyledonous there are generally two. *Gesneriaceæ* have generally three; *Empetrum* and *Santalum* have four, *Eriostemon* five; *Polemoniaceæ, Cuscuteæ,* and other plants with panicled inflorescence, an indeterminate number. We possess the following means of showing the existence of suppressed bractlets:—1. The position of the parts of the flower relatively to the axis of origination from which the lateral flowers spring. 2. Analogy. 3. The study of malformations. 4. Observations of the flower's development. The first criterion can be applied only where we can determine the succession of the parts of the flower. The position of the parts of a lateral flower depends, in fact, upon determinate laws of rameal origination; when they do not harmonize with these laws, we must conclude that preceding leaves have been suppressed. In this way, *e. g.,* we can explain the very common position in the 2–5th arrangement of the calyx with the second sepal posterior, by supposing two bractlets according to the fixed law, while it cannot be explained without these bractlets. Analogy aids us most by confirming our conclusions, as *e. g.* in the families *Scrophularineæ, Labiatæ,* &c., in which many genera present distinct bractlets, while others appear to be without them. In monstrous flowers (in cases of *antholysis* and *chlorysis*), sometimes without any other malformation, bractlets otherwise imperceptible appear in an abnormal growth. Not unfrequently in *Digitalis purpurea,* which in its normal state presents no bractlets, but in which we inferred their original existence from æstivation and the position of the calyx relatively to the axis, I have found bractlets developed in the most heterogeneous degrees, especially on the lowest flowers of the raceme of cultivated specimens. C. Schimper and myself have both observed the same fact in *Tropæolum majus,* which, like most species of this genus, presents no trace of bractlets in the normal state. We have seen them in the form of very small, white, subulate leaves, about in the middle of the flower-stalk, while the flower remained unchanged in all other respects. Their existence, however, was already indicated by the position of the quincuncial calyx relatively to the axis, as well as confirmed by analogy, for *Tropæolum ciliatum,* R. et P. (Pöpp. et Endl. Nov. Gen. t. 38), in its normal development has two round and

interpretation of Schleiden's language demands, we should have to draw a most unnatural and often impracticable line of demarcation between branches which, physiologically speaking, are perfectly homologous (floral branchlets which really have no bracts), and those which bear imperceptible or even suppressed (abortive) bracts. If, on the other hand, we would reckon the latter also among the branches which are not individuals, then it may be contended that there is such a series of gradations in regard to number and vigour in the leaves which precede the rameal flower, that it is impossible to draw a dividing line even in this manner.

The above-mentioned distinction between unessential and essential branches seems to afford a better stopping-place, no matter whether the branch bears nothing but a flower or not. We might say, all essential branches must be regarded as individuals since they repeat the process of specific development laterally, and can become independent plants, as layers, whether natural or artificial. Those branches, on the contrary, which appear as necessary members in the line of development which is advancing towards flower and fruit, and which therefore complete the series of formations belonging to the species, and without which the plant is either unable to eke out its vegetable life or to accomplish propagation, must be regarded as members of one and the same history of development. Let us take a case where the main stem bears only proper leaves, branches of the first order only bracts, and those of the second order only flowers and fruit, as is really the case in *Plantago, Melilotus, Veronica officinalis* and *Chamædrys*; here it is evident that these three divisions cannot be isolated; that all three must necessarily be present in order that the specific life may attain a complete representation in one individual*.

Notwithstanding the importance of this discrimination be-

prettily ciliated bractlets on the flower-stalk. I have mentioned the history of development last, not to disparage study, but because the morphology must be rightly understood beforehand by means of comparisons of developed structures, and because in its present stage the development is incapable of giving us reliable information in regard to all the leaves which are present in the germ, though they may not develope. To know what parts then exist, we should have to be able to distinguish the leaf as a cell or a group of cells before it rises to view above the surface of the stem.

* [But why assume (as here and *supra*) that the species must attain a complete representation in a single individual in vegetables?—since this is by no means the case in the higher (unisexual) animals, where there is no doubt as to what corporeally constitutes the individual,—that is, in the very cases whence we derive our idea of individuality, and the standard of comparison which our author is endeavouring to apply to the case of plants.—Asa Gray.]

tween essential and unessential branches, it cannot, when analysed, establish a distinction which will enable us to decide upon their importance as individuals; for even those branches which appear unessential, in relation to the formation of flowers and fruit, may yet be essential to the plant in other relations: as when they appear as characteristic elements of the vegetable structure, or when they play any important part in the œconomy of the plant, as I have shown *in extenso* elsewhere*. Nay, more; one and the same branch, as to whose nature there seems to be no doubt, may appear either as essential or as unessential, according to circumstances. When those branches which conduct the structure to a higher stage of its development appear in great numbers, on a principal axis, as *e. g.* in indefinite racemose or spicate inflorescence, the lateral branchlets appearing as flowers are then indeed, generally speaking, necessary to the plant's full completion of the series of formations, and in this sense essential; but their number is immaterial as regards this completion; and this the plant itself shows in producing either a larger or a smaller number of them; sometimes the number is reduced to one†. Therefore, properly speaking, only *one* lateral flower is essential; and we may arbitrarily consider any one of the number to be this essential one. Hence each of them may be regarded indifferently as essential or unessential. This is not the case in those racemes and spikes which possess a terminal flower, as is the case in many *Campanulaceæ, e. g.* in *Campanula rapunculoides*. Here, all the lateral flowers are unessential; yet if the terminal flower is cut off, the lateral branchlets which bear the flowers at once become essential. Such a change is not always artificial, for it often happens naturally, as there are plants in which the terminal flower may be either present or absent. *Agrimonia Eupatoria* and *Campanula rapunculoides* are examples of this variability‡.

* Verjüngung, p. 41 *et seq.*

† *E. g.* not unfrequently in the raceme of *Lathyrus odoratus.*

‡ *Agrimonia Eupatoria* bears usually one spike without any terminal flower; in weak specimens, a terminal flower not unfrequently makes its appearance, which opens before the upper lateral flowers. This has been observed by Wydler (Bot. Zeit. 1844, p. 642). In *Campanula rapunculoides* the case is just the contrary: its looser spikes are usually terminated with a flower, while denser ones end in a coma of bracteal leaves, without any terminal flower. *Dictamnus* resembles *Agrimonia*; while *Triglochin* (especially *Tr. maritimum*) on the other hand imitates *Campanula*. Even in plants in which the essentiality of the lateral position of the flower is expressed by their zygomorphic development, terminal flowers make their appearance in some cases; they then resemble *Peloriæ*. This is the case in *Linaria, Orobanche*, and a *Digitalis purpurea monstrosa* (described by Vrolik, Flora, 1844, No. 1), which propagates by seeds, and is now widely disseminated in our gardens.

We can cut this Gordian knot only by deciding to consider every branch as an individual, however appearances may be against it, provided that we have other grounds sufficient to regard branches as individuals. The genesis of branches justifies us in so doing; for each branch is not a direct continuation laterally, is not a development belonging to the stem (like the leaf), but is a new formation; like the main axis itself, it has its own centre of formation, with its peculiar development. Branch and stem, main axis and lateral axis, differ therefore only in their origin and relative position; but they are essentially of the same nature; they are united in the idea of the *shoot*. The stem is the primary and principal shoot of the whole plant; the branch is a lateral shoot in reference to the main shoot; but it can itself become a relatively main shoot, and the stem of a succeeding generation of shoots in its turn. As far, then, as we are justified in speaking of vegetable individuality at all, we must hold fast to the individuality of the shoot: *the shoot is the morphological vegetable individual*—is that form or that part of its specific realization which is analogous to the animal individual, if any part is.

In zoology we give the name of individual to every whole which is controlled and bound together from one vital centre. Since such an internal domination of the organism as that which characterises animal life is wanting in plants, whose existence is a process of growth directed externally alone, we can only demand, as the criterion of vegetable individuality, that the individual shall be formed in direct continued development from one centre, and thus, in accordance with its origin, *shall, in all its parts, belong to one centre.* Now this is the character of the shoot. Its centre of formation has been known since C. F. Wolff's celebrated "Theoria Generationis" (1759) under the name of "*punctum vegetationis;*" it is what is called in common life the "heart" of the plant, or, at the first appearance of the lateral shoot, the "eye." The whole future of the plant slumbers unseen within it; leaf after leaf arises out of it, step by step, at a measured pace, prescribed by law, until (in case the shoot is destined to conduct the development thus far) the series concludes with the last formation, that of the carpels, which close over the dying point of vegetation and form the fruit. In this progress the centre, always keeping the lead, is ever advancing, rising more and more, and leaving behind it an axis arrayed with the organs already formed. Hence we may designate the vegetable individual as *the sum of the parts belonging to one axis.* Just as the body of the animal has only one trunk and one head, the shoot has but one axis and one apex. As the trunk of the animal has a second extremity opposite to the terminating head, and gradually dwindling down till it forms the tail, so the perfect shoot has a second extremity opposite to that which terminates with the most perfect structure (the fruit), and dwindling down to an indeterminate end, the root, by means of a *punctum vegetationis* turned downward*.

But it will be objected: is not the vegetable shoot indefinitely divisible; can we not cut it up into an arbitrary number of pieces, each of which is capable of reproducing the whole plant in its turn? Were this the case, the phænomenon would not be without its parallel among the lower animals. But this is not the case. The supposed divisibility of the vegetable shoot, at least in perfect plants (the Phanerogamia), to which I am now alluding, is a delusion, which rests simply upon the fact that the formation of new shoots has been confounded with a reproduction of the shoot as such. As the injured shoot has the faculty of producing new shoots, so the parts of the divided shoot have also this faculty in many cases; but this is no recompletion of the shoot itself; the fragment of the old shoot can continue to develope in one single case only—when, in fact, it bears the apex of the axis with the point of vegetation. Let us examine this case more closely. If a shoot is divided transversely, under certain circumstances the upper part, on which the *punctum vegetationis* ("the heart") is still remaining, may continue the development; but the lower part is nothing but a stump, and continues to be a stump which can never complete itself by a terminal shoot, and which never fails to die if it is not nourished by lateral sprouts formed before, or sometimes after, the division took place, and thus kept alive by its posterity. This cannot be called divisibility, in the usual meaning of the term; the whole phænomenon, on the contrary, strongly reminds us of the capacity animals possess of losing the less essential caudal extremity

* Aristotle, on the contrary, considered that the root, being the imbibing organ, was the part of the plant which corresponds to the upper part, to the head and mouth of the animal; and he regarded the stem as the inferior part. He found the cause of this topsy-turvy position of plants in the necessity under which they labour of drawing their nourishment from the earth, as they are incapable of moving from place to place. In this respect he compares plants to mussels (*ὀστρακόδερμα*), which also have their heads turned downwards. Cf. Wimmer, Phyt. Arist. Frag. 56–65. This comparison of the root with the animal's head is however, morphologically speaking, inverted; for as the highest stratum of the spinal cord (the sensorial portion) attains its maximum state of development in the head of animals, it can only be compared to that extremity of the plant's axis in which the highest and noblest part of the plant is exhibited. Besides, the peculiar and striking characteristic of the animal's head, its involved structure terminating the organism, is by no means to be found in the root end of the plant; but it is seen in the opposite end which terminates with flower and fruit.

without any cessation of life. In favour of this view the fact may be adduced, that a similar phænomenon occurs in the normal process of development of plants and animals. As there are animals which may spontaneously lose the posterior extremity of their body during the course of their development, as *e. g. Cercaria, Comatula,* Frogs, &c., so there are also numerous plants in which the posterior extremity gradually dies off, and is cast aside, during the course of growth, while the anterior end of the shoot, which bears the *punctum vegetationis,* continues to unfold; as is seen in the growth of many Mosses, especially of Peat-mosses; in the creeping and climbing root-stocks of Ferns and *Aroideæ;* in the long creeping stems of *Lysimachia nummularia;* the little subterranean creeping root-stocks of *Paris;* in most plants which possess a *radix præmorsa,* as *e. g. Succisa pratensis,* the perennial species of *Plantago,* in *Tormentilla,* &c., with which the perennial bulbs of Monocotyledonous plants agree in all essential respects; and finally, this is especially remarkable in *Utricularia* and in *Selaginella increscentifolia,* whose apices only form close buds, and last through the winter, while all the remaining parts of the shoots perish. If the shoot is indivisible transversely, it is still less so longitudinally. There is not a single case to prove that a shoot longitudinally divided can as such continue to develope; nor do we know of a single case where such a longitudinal division takes place spontaneously. What has been usually described as a bifurcation of the stalk depends in the Phanerogamia in every case upon a true ramification which takes its rise laterally close under the apex, as I have have already described it in the case of *Erythræa pulchella.* As a *normal* formation no immediate division of the stalk occurs among Phanerogamia; for the phænomenon known as "fasciation," which might be adduced here, is always a monstrosity*.

* Fasciation depends upon a real division of the *punctum vegetationis* into two parts of equal importance; in the simplest case it produces a simple division into two parts. Here neither of the two parts can be regarded as a branch of the other. If repeated bifurcations follow each other in the same plane and in unbroken connexion, the well-known "ribbon and fan"-like forms arise, which however usually end at last in single apices. Very rarely more than two parts lying in different planes are produced by the division of the *punctum vegetationis,* a case which I have noticed in the capitula of *Compositæ.* The rarest phænomenon which bears upon our subject is the annular fasciation, in which an annular border arises from the simple point of vegetation, of which I shall speak more at large in the following Part, when I compare the relations of growth in the Cryptogamia. A division of the individual corresponding to fasciation in phanerogams, and to dichotomy, its homologue, in many cryptogams, also occurs in the animal kingdom, as appears especially in many genera of corals, *e. g. Caryophyllia,* whose stocks are formed in this manner exclusively, and in *Astræa* and *Favia,* in which it appears in conjunction with

The stalk, or axis of the shoot, is hence indivisible in the higher plants, in the same sense that the body of the higher animals is indivisible*. The only phænomenon which might be described as a division of the stalk is leaf-formation. This, however, is not a division into new stalks, but a formation of subordinate parts belonging essentially to the stalk, as it were an eradiation of the stalk itself, which may be aptly compared to the formation of the extremities in the animal body. We may therefore justly describe the shoot, or the vegetable individual, as an indivisible axis,—as an axis with its appurtenant radii which are inseparable from, and regularly arranged by, its own development. With the first appearance of the branch a new axis is formed, and a new system of subordinate radii appears. However completely the branch may contrive to interweave itself with the trunk during the course of its development, it always owes its origin to an accessory point of vegetation which developes into a particular axis. The vegetable individual thus presents in its nature a certain analogy to the mineral individual,—the crystal,—as well as to the animal individual; for the crystal is determined by the relation of its parts to one and the same system of axes. As soon as this system of axes holds another position there results another individual, which may be distinguished even when two or more individual crystals intersect, so as to form twin crystals, or stellate crystals.

In the preceding considerations on the indivisibility of the axis, I described the leaves as its radiations,—as members of the stalk, and belonging essentially to it,—and I attempted to distinguish the leaves from the branches, by considering the latter as new axes. But how are leaves and branches distinguished in their genesis? Are not the branches as much radiations or lateral members of the stalk as the leaves? It would lead me too far from my subject to make a fundamental critical investigation into this question, and to examine the existing views of the mode of formation of leaves and branches, especially as investigations into this subject have not been complete enough to enable us to obtain reliable results. I can therefore only allow myself a few hints in this place. The leaf originates in the earliest period of

shoot-formation (gemmation), as was shown by Ehrenberg (Beiträge, &c., Abh. der Akad. 1832, p. 242). Ehrenberg explains the form of *Dædalinæ* as a result of incomplete termination of the individuals in gemmation; in appearance it resembles the cockscomb-like forms of fasciation as they occur in a remarkable way in some monstrous *Cacti* of the genera *Mammillaria* and *Echinocactus*, as well as in *Celosia cristata*, well known as an ornamental plant.

* [Some criticisms upon this may be given at the close of the whole memoir.—A. G.]

the formation of the stalk; and its rudiment is contemporaneous with the first stages of the formation of tissue in the *punctum vegetationis*. A leaf can never be formed at a later period from the developed axis. It is a necessary consequence of the manner in which the leaf originates, that an absolute dividing line cannot be drawn between leaf and axis; for the subsequent position of the leaves upon the organism affords no standard of appreciation, especially as most of them do not mark the basis of the leaf, which loses itself in the axis. Earlier, before the extension of the axis begins, the rudiments of the leaves are always closely pressed together, so that they appear as a peripherical development of the axis itself, occupying the whole upper surface, and dividing it into clearly defined planes, which may be recognized even in the developed state, in those plants whose foliaceous *pulvini* are distinctly marked, as *e. g.* in many Ferns, most acerose plants, in *Cacti*, and particularly in *Nymphæa* and *Victoria*, where the *pulvini* may be distinguished even in the interior of the axis. The primitive vascular system of the axis enters directly into the leaves, and ramifies there; while the woody layers of the stem, which are found later, have no connexion with the leaves. With branches the case is totally different. In their origin and development they always succeed the leaves; and even at a much later period, when the leaves have been long cast off, shoots may originate in places where, at an earlier period, no trace of a rameal rudiment, or of an eye, was to be found. If we now consider the axillary shoots,—*i. e.* those branches whose position is predetermined by the situation of the leaves,—at an early period we shall find their rudiments, even though they develope very late or not at all, in the form of a circular and slightly prominent gibbosity, which may be compared with the apex of the axis; or rather, it is an accessory *punctum vegetationis* forming near the apex. The circumstance of the epidermis of the axillary shoot being a continuation of that of the stem, is explained by the early date at which it originates; for this takes place at a time when the surface of the axis has not yet lost its flexibility. The eye is shown to be an independent centre of vegetation by its subsequent internal and external conformation; for it not only developes leaves upon its surface, and this too with an independent commencement of its phyllotaxis, but even in its interior the first system of vascular fibres seems to be formed independently of that of the main axis; as originally it lies upon it, and afterwards becomes intimately blended with it by later layers of tissue. Notwithstanding the intimacy with which later formations of woody tissue unite branch and stem, still, according to Unger's investigations, no immediate influence is exerted by the branch upon the conformation of the stem, since the stem owes none of its essential parts to the branches*. This independence of the branches is shown still more decisively in adventitious shoots, whose position is not predetermined by the leaves. Originating at a later period, they take their rise, not from the surface but from the cambium layer,—the internal tissue which preserves the faculty of producing new growths. Hence, if they would come to the light of day they must break through the bark. Their origin has been particularly described by Trécul†. W. Hofmeister, however, as I have already remarked, succeeded in tracing it in *Equisetum* back to the first cell, a cell in the interior of the stem. As is the case with axillary buds, such adventitious buds sometimes remain undeveloped for a long time (ten years and more) without losing their vital activity; a fact to which attention has lately been called by C. Schimper‡, in a Report on Exostoses. When this is the case they not unfrequently develope into spherical or conical wood-kernels, which continue to exist without any connexion with the ligneous body of the maternal stem; this is especially the case in Beeches and Poplars.

The individual nature of the shoot is confirmed not only by the mode, but by the place of its origin. While the organs of the individual organism—the leaves of the plant—occupy a position determined with geometrical accuracy, shoots, on the contrary, can arise out of almost any part of the plant,—wherever indeed any cambium exists; and they may be even enticed by art, out of places where they do not usually appear. There are shoots from the *stem*, the *root*, and the *leaves*. In herbaceous stems they appear in situations determined by the leaves (in the axils of the leaves), while they may be found anywhere on old woody stems§ as adventitious buds, or on any part of the lignified roots of most dicotyledonous woody growths, and even on some monocotyledonous ones, as in *Umbraculiferæ*‖. Shoots appear less frequently on the roots of herbaceous plants¶. Shoot-formation from leaves has often been discussed and described in

* Unger, Ueber den Bau des Dicotyledonen-Stammes (1840), pp. 65, 66.

† Recherches sur l'orig. des bourg. adv. Ann. des Sc. Nat. viii. (1847) p. 268.

‡ In Sept. 1852, in the Versammlung der Naturforscher in Wiesbaden.

§ Rarely scattered shoots appear on the herbaceous stem, and especially on the first internode under the cotyledons, as Roeper (Enum. Euphorb. 1824) first showed in *Euphorbia*, and Bernhardi in the germ of *Linariæ*. A specimen of *Begonia manicata dipetala*, cultivated in our [Berlin] Botanical Garden, which is probably the same species as the *B. phyllomaniaca* of Martius, presents the case of a plant which produces a multitude of shootlets in the whole leaf-region; they arise from the sappy stem which is not yet hardened, soon after the fall of the leaves.

‖ According to Rheede, *Corypha umbraculifera* sends forth root-shoots when the stem dies off, after the fruit has ripened.

¶ I have often observed them in *Linaria vulgaris, Helichrysum arenarium,* regard to many plants, especially *Bryophyllum, Cardamine pratensis, Drosera, Malaxis paludosa,* &c. A fine example of this is shown by a *Chelidonium majus var. laciniatum* reared by Bernhardi in the Botanical Garden at Erfurt, from whose leaves floral bractlets arose, partly unifloral, partly multifloral, without any preceding leaves*. Shoots may be allured by the gardener out of most leaves which do not wither too soon†. Finally, the little budlets in whose bosom the germ of the new plant is formed and developed, and which we call seeds, are a kind of shoots, which in most cases owe their origin to leaves (carpels), out of which they spring (on the margins, which unite to form the placenta), or more rarely, out of their whole inner surface.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Glaucus; or the Wonders of the Shore. By Charles Kingsley. Cambridge: M'Millan. 1855. 12mo.

The relief of the hapless individuals who feel themselves compelled to pass a certain number of weeks every summer out of town, without knowing in the least what to do with their time when away from their accustomed haunts, is the object which Mr. Kingsley has proposed to himself in the publication of this little book, which in our opinion is one of the most charming amongst the many admirable popular works on Natural History that have appeared of late. It may be defined, and we trust that the Reverend author will not be offended at the expression, as a Sermon on the Advantages of the Study of Natural History, but written in such a style and adorned with such a variety of illustration, that we question whether the most unconcerned reader can peruse it without deriving both pleasure and profit from his labour.

At the outset, as was to be expected, our author expatiates upon the great superiority of the study of Natural History over all the other sources to which mankind generally resort for their amusement, and here we think he has been betrayed by his zeal into a slight indiscretion; not that he has placed his favourite studies upon too high a pedestal, but he has treated those from which he wishes to wean his readers with too little consideration. In Mr. Kingsley's

Rumex Acetosella, Ajuga Genevensis, Jurinea Pollichii, Nasturtium sylvestre et *pyrenaicum*. According to Wydler, they often appear in *Viola sylvatica*.

* I may add to the examples I have given of shoot-formation taking place out of the leaves, one which I observed in June 1853, in *Levisticum officinale*. I found, in fact, in several species of this Umbellifer, one or more, frequently two, shoots in the points of division of the leaves, which after producing a few weak leaves bore a small umbel.

† Kirschleger (Flora, 1844, No. 2) notices a fine example of this in *Gloxinia speciosa*.

view, all the lighter amusements of life are frivolous and vexatious; like the original Shepherd in "Pickwick," he regards them all as "wanities;" and although this may be true in the abstract, we question whether it would not have been a more successful way of carrying the war into the enemy's country, to have treated these little weaknesses with more tenderness, rather than to insinuate that when once a man has put his hand to the plough of science, it becomes in a manner his duty to eschew all his previous amusements.

To compensate for this somewhat disrespectful view of what, to many, constitute the chief business of life, Mr. Kingsley certainly lays before his readers in a most attractive form the gratifications to be derived even from a *dilettante* study of the great book of Nature. Scarcely a branch of Natural History but has some of its most pleasing features put forward in the pages of this charming little volume, and although many of these are conveyed in hints, they still produce a sufficiently distinct impression upon the mind to awaken a desire for further information on the mysteries concealed by the half-raised veil.

Few subjects could be better adapted for the author's purpose than that expressed in the title of his book,—The Wonders of the Shore. On the shores and beneath the waves of the ocean dwell myriads of creatures whose very existence is unknown to the great mass of the public, as indeed was that of many of them until very lately even to the scientific naturalist. The remarkable forms, the beautiful colours, and the singular histories of these creatures render them objects of the highest interest; whilst the imperfect state of our knowledge of many of them, resulting from the difficulties presented to investigation by the very conditions of their existence, may raise hopes even in the beginner, that before he has long prosecuted his studies in marine Zoology, he may be rewarded, if not by the discovery of new species (which by the way Mr. Kingsley appears to think one of the most ecstatic occurrences of life), at least by the observation of some new facts, which, by supplying the deficiencies of our previous knowledge, may be of still greater scientific importance.

Of the scientific merits of 'Glaucus' we need say but little. The book, as we are told at its commencement, is an amplification of an article contributed by the author about a twelvemonth ago to the North British Review, on Mr. Gosse's recent contributions to British Marine Zoology. The strictly zoological portion of the book is consequently to a great extent composed of extracts from the works of that naturalist, a circumstance which gives rather a peculiar character to the book when regarded as an independent publication, although legitimate enough in the pages of a review. There is, however, an admirable and most amusing original account of the habits of the Spider Crab (*Maia Squinado*), and of the multitude of zoophytes which that crustacean usually carries about with him, and we regret that its length prevents our transferring it to our pages, as an illustration of our author's mode of dealing with such subjects. We must content ourselves with adding, that, for the assistance of those who may be induced by the perusal of his book to take up the study of marine

Zoology,—and we hope his disciples may be numerous,—Mr. Kingsley has given a description of the dredge and dredging, and of the mode of forming an aquarium, the former extracted from Mr. Gosse's 'Devonshire Coast.'

We regret, however, to see such a faulty list of works recommended to the beginner in Zoology as that with which Mr. Kingsley concludes. Several of our best English works, even on Marine Zoology, such as Forbes's British Starfishes, and the British Mollusca of Forbes and Hanley, are entirely omitted; and we are told that "for Ornithology, there is no book after all like dear old Bewick"!—a statement that will be rather surprising to the possessors of Yarrell's 'British Birds,' a work which is not even mentioned.

We are also sorry to see that Mr. Kingsley has fallen into the common cant of talking about "closet and book naturalists," "big-word mongers," "synonym makers," and the like. This practice, which has become almost universal amongst our popular writers, arises, as a general rule, from their knowing little or nothing of the real nature of the things which they take upon themselves to censure, and if they were called upon to lay down rules by which the evils they cry out about might have been avoided, we suspect they would find themselves somewhat at a loss. These writers either don't know, or won't say, that it is the abuse of these things that is injurious and absurd, and their readers are of course unable to make the distinction. For this very reason, however, these tirades do all the more harm, as they beget in the mind of the beginner a feeling of contempt for the only means by which he can be sure of obtaining information.

PROCEEDINGS OF LEARNED SOCIETIES.

LINNÆAN SOCIETY.

May 1, 1855.—Thomas Bell, Esq., President, in the Chair.

Read a paper entitled, "Notes on the White Secretion of the *Flata limbata*, and on its relation to the Insect White Wax of China." By Dr. Charles Murchison, formerly of the Bengal Medical Service.

The author's observations were drawn from an insect which he had found in the month of April 1854, in the jungles in the neighbourhood of Rangoon, specimens of which were exhibited to the Society. This insect was observed adhering in clusters to the leaves and twigs of various species of plants in the jungles, imparting to them a beautiful snow-white appearance. On endeavouring to secure one of the leaves with the adhering insects, a number of perfect hemipterous insects furnished with four wings, and a little larger than a common house-fly, were observed to spring by sudden jerks in various directions, leaving the white matter still adhering to the leaf. On close inspection, this white matter was found to consist of a number of insect-cases, each furnished with six legs, and with a dense tuft of white pectinated appendages adhering to the dorsal and lateral aspects of the posterior segments. These appendages were about two-thirds of an inch in length, and in the fresh state spread out in all directions from the tail, some of them curving upwards and forwards towards the head. They were extremely fragile, the slightest touch reducing them to a fine white powder, with which the whole body of the insect was thickly bestrewed. Distinct from these there were on each insect two smaller tufts of straight white filaments, exhibiting under the microscope the ordinary characters of the hairy appendages found upon insects, with a tendency to split up at their distal extremities. These insect-cases were evidently the remains of the *pupal* stage of the more perfect insect which had sprung away. The author then proceeded to show the identity of this insect with *Flata limbata*, originally described and figured by Sir George Staunton in his account of Lord Macartney's 'Embassy to China' (vol. i. p. 353), as the source of the Chinese Insect-wax, and afterwards by Mr. Westwood in his edition of Donovan's 'Insects of China' (p. 40. pl. 17), and in the 'Gardener's Chronicle' for July 1853.

After considering the importance of the Chinese Insect-wax, in an economical point of view, and enumerating the several uses, medicinal and economical, to which it has been applied in this country and in China, the author proceeded to mention the various sources to which the substance had been attributed. He quoted the statements of Sir G. Staunton and others already alluded to, which referred it to the white secretion of the *Flata limbata*. He then alluded to the detailed observations on the subject which have been recorded by Capt. Hutton of the Bengal Service in the Asiatic Society's Transactions (1843), in which that gentleman had endeavoured to prove, that the substance formed by the *Flata limbata* presented very different properties from those of the Chinese wax. He showed, however, that Capt. Hutton had confounded the viscid excretion of the insect with the white secretion originally described by Sir George Staunton, and which in its properties is really almost identical with the Chinese wax.

He then observed, that in the Reports of the Juries of the Great Exhibition of 1851, the Chinese Insect-wax was said to be the produce of the male *Coccus ceriferus*. This insect, however, had been shown by Dr. James Anderson to yield the "white lac" of Madras, a substance which presented very different chemical relations from those of the Chinese wax, being, as shown by Dr. Pearson, soluble in alcohol and æther, and of higher specific gravity than water.

The author then reviewed the elaborate paper on the subject of the Insect-wax published in the 'Pharmaceutical Journal' (April 1853) by Mr. D. Hanbury, in which that gentleman had endeavoured to show that the substance was the production of a species of *Coccus* hitherto undescribed. His conclusions were drawn from specimens of the crude wax, as scraped from the tree, transmitted to him by William Lockhart, Esq. of Shanghae, in which were a number of full-grown bodies of a female *Coccus*, as well as pieces of stick incrusted with wax, and with the insects still *in situ*. This insect had been named by Mr. Westwood *Coccus sinensis*, and afterwards *Coccus Pela*. Mr. Hanbury's description and figures were shown to agree for the most part with the accounts and figures given by Chinese authors of the mode of production of the Insect-wax of China, and which had been translated into French by Du Halde and M. Stanislas Julien. Mr. Hanbury, however, apparently misled by the arguments of Capt. Hutton, concluded that the *Flata limbata* could not produce the Chinese wax.

The author then proceeded to consider the physical characters and chemical properties of the Chinese wax of commerce, and to compare with them those of the waxy matter of the *Coccus Pela*, described by Mr. Hanbury, and of the white secretion of the *Flata limbata*, exhibited to the Society.

1. The physical and chemical properties of the wax of commerce were shown to have been ably investigated by Mr. B. C. Brodie, Mr. Ure, and Dr. Maskelyne of Oxford. It was described as occurring in circular cakes of various dimensions, often about a foot in diameter, 3 or 4 inches thick, and perforated in the centre. In structure it closely resembled spermaceti, being of a brilliant white, and of a sparkling, highly crystalline appearance. It differed, however, from spermaceti in being harder, more brittle and pulverizable, and presenting a more fibrous character of crystallization. Under a low magnifying power it was seen to consist of a mass of irregularly shaped crystalline tabular scales. Its specific gravity was ·965, and its melting-point had been stated by Mr. Brodie to be 181°·4 Fahr., and by Mr. Ure to be 196°, the melting-point of pure white wax being only 155° Fahr. When melted, it became transparent and colourless, and again opake white upon cooling, and was then seen to consist of acicular crystals for the most part arranged in a stellate manner. It was but very sparingly soluble in either alcohol or sulphuric æther, and did not saponify with the solution of caustic alkali. It dissolved, however, with great facility in naphtha, out of which fluid it might be crystallized. It was combustible and made good candles, for which purpose it was largely used in China, and to a smaller extent had been employed in this country by Mr. Samuel Childs. The investigations of Mr. Brodie relative to the proximate and absolute analysis of the Chinese wax, as published in the 'Transactions of the Royal Society' (1848), were then considered.

2. The characters of the crude wax furnished by the *Coccus Pela* were then enumerated. As forwarded to Mr. Hanbury by Mr. Lockhart of Shanghae, it consisted of the crude wax as scraped from the tree, along with a number of full-grown bodies of the *Coccus Pela*, as well as pieces of stick incrusted with the wax, and with the insects still *in situ*. The crude wax itself formed around the branch a white, soft, fibrous, velvety coating of from one- to two-tenths of an inch in thickness, and when scraped off, occurred in whitish, flattened, curled, or generally irregular masses, the largest pieces about half an inch in length. These masses exhibited no crystalline

structure, but were fibrous-looking, and so soft as to retain the impression of the finger, It presented peculiar microscopic characters, which had been described and figured by Mr. Quekett in an appendix to Mr. Hanbury's paper published in the 'Pharmaceutical Journal.' When examined with a power of 250 diameters linear, it was "found to consist of a series of short filaments or cylinders, some of which are straight, but others more or less curved; within each cylinder is a tubular cavity, extending throughout its whole length. The diameter of the cylinders is on an average $\frac{1}{4000}$th of an inch, whilst that of the tube within varies from $\frac{1}{7500}$th to $\frac{1}{8000}$th." Mr. Quekett had found similar tubular filaments in the cocoons of the Cochineal insect. The specific gravity of the crude wax had not been ascertained, but the melting-point of a purified wax obtained from the crude substance had been shown by Mr. Hanbury to be 182°·75 Fahr. It did not dissolve, or at all events but very sparingly in alcohol, æther, or solution of caustic alkali, but it dissolved readily in naphtha and vegetable oils, uniting with the latter to form a solid white mass. When melted, it formed a clear, colourless liquid, which became opake white on cooling, and was then found to have lost its tubular structure, and to be composed of acicular crystals arranged in stellate masses, like those produced by the commercial wax when similarly treated. From these characters, as well as the evidence of Mr. Lockhart of Shanghae, Dr Murchison thought that there was good reason for coinciding with the conclusion arrived at by Mr. Hanbury, that the *Coccus Pela* is a source of the commercial wax.

3. The characters of the white appendages of the *Flata limbata* were then considered. Close inspection showed that these appendages were of two sorts. First, there was on each insect a small tuft or brush of minute white hairs, adhering firmly to either side of the insect's body, and distinguished from the great bulk of the white appendages by their smaller size, greater slenderness, less opacity, and greater strength, admitting of being handled with perfect impunity. These filaments under the microscope presented the ordinary characters of the hairy appendages often found on insects, with a remarkable tendency to split up at their distal extremities. The greater bulk of the white appendages were thicker, longer, and more opake than the preceding. They were but loosely attached to the surface of the insect's body, and extremely delicate and fragile, so that the slightest touch with the point of the finger reduced them to a fine white powder, and hence was explained the fact, that the leaves and branches upon which these insects occur, become completely whitened by a white powdery substance in the manner described by Sir G. Staunton. On microscopic examination they presented a beautiful appearance of spiral structure. When one of the appendages was compressed with care between two glass plates, and examined under a power of 250 diameters, it was found to consist of a mass of spiral threads, with their long axes running in the same direction. The slightest friction of the surfaces of the glass plates broke up these threads into fragments more or less minute, and if the friction was continued, they were almost entirely converted into

granular matter. The threads differed from the cylinders found in the crude wax of the *Coccus Pela* in not being tubular, and in their diameter measuring on an average only $\frac{1}{8000}$th of an inch, or about one-half. Attempts were made to trace the mode of connexion of these filaments with the insect's body, but owing to their extreme delicacy and fragility this was found impossible. The integument, however, to which they were attached was found to be perforated by a number of circular openings, having a distinct double outline, the diameter of the inner circle exactly corresponding with that of one of the filaments. Hence it seemed probable that the spiral threads, which were evidently a secretion, had issued from these circular openings. What was the chemical nature of this white secretion? A small portion, placed on a glass slide and melted over the flame of a spirit-lamp, became a transparent, colourless drop, which on cooling became opake white, and was then found to have lost its original structure and to have become crystalline. The crystals consisted partly of irregularly-shaped fragments, and also contained, especially when the cooling had been conducted slowly, acicular crystals arranged in stellate masses as in the case of the two substances already described. The melting-point, as far as could be ascertained with the small quantities experimented on, was between 190° and 200° Fahr. The substance floated in water, and was perfectly insoluble in this fluid, and but sparingly, if at all, soluble in alcohol, sulphuric æther, or solution of caustic alkali, whereas in naphtha it dissolved readily, as also in vegetable oils, forming with the latter a white solid substance. From these characters there could be little doubt that the white secretion of the *Flata limbata* was of a waxy nature, and also very similar in its properties to the Chinese Insect-wax of commerce.

The author concluded as follows:—

"The *Flata limbata* occurs in great abundance in China, and also in some parts of India, and I believe, from the facts above stated, that there is nothing improbable in the original statement of Sir George Staunton, that it may be a source of the Insect-wax of commerce. That it is the sole source, as was once believed, I think is disproved by the arguments which Mr. Hanbury has brought forward in favour of the *Coccus Pela*. That it is one source, however, of the Insect-wax employed for economical purposes by the Chinese, I think is rendered highly probable by the following considerations:—

"1. We have seen that the *Flata limbata* secretes a waxy matter in considerable quantity.

"2. This waxy matter resembles closely in its characters and chemical relations the Chinese insect-wax of commerce.

"3. The *Flata limbata* is known to be very common in many parts of China.

"4. Sir George Staunton, when travelling in Cochin China, found that it was generally believed that the white matter secreted by the *Flata limbata* formed the white wax of the East, and he adds, 'It is asserted on the spot, to have the property, by a particular manipulation, of giving in certain proportions with vegetable oil such solidity to the composition, as to render the whole equally capable of being moulded into candles.' The truth of this statement I have myself verified.

"5. It has been stated by Dr. Macgowan (Journal of Horticult. Soc. of India, vol. vii. p. 164), that the annual produce of the Insect-wax in China is not far from £400,000; and when we consider the very small quantity yielded by an individual insect, whether the *Coccus Pela* or the *Flata limbata*, it would appear probable that the substance may be obtained from several insects, of which no doubt the *Coccus Pela* is one, and probably the *Flata limbata* is another."

The paper was illustrated by specimens of the insect in its natural state adhering to the leaf, and also by numerous preparations, illustrative of the microscopic appearances and chemical relations, of the waxy matter both of the *Coccus Pela* and *Flata limbata*. The specimens of the *Flata limbata* adhering to the leaf have since been deposited in the Museum of the Royal Gardens at Kew. Microscopical delineations of appearances seen in the secretions both of *Flata limbata* and of *Coccus Pela*, and of the spiral threads and white hairs of the pupa of *Flata limbata*, also accompanied the paper.

June 5.—Thomas Bell, Esq., President, in the Chair.

Read the first of a Series of Memoirs, entitled "Horæ Carcinologicæ, or Notices of *Crustacea*. I. A Monograph of the *Leucosiadæ*, with observations on the relations, structure, habits and distribution of the family, a revision of the generic characters, and descriptions of new genera and species." By Thomas Bell, Esq., V.P.R.S., Pres. L.S.

The author commences this paper with remarks on the distinct limitation of the *Leucosiadæ*, and the absence of any obvious osculant forms by which to associate them closely with neighbouring groups of the *Oxystomata*, and the no less striking want of any distinct representation of this family within the limits of other members of the same great group. He refers, however, to a probable affinity in the structure of the type of the *Pinnotheridæ*, which has hitherto been overlooked. The apparent approximation of the genus *Oreophorus* to the *Calappadæ* is also suggested, and a corresponding tendency to a lateral expansion of the carapace pointed out in the genera *Lithadia*, *Nursia*, *Phlyxia* and *Ebalia*.

The history of the progressive knowledge of the family from its first detection by Fabricius as a distinct group is then given. The author enters at some length into the consideration of the nature of specific characters in general, and the necessity of adopting such as are tangible and certain; and after deprecating the use of such as are merely comparative between different species, he urges the importance of giving, in all cases when a new species is described, such a definition as shall point out as briefly as may consist with clearness and certainty the points of distinction from all those which are already known, and a description so full as to enable the future observer to ascertain whether any individual afterwards examined is new, or identical with the one so described. Specific characters, the author says, should always be either absolute, or derived from points of comparison within the individual itself.

After a general view of the structure, it is shown that from a low degree of development of the organs subserving the functions of relation, these animals are necessarily slow and circumscribed in their locomotion, and dependent for their safety from injury upon external means of protection.

In referring to the distribution of the family, it is shown that every genus, without exception, is restricted to its own geographical limit; and this is true to such an extent, that there is no instance of one species of any genus inhabiting the old world, and another of the same genus being found in the new.

The systematic portion of the paper consists of the characters of, and observations on, all the genera whether new or previously known, and characters and descriptions of every known species. Five new genera and no less than thirty-six new species are described. The following are the generic and specific characters as given in the paper:—

Genus Leucosia. *Testa* ovato-orbicularis, subglobosa, lævis, polita; fronte subproducto, fossulas antennarias tegente. *Orbita* fissuris tribus. *Fossæ antennariæ* obliquæ, apertæ. *Pedipalpi externi* caule exteriore lateribus parallelis, recto vel subcurvo, apice obtuso; caule interiore acutè triangulari. *Pedes antici* crassiores, longitudine mediocres, brachiis ad basin et ad latera tuberculatis. *Abdomen maris*, in nonnullis speciebus, segmentis omnibus primo et ultimo exceptis—in aliis tertio cum quarto et quinto cum sexto; *fœminæ* a tertio ad sextum coalitis.

1. *Leucosia Urania*, Herbst. Testâ subglobosâ, anticè productâ, fronte rotundato; brachiis triedris, suprà ad basin tuberculis paucis; sinu thoracico usque ad latera regionis hepaticæ anticè attingente, granis marginato.

2. *Leucosia craniolaris*, Linn. Testâ ovato-rhomboideâ, fronte tridentato; brachiis serie tuberculorum ad latera et tuberculis duobus tantùm ad basin.

3. *Leucosia obtusifrons*, De Haan. Fronte rotundato, sinu thoracico anticè circulari, tuberculis circumscripto; brachiis ad latera et ad basin tuberculatis, manibus longioribus quam latioribus, serie granorum ad marginem interiorem.

4. *Leucosia unidentata*, De Haan. Fronte unidentato; sinu thoracico anticè circulari, tuberculis perlatis circumscripto; brachiis facie superiore seriebus binis tuberculorum.

5. *Leucosia rhomboidalis*, De Haan. Testâ rhomboidali, anticè productâ, multò longiore quam latiore; brachiis basi utrinque densè tomentosis, lateribus tuberculatis, suprà plerumque lævibus.

6. *Leucosia longifrons*, De Haan. Testâ subglobosâ, fronte producto, integerrimo; sinu thoracico anticè elliptico, granis non cincto; brachiis ad latera tuberculatis, et granulis paucis ad basin.

7. *Leucosia orbicularis*, Bell. Testâ orbiculari, fronte lato, brevissimo, bidentato; sinu thoracico nullo; sterno anticè granulato.

8. *Leucosia pallida*, Bell. Fronte tridentato, ultra orbitâ producto; sinu thoracico in sulco brevi profundo anticè terminato; granulis paucis supra insertionem pedum anteriorum; manibus utrinque carinatis lævibus; digitis inermibus.

9. *Leucosia obscura*, Bell. Testâ suborbiculari; rostro minutè tridentato; sinu thoracico angustissimo; manibus longioribus quam latioribus utrinque carinatis, lævibus; digitis inermibus.

10. *Leucosia marmorea*, Bell. Fronte minutè tridentato, dente medio longiore; sinu thoracico anticè brevi, lineâ semicirculari granulatâ terminato; brachiis ad basin et ad latera tuberculatis; manibus margine interno granulato.

11. *Leucosia punctata*, Bell. Testâ impresso-punctatâ; fronte subemarginato; brachiis suprà omninò granulatis.

12. *Leucosia affinis*, Bell. Testâ anticè angustatâ, fronte producto, subemarginato; manibus utrinque carinatis; brachiis anticè tumidis, lævissimis, politis.

13. *Leucosia brevimana*, Bell. Testâ subrhomboidali; fronte emarginato; margine laterali haud granulato; manibus æquè longis ac latis.

14. *Leucosia margaritacea*, Bell. Testâ multò longiore quam latiore, lævissimâ, margaritaceâ; sinu thoracico margine lævi; brachiis suprà tuberculis albis, rubro-cinctis.

15. *Leucosia ocellata*, Bell. Testâ rhomboidali; fronte bidentato; regione gastricâ maculis quatuor parvis rubris signatâ, quarum binæ anteriores ocellatæ.

16. *Leucosia Whitei*, Bell. Testâ rhomboideâ; fronte producto, minutè tridentato; regionibus hepaticâ et branchiali granulis tribus vel quatuor; brachiis tomentosis, tuberculis magnis omninò instructis.

17. *Leucosia hæmatosticta*, Adams & White. "Thorace trapezoidali suprà valdè convexo, post angulum latero-anteriorem incisurâ profundâ, maculis multis sanguineis obsito."

18. *Leucosia Cumingii*, Bell. Testâ suborbiculari, margine lævi; sinu thoracico incisurâ inter regiones hepaticam et branchialem terminato; regionibus branchialibus valdè tumidis.

19. *Leucosia pulchella*, Bell. Testâ æquè longâ ac latâ, margine lævi, tenui, subreflexo; brachiis suprà et infrà omninò tuberculatis; pedipalpis externis anticè paulo angustatis.

20. *Leucosia phyllocheira*, Bell. Manibus latioribus quam longioribus, utrinque lamellatis; pedibus omnibus posterioribus articulo penultimo lato, compresso.

Genus Ilia, Leach. *Testa* subglobosa, postice dentibus quatuor armata, quarum utrinque una compressa ad regionem intestinalem, et una conica ad brachialem; fronte bifido. *Orbita* suprà bifissa. *Pedipalpi externi* caule exteriore recto, apice obtuso. *Pedes antici* longissimi, manibus contortis, antrorsùm angustatis.

1. *Ilia nucleus*, Linn. Testâ minutè et confertè granulosâ, granulis majoribus distantibus instructâ.

2. *Ilia rugulosa*, Roux. Testâ glabrâ, sparsim granulosâ, anticè lævi.

Genus Persephona, Leach. *Testa* ovalis seu orbicularis, depressa, dentibus tribus ad partem posteriorem armata, regionibus pterygostomianis angulatis. *Orbita* trifissa. *Fossæ antennariæ* transversæ. *Pedipalpi externi* caule exteriore paulo dilatato sensim angustato, ad apicem internè truncato. *Pedes antici* robusti, testâ haud bis longiores; *reliqui* articulis ultimo et penultimo compressis. *Abdomen maris* segmentis a tertio ad quintum,—*fœminæ* a quarto ad sextum, coalitis.

1. *Persephona Guaia*, Bell. Testâ ovatâ, sparsim tuberculatâ, angulo pterygostomiano obtusissimo, spinâ mediâ posticâ lateralibus paulo superiore.

2. *Persephona Lichtensteinii*, Leach. Testâ orbiculari, angulo pterygostomiano dentiformi, margine laterali unidentato, spinis posticis æqualibus, medio cum lateralibus triangulum æquilateralem designante.

3. *Persephona orbicularis*, Bell. Testâ orbiculari, angulo pterygostomiano in tuberculo abruptè producto; spinis posticis æqualibus, angulum ferè rectum designantibus.

4. *Persephona Edwardsii*, Bell. Testâ orbiculari, anticè subproductâ, angulo pterygostomiano obsoleto; spinâ posticâ mediâ lateralibus multò altiore.

Genus Leucosilia, Bell. *Testa* globosa, fronte dentibus binis divergentibus terminata; regione intestinali unidentatâ. *Orbita* trifissa. *Fossæ antennariæ* obliquæ in dentibus frontis excavatæ. *Pedipalpi externi* caule exteriore subcurvo, obtuso. *Pedes antici* robusti, longitudine mediocres. *Abdomen maris* segmentis 3tio 4to 5to coalitis, penultimo unidentato; *fœminæ* latè ovatum, valdè convexum.

Sp. unica, *Leucosilia Jurinii*, Saussure.

Genus Myra, Leach. *Testa* ovato-globosa, posticè tridentata. *Orbita* profundè trifissa. *Fossæ antennariæ* obliquæ. *Pedipalpi externi* caule exteriore dilatato. *Pedes antici* longissimi, graciles, manibus rectis.

1. *Myra fugax*, Fabr. Testâ subglobosâ, medio elevatâ, non carinatâ; spinâ posticâ mediâ lateralibus bis longiore; spinis lateralibus compressis.

2. *Myra affinis*, Bell. Testâ ovato-globosâ, spinis posticis brevibus, subæqualibus; pedibus anticis testâ vix bis longioribus; manu digitis tertiâ parte longiore.

3. *Myra carinata*, Bell. Testâ ovatâ, minutè granulatâ, medio carinatâ, spinâ posticâ mediâ lateralibus ter quaterve longiore, spinis lateralibus acutè conicis.

4. *Myra elegans*, Bell. Testâ bis longiore quam latiore (spinâ posticâ non inclusâ), margine anteriore setoso.

5. *Myra mammillaris*, Bell. Testâ ovatâ, glabrâ, tuberculis parvis elevatis sparsim instructâ; dentibus posticis brevissimis, rotundatis.

Genus Myrodes, Bell. *Testa* ovata, rostro emarginato terminata, posticè dentibus tribus, quarum media longior, armata. *Orbita* trifissa. *Fossæ antennariæ* ferè longitudinales. *Pedipalpi externi* caule exteriore subcurvo, haud dilatato. *Pedes antici* testâ vix longiores; manibus pyriformibus haud longioribus quam latioribus; digitis tenuibus, valdè elongatis, curvis, apice aduncis.

Sp. unica, *Myrodes eudactylus*, Bell.

Genus Philyra, Leach. *Testa* orbicularis, depressa, inermis, fronte epistomate breviore. *Orbita* suprà aperta, trifissa. *Fossæ antennariæ* ferè transversæ. *Pedipalpi externi* caule exteriore dilatato. *Pedes antici* mediocres; *octo posteriores* tarso compresso lamelloso. *Abdomen maris* hastato-lanceolatum; *fœminæ* articulo ultimo angusto, producto.

1. *Philyra scabriuscula*, Fabr. Testâ depressâ, granuloso-scabrâ, fronte epistomate multo breviore; brachiis tuberculatis; manibus ad marginem interiorem lineis duabus granulatis.

2. *Philyra globulosa*, Fabr. Testâ globosâ, lævi, margine laterali granulato; fronte vix epistomate breviore; brachiis granulatis.

3. *Philyra porcellana*, Fabr. "Testâ globosâ, minutè punctatâ; fronte epistomate parùm breviore, margine granulato; brachiis cylindricis tuberculatis; manibus lævibus inflatis."

Hanc speciem non vidi—a præcedente anne distincta?

4. *Philyra Pisum*, De Haan. "Fronte epistomate parùm breviore; regionibus pterygostomianis medio angulatis; thorace granulato; chelis in maribus thoracem dimidio superantibus; digitis in longitudinem 5-sulcatis margine interno denticulatis."

5. *Philyra platycheira*, De Haan. "Parva, regionibus pterygostomianis medio angulatis; fronte epistomate parùm breviore; chelis in maribus thorace bis longioribus; digitis valdè depressis, lævibus, margine interno integerrimis."

6. *Philyra lævis*, Bell. Testâ, corpore, pedibus omninò lævibus.

7. *Philyra Adamsii*, Bell. Testâ glabrâ, regionibus partim et lineâ longitudinali granulatis; margine posteriore utrinque bituberculato.

8. *Philyra punctata*, Bell. Testâ orbiculari, lævi, punctatâ; angulo pterygostomiano obsoleto; brachiis triquetris.

9. *Philyra carinata*, Bell. Testâ partim granulosâ, inter regiones cardiacam et branchialem lævi, medio carinatâ; manibus lineis duabus granulosis.

10. *Philyra macrophthalma*, Bell. Testâ ovatâ, minutissimè granulatâ; pedunculis oculorum elongatis; abdomine maris angusto, lineari.

Genus Ebalia, Leach. *Testa* rhomboidalis vel subhexagona; fronte producto, emarginato. *Orbita* bifissa. *Fossæ antennariæ* tectæ, obliquæ. *Pedipalpi externi* ad marginem epistomatis extendentes, caule exteriore margine externo recto, caule interiore acuminato. *Pedes antici* breves, crassi; *posteriores* ungue forti styliformi terminati.

1. *Ebalia Pennantii*, Leach. Testâ granulatâ, eminentiâ cruciformi; margine latero-anteriore bilobato; abdomine maris segmentis a tertio ad sextum confluentibus.

2. *Ebalia Bryeri*, Leach. Testâ minutè granulatâ, margine laterali integro, subrevoluto, posteriore bilobato; regione cardiacâ bituberculatâ, branchiali utrinque tuberculo uno; brachio haud bis longiore quam latiore.

3. *Ebalia Cranchii*, Leach. Testâ granulatâ, carinatâ, tuberculis quinque; margine latero-anteriore fere integro; brachio ter longiore quam latiore.

4. *Ebalia granulosa*, Edw. Testâ granulosâ, tuberculis sex; margine latero-anteriore bilobo.

Genus Phlyxia, Bell. *Testa* rhomboidea, tuberculis tribus posticè instructis. *Orbita* suprà emarginata, bifissa. *Fossæ antennariæ* cum orbitis communicantes. *Antennulæ* elongatæ, porrectæ. *Pedipalpi* *externi* caule exteriore lato, margine externo curvo, anticè angustato; caule interno segmento penultimo lateribus parallelis, ultimo triangulari. *Abdomen* in utroque sexu segmentis a tertio ad sextum coalitis.

1. *Phlyxia crassipes*, Bell. Testâ subcarinatâ; rostro quadrato, quadridentato; pedibus anticis testâ plus quam duplò longioribus; brachiis rotundis, medio tumescentibus.

2. *Phlyxia lambriformis*, Bell. Testâ carinatâ; rostro triangulari, emarginato; margine latero-anteriore inciso, latero-posteriore acutè carinato.

3. *Phlyxia lævis*, Bell. Brachiis triedris; testâ lævi, margine laterali unidentato.

Genus Lithadia, Bell. *Testa* rhomboidea, rudis; regionibus gibbosis; rostro bifido, resupinato. *Orbita* suprà et extrorsùm aperta. *Fossæ antennariæ* obliquæ. *Pedipalpi externi* caule exteriore ensiformi obtuso; interiore lanceolato, exteriore longiore. *Pedes antici* robusti, rudes, tuberculati. *Abdomen maris* segmentis tertio, quarto et quinto coalitis.

Species unica, *Lithadia Cumingii*, Bell.

Genus Oreophorus, Rüppell. *Testa* tuberosa, posticè supra pedes dilatata. *Fossæ antennariæ* obliquæ. *Pedipalpi externi* caule exteriore arcuato, apicem versus sensim angustiore. *Pedes anteriores* longi, robusti; *octo posteriores* subæquales, scuto dorsali reconditi.

1. *Oreophorus horridus*, Rüpp. Testâ subtriangulatâ, regionibus branchialibus fortitèr et obliquè carinatis; chelis mediocribus; manu digitis longiore.

2. *Oreophorus reticulatus*, Adams & White. Testâ subpentagonâ, reticulatâ; digitis maximis, manu bis longioribus.

3. *Oreophorus nodosus*, Bell. Testâ nodosâ, margine undato; manu tumidâ, ad margines carinatâ, bisulcatâ, digitis longiore.

Genus Nursia, Leach. *Testa* polyedra, fronte producto. *Orbita* extrorsùm aperta. *Fossæ antennariæ* transversæ. *Pedipalpi externi* caule exteriore curvo, dilatato, anticè et posticè obtuso; caule interiore margine interno recto, articulo penultimo quadrato, ultimo triangulari. *Pedes antici* digitis deflexis. *Abdomen maris* articulo penultimo apice processu dentiformi instructum.

1. *Nursia plicata*, Herbst. Testâ utrinque 4-dentatâ, medio tuberculis tribus triangulum delineantibus, posticè lineâ elevatâ transversâ tuberculum gerente; fronte 4-dentato.

2. *Nursia abbreviata*, Bell. Testâ orbiculari, margine undato, lineâ elevatâ longitudinali, alterâ transversali decussatâ; fronte integro.

Genus Nursilia, Bell. *Testa* latior quam longior, margine polygono, fronte producto. *Orbita* bifissa, extrorsùm aperta. *Fossæ antennariæ* obliquæ. *Pedipalpi externi* epistoma superantes, caule exteriore curvo, medio dilatato; interiore elongato, margine interno arcuato. *Abdomen fœminæ* valdè convexum, articulo ultimo inter bases pedipalporum externorum producto.

Species unica, *Nursilia dentata*, Bell.

Genus Arcania, Leach. *Testa* subglobosa, spinis seu tuberculis elevatis plurimis armata. *Orbita* suprà et extrorsùm aperta. *Fossæ antennariæ* longitudinales. *Pedipalpi externi* caule exteriore recto, lineari, apice interiore emarginato-truncato; caule interiore gradatim acuminato.

Pedes antici gracillimi. *Abdomen maris* lanceolatum, segmentis a tertio ad sextum coalitis.

1. *Arcania Erinaceus*, Herbst. Corpore atque membris densè spinosis, spinis spinulosis.
2. *Arcania* 11-*spinosa*, De Haan. "Thorace spinuloso, spinulis obtusis, ambitu 11-spinoso, spinis acutis simplicibus; brachiis granulatis, digitis manibus longioribus."
3. *Arcania novem-spinosa*, Adams & White. "Thorace lævi, granuloso, marginibus latero-anterioribus spinis duabus, latero-posterioribus spinis duabus, posteriore spinâ longâ rectâ."
4. *Arcania septem-spinosa*, Bell. Testâ paulò latiore quam longiore, tuberculatâ, margine spinis septem tuberculatis armato, laterali utrinque reliquis longiore.
5. *Arcania tuberculata*, Bell. Testâ paulò longiore quam latiore, omnino tuberculatâ, margine spinis novem tuberculatis instructo; brachiis granulatis, manibus lævibus.
6. *Arcania gracilipes*, Bell. Testâ granulosâ, tuberculis quindecim suprà, et tribus ad marginem posteriorem instructâ; pedibus anticis tenuissimis.
7. *Arcania lævimana*, Bell. Testâ granulatâ, tuberculis numerosis distinctis, ad marginem spinis novem simplicibus armatâ; manibus glabris.

Genus Iphis, Leach. *Testa* rhomboidalis, transversa, angulis rotundatis, utrinque spinâ longissimâ horizontali armata; fronte emarginato.

Species unica, *Iphis septemspinosa*, Fabr.

Genus Ixa, Leach. *Testa* elliptico-rhomboidalis, processu utrinque subcylindrico à regione branchiali producto; regionibus sulco profundo separatis. *Orbita* suprà bifissa. *Pedipalpi externi* caule exteriore lato, interiore longiore. *Pedes* filiformes.

Species unica, *Ixa cylindrus*, Fabr.

Read also, a "Notice of a species of Carabideous Insect, *Helluo* (*Acanthogenys*) *myrmecophilus*, Westw., found together with its larva, in Ants' nests in Ceylon, by G. H. K. Thwaites, Esq., F.L.S." By J. O. Westwood, Esq., F.L.S. This paper was accompanied by figures of the larva and imago states of the insect.

ZOOLOGICAL SOCIETY.

June 27, 1854.—Dr. Gray, Vice-President, in the Chair.

Descriptions of three new species of Titmice. By Frederic Moore.

Fam. Pipridæ, Vigors. Subfam. Pariana.

Genus Orites, Mœhring.

1. Orites? leucogenys, Moore.

Colour above grey, tinged with pinkish on the rump: before the eye and a broad streak over it black, passing to mixed black and grey on the nape; the centre of the head dusky reddish-isabelline; base of lower mandible, below the eyes, ear-coverts and sides of the neck white; chin and throat jet-black; abdomen pale pinkish-isabelline; wings dusky and having an isabelline tinge, the winglet and coverts of the primaries black; the primaries and secondaries fringed externally with grey; axillæ white; tail dusky, tinged with isabelline, the outer feathers graduated and obliquely tipped externally with white, the centre feathers margined with grey. Bill black; feet yellowish-brown.

Length $4\frac{1}{2}$ inches; of wing $2\frac{1}{8}$th; of tail $2\frac{1}{4}$; the three outer feathers graduated, the middle pair $\frac{2}{10}$ths shorter than the next; bill to frontal plumes $\frac{2}{10}$ths; to gape $\frac{5}{12}$ths; height from chin to front $\frac{2}{12}$ths; and tarse $\frac{7}{12}$ths of an inch.

Hab. Afghanistan. In the Museum of the East India Company. "Found in pairs, in the woods above Balu Chughur, at 4000 feet elevation. Irides straw-colour." Griffith, MSS. Notes.

This species is allied in colour to *O. jouschistos*, Hodgson, from which it may at once be distinguished by its broad, thick and higher bill, by its white cheeks and ear-coverts, and by its black chin and throat; and from *O. erythrocephalus*, Vigors, by its larger size, by the absence of the white superciliary streak, white chin, black ear-coverts, &c. On the habits of the latter species I beg to quote the following remarks made by Capt. Hutton, in 'Journ. A. S. Bengal,' 1848, p. 689. He says, "It is common at Mussooree, and in the hills generally throughout the year. It breeds in April and May; the situation chosen is various, as one taken in the former month at Mussooree at 7000 feet elevation, was placed on the side of a bank among overhanging coarse grass; while another taken in the latter month at 5000 feet, was built among some ivy turning round a tree, and at least 14 feet from the ground. The nest is in shape a round ball with a small lateral entrance, and is composed of green mosses warmly lined with feathers. The eggs are five in number, white with a pinkish tinge, and sparingly sprinkled with lilac spots or specks, and having a well-defined lilac ring at the larger end. Diameter $\frac{8}{16} \times \frac{6}{16}$ in."

2. Orites (?) glaucogularis, Gould, MS.

Colour above greyish-ash; crown black, with a broad pale-buff line extending down the centre; forehead and lores isabelline; base of lower mandible, ear-coverts, chin, breast, and middle of belly buff colour; rump, upper tail-coverts, flanks and sides of belly pinkish-isabelline, brightening to ferruginous on the vent and under tail-coverts; throat of a silvery or bluish-ash; sides of the neck below the ear-coverts whitish; wings brownish-black, coverts and speculars quite black, primaries and secondaries margined with greyish-white; axillæ and edge of shoulder white; tail black, the four outer feathers obliquely across both webs white. Bill black, and thick as in *O. leucogenys*; legs dark brown.

Length $4\frac{1}{2}$ inches; of wing $2\frac{1}{8}$th; tail $2\frac{1}{2}$; its outermost feather

1 inch shorter; bill to frontal plumes $\frac{2}{10}$ths, to gape $\frac{5}{12}$ths; and tarse $\frac{7}{12}$ths of an inch.

Hab. China. In the collection of John Gould, Esq.

3. Orites (?) niveogularis, Gould, MS.

Forehead white, passing to buff-brown on the back of the head, nape, and fore-part of the back, and thence to the tail grey, tinged with isabelline on the rump; lores, over the eyes and ear-coverts black, passing into the brown on the nape; ear-coverts blackish anteriorly and brownish-buff posteriorly, and somewhat striped longitudinally with white; base of lower mandible, chin, throat, fore-part of breast, and sides of the neck to the nape behind the ear-coverts snowy-white, and contrasting with a brownish band which runs from the nape across the middle of the breast; the lower part of the breast with the abdomen pale pinky-isabelline passing to white in the middle of the belly: wings brown, margined with greyish-white, coverts and speculars blackish: tail dusky-black, margined externally with greyish-white, its outermost feathers white on the outer web. Bill black, longish, and slender as in *O. jouschistos*, Hodgson; feet yellowish.

Length $4\frac{1}{2}$ inches; of wing $2\frac{1}{2}$; tail $2\frac{5}{8}$ths, its outermost feather $\frac{1}{2}$ inch shorter; bill to frontal plumes $\frac{3}{10}$ths to $\frac{5}{10}$ths; tarse $\frac{7}{12}$ths of an inch.

Hab. N. India. In the collection of John Gould, Esq.

Remark.—These three new species, together with *O. erythrocephalus*, Vigors, and *O. jouschistos*, Hodgs., will, I believe, upon further examination, prove to form two separate divisions, distinct from the genus *Orites*; the species named *erythrocephalus*, *leucogenys*, and *glaucogularis* forming one division, and *jouschistos* with *niveogularis* the second.

Notice of some imperfectly-known species of Birds contained in the Museum of the Hon. East India Company. By Frederic Moore.

Fam. Merulidæ, Vigors.

Subfam. Brachypodina, Swainson.

Genus Ixulus, Hodgson, P. Z. S. (1845) p. 23.

1. Ixulus occipitalis, Blyth.

Siva occipitalis, Blyth, J. A. S. Beng. xiii. p. 937. (1844.)

Ixulus occipitalis, Blyth, J. A. S. Beng. xiv. p. 552. xvi. p. 448; Cat. B. Mus. A. S. Beng., p. 100.

Hab. Sikim, Nepal. (No. 955, Hodgson's Catalogue.)

"Colour dull brownish olive-green above, the shafts of the dorsal and scapular feathers pale; below much lighter and rufescent, the throat whitish, the feathers of the fore-neck having dark shafts: crown, nape, and lower tail-coverts ferruginous-brown, which also tinges the flanks ; coronal feathers considerably elongated, and the occiput beneath the crest white ; bill black ; legs yellowish-brown.

"Length about 5 inches ; of wing $2\frac{1}{2}$; tail 2 ; bill to gape $\frac{9}{16}$ths ; and tarse $\frac{7}{8}$ths of an inch."

A single specimen only of this species was collected in Nepal by B. H. Hodgson, Esq.

2. IXULUS CASTANICEPS, Moore, n. sp.

Colour above dull brownish-olive, the shafts of the dorsal and scapular feathers pale ; crown dark-chestnut, and subcrested, the frontal plumes short and sealy, and having pale margins, the occiput paler chestnut ; behind the eyes whitish ; ear-coverts chestnut ; wings blackish, the secondaries and tertiaries with pale shafts ; axillæ white ; tail black, the three outer feathers graduated, and tipped obliquely externally with white, the next white at the extreme tip only, and the rest entirely black ; the whole underparts of a dirty ruddy-white colour ; bill reddish-brown ; legs yellowish.

Length $5\frac{3}{4}$ inches ; of wing $2\frac{3}{10}$; tail $2\frac{1}{4}$; its outermost feather $\frac{5}{8}$ths less ; bill to front $\frac{3}{10}$ths ; to gape $\frac{1}{2}$; and tarse $\frac{3}{4}$ of an inch.

Hab. Afghanistan.

This species is at once distinguished by the white tips to the tail-feathers.

Genus STACHYRIS, Hodgson, J. A. S. Beng. 1844, p. 378.

3. STACHYRIS RUFICEPS, Blyth.

Stachyris ruficeps, Blyth, J. A. S. Beng. xvi. p. 452 (1847) ; Catal. B. Mus. A. S. Beng. p. 150. Bonap. C. G. Av. p. 332.

The rufous-headed *Stachyris*.

Hab. Sikim ; Nepal. (No. 923, Hodgson's Catalogue.)

"Allied in form and size to *St. pyrrhops*, but having the crown light ferruginous, and the chin and middle of the throat white, with slight black central streaks to the feathers ; rest of the upper parts plain olive, and of the lower whitish, with a fulvous tinge on the sides of the neck and breast" [in some specimens the crown and nape are bright ferruginous, and the whole under-parts pale ferruginous]. Bill and legs pale horn-colour.

Length $4\frac{1}{2}$ inches ; of wing $2\frac{1}{8}$th ; tail 2 inches ; bill to frontal plumes $\frac{4}{10}$ths ; to gape $\frac{6}{10}$ths ; and tarse $\frac{7}{8}$ths of an inch.

Fam. PIPRIDÆ, Vigors.

Subfam. LEIOTHRICHINA.

Genus LEIOTHRIX, Swainson.

4. LEIOTHRIX CINEREA, Blyth.

Minla cinerea, Blyth, J. A. S. Beng. xvi. p. 449 (1847).
Leiothrix cinerea, Blyth, Catal. B. Mus. A. S. Beng. p. 100.
The grey *Leiothrix*.

Hab. S. E. Himalaya ; Nepal. (No. 671, Hodgson's Catalogue.*)

"Colour olive-grey above, tinged with green ; beneath white, tinged on the flanks with ashy, and showing some yellow along the middle of the abdomen ; a broad yellowish-white supercilium, and over this a black one ; the coronal feathers margined with black, and the cheeks mingled black and white ; orbital feathers subdued white ; wings and tail without markings, the tertiaries edged with grey, and the secondaries with very faint dull yellowish. Bill yellowish-horny above, paler beneath, legs yellowish."

"Length $4\frac{1}{2}$ inches ; of wing $2\frac{1}{4}$; tail $1\frac{3}{4}$; bill to gape nearly $\frac{5}{8}$ths ; and tarse $\frac{3}{4}$ of an inch."

Allied in form and size to *L. castaniceps.*

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

Family Sylviadæ.

Genus Thamnobia.

Thamnobia fulicata. Indian Robin.

This bird is well known in the Deccan, and is found not only about villages, walls and outhouses, but is also common on low stony hills. Dr. Jerdon says that "its familiar habits have gained for it its name of Indian Robin." It breeds during the months of March, April and May, building its nests in holes of walls and rocks, as also in hollows under tussocks of grass. I subjoin some notes on the subject:—"May 9, 1850. When passing outside the wall of a town, an Indian Robin flew off the wall and hovered before me, uttering a sharp hissing cry. Knowing by her manner that she had a nest near, I searched in the wall and found the nest, composed of rotten grass and straw, and some threads of woollen cloth ; the nest contained three young ones, quite unfledged ; their skin was of a black-lead colour."—"March 19, 1851. Found in a hole in the rocks the nest of the Indian Robin, containing two eggs."—"March 27, 1851. Found the nest of the Robin, containing two eggs, built at the foot of a little tuft of grass, in a hole amongst the roots."

The egg of this bird is of a very pale dusky blue spotted all over with light brown, and a few purplish spots here and there ; length rather more than $\frac{8}{10}$ths of an inch, by $\frac{6}{10}$ths in width.

Dr. Jerdon says: "I have twice seen the nest of this bird ; once, built among a heap of large stones raised from a boury, and the bird made its nest during the time the well was being blasted, and continued the process of incubation till the young ones were hatched, when it was accidentally destroyed. On the other occasion it had built its nest in a hole inside the wall of a house. It has four eggs, light dusky bluish colour, spotted with purplish brown."

* No. 887 of Mr. Hodgson's Catalogue was attached to this bird, which number was previously used for *Loxia himalayana* ; the above number being unoccupied, it is retained for the present species.

Genus Prinia.

Prinia inornata, Sykes. Common Wren Warbler.

I believe that the nest and egg herewith forwarded, are the nest and egg of this little Warbler, though, not having shot the bird from her nest, I cannot say so positively. I think, however, that Dr. Jerdon's observation, though it differs in not mentioning the spots on the eggs, partly corroborates it. He says: "I once procured the nest of this species; it was open at the top, neatly enough made of grass well interwoven, without any lining, and fixed in a low bush very near the ground; it contained four blue eggs." The nest which I forward was found in the midst of some low jungle shrub, about a foot from the ground, during the monsoon. The egg is a little less than $\frac{6}{10}$ths of an inch in length, by rather more than $\frac{4}{10}$ths in width, of a rich blue ground, blotched and spotted with two shades of red-brown and pale purple.

Tribe Conirostres.

Family Corvidæ. Subfamily Corvinæ.

Genus Corvus.

Corvus splendens, Vieill. Common Indian Crow.

All the noise and impudence of the tribe appear to be concentrated in the Common Indian Crow. They abound, I believe, in every part of the Indian continent; and when to their number is added their thievish character, some idea may be formed of the nuisance they are. There is, however, a redeeming point in their character, viz. that they are very efficient scavengers. An officer of the Bombay army told me an anecdote illustrative of their sagacity, which he himself witnessed. Some crows had been sitting near a young dog, watching him whilst engaged with a bone. Having apparently concerted the plan, one of them alighted, stepped up and took a peck at the dog's tail; the dog, irritated, made a snap at the bully; on which a comrade, who appears to have been ready, made a dash and went off with the prize. He told me that he had seen another crow coolly walk off with a bit of bread, having actually taken it out of the hand of a child who was eating it. No one who has not been in India can form an idea of the noise which these crows make. In the morning, in Bombay, the tops of some of the bungalows are covered with them, squabbling and chattering, and it is reported that these black gentry are not proof against the seducing influence of the pots of toddy hanging up in the cocoa-nut trees. The juice of these trees is harmless before the sun is hot, but if taken after, has a decidedly inebriating effect. The common Crow begins to build at the end of April, forming its nest of sticks. It lays four eggs, of a dull greenish-blue, blotched and spotted with greenish-brown and grey, $1\frac{4}{10}$th in. in length by rather more than 1 inch in width. The eggs, however, differ in size and colour.

Corvus culminatus, Sykes. Large Black Crow.

Less numerous, and of less intrusive and impertinent habits than the last. It breeds at the same time, and lays the same number of eggs as the Common Crow of India. The eggs are of a pale blue dashed and spotted with olive and grey, 1 inch and rather more than $\frac{7}{10}$ths of an inch in length, by 1 inch and rather more than $\frac{2}{10}$ths of an inch in width. The eggs of this Crow also vary in size and colour.

Family Sturnidæ. Subfamily Sturninæ.

Genus Pastor.

Pastor Tristis, Temm. Common Myna.

This sprightly talkative bird is common in Western India. It lives in small flocks, and is a close attendant on cattle, walking amongst them with a cheerful upright gait, its head inclined, now on this side now on the other, watching for insects, all the while talking and muttering with its peculiarly smooth and oily note. It is a great favourite with the natives, who keep numbers of them in cages. The Myna breeds during the month of May, making its nest in the holes of trees and buildings, also in stacks and ricks. It lays as many as six eggs, of a pale blue colour, 1 inch and rather more than $\frac{2}{10}$ths of an inch in length, by $\frac{9}{10}$ths of an inch in width. Eggs out of the same nest differ in size.

July 25, 1854.—John Gould, Esq., F.R.S., in the Chair.

Description of a New Species of Momotus. By John Gould, F.R.S. etc.

Mr. Gould exhibited a species of *Momotus*, which he had had in his collection for many years, and which he believed to be entirely new to science. It is most nearly allied to the *Momotus Mexicanus*, but differs from that species in its much larger size, in the deeper chestnut-colour of the head, and in having a greyish-white mark under the eye, in lieu of the rich blue one observable in *M. Mexicanus*. These differences induce Mr. Gould to consider it to be distinct; in which opinion he was greatly confirmed by finding other examples, precisely similar in colour, in the fine collection of the late Earl of Derby, now in Liverpool. He therefore proposed for it the name of

Momotus castaneiceps.

Crown of the head very deep chestnut, gradually blending on the back of the neck into the reddish grass-green of the back and wing-coverts; primaries and secondaries bluish green on the external web and next the shaft on the internal web, the remainder of the feathers being brownish-black, largely margined with buffy-yellow at the base, and with black shafts; upper tail-coverts and tail bluish-green, the latter with black shafts, and the spatulate terminations of the two centre feathers largely tipped with black; lores and lengthened ear-coverts black, the latter bounded above by a narrow line of blue; beneath the eye a narrow streak of greyish-white, bounded above by a finer streak of blue; under surface very pale green, becoming of a still paler and more buffy hue on the vent; on the centre of the breast a few lanceolate pendent feathers of a deep velvety black, narrowly bordered with pale blue; bill black; feet brownish-black.

Total length, $15\frac{1}{2}$ inches; bill, 2; wing, $5\frac{1}{4}$; tail, $8\frac{5}{8}$; tarsi, $1\frac{1}{8}$.

Hab. Guatemala.

On the Anatomy of the Great Anteater (Myrmecophaga jubata). By Professor Owen, F.R.S., V.P.Z.S.

Professor Owen read a paper on the Anatomy of the Great Anteater (*Myrmecophaga jubata*). The animal dissected was a full-grown female; it was received at the Gardens September 29, 1853, and died July 6, 1854. It weighed 62 lbs.; the weight of the brain was 3 oz. avoir. The nipples were two in number, post-pectoral in position; the vulva and vent opened by a common cloacal aperture. The integument was thick; well-developed dermal muscles attached it to parts of the skeleton: the extent and attachments of these were described. The position of the viscera on opening the abdominal cavity was detailed. The intestinal canal is supported by one broad fold of peritoneum, as in reptiles. A long narrow continuous gland extends along the base line of the mesenteric part of the fold, and a parallel series of detached glands along the mesocolic part. Other modifications of the peritoneum were described in relation to the support and connection of other viscera. The stomach consisted of two parts, a cardiac or membranous, and a pyloric or muscular part. The cardiac part is a subglobular cavity, measuring when distended 9 inches in its longest diameter, 7 inches in depth from the cardia, to the left of which the cavity bulges about 4 inches. The circumference of the cavity is 18 inches. The pyloric part is 3 inches in both longitudinal and vertical diameter, $2\frac{1}{2}$ inches across; its muscular part is so thick that it may be called a gizzard: it has not however the thick callous epithelial lining of a true ornithic gizzard.

The lining membrane of the stomach, as compared with that of the œsophagus, becomes more vascular and is furnished with a thinner epithelium at the cardiac orifice; but the lining membrane for some distance from that orifice, and between it and the entry to the gizzard, is smoother and covered by a thicker layer of epithelium than in the rest of the cardiac cavity, where the ordinary vascular villous gastric surface prevails: the one modification passes insensibly into the other. When fully distended, the cardiac cavity is smooth; as it contracts, the lining membrane falls into rugæ, very minute and irregular near the cardia, thicker and larger at the greater curvature, and assuming a longitudinal direction as they approach and converge towards the entry to the gizzard: at this part the folds were ten in number. In the distended stomach of the female Anteater the transverse diameter of the aperture was 1 inch 3 lines; its vertical diameter from 3 to 4 lines; the distance from it to the cardia, 3 inches.

In the smaller male Anteater, subsequently dissected, the gizzard was 2 in. 3 lines in length and 2 in. 9 lines in depth.

Vertically and longitudinally bisected, the cavity of the gizzard appeared as a gently bent canal about a line in diameter, suddenly expanding near the pylorus to receive a valvular prominence from the upper muscular wall, which projected towards that opening. The vertical thickness of the muscular wall above the canal was 1 inch 10 lines, below the canal 1 inch.

In the female Anteater Prof. Owen divided the gizzard, previously injected and distended with alcohol. When the gizzard was divided vertically and transversely the cavity presented a crescentic figure, with the horns directed upwards, on each side a large fleshy protuberance which descended into the cavity. On the lower part of the protuberance are three or four thick angular longitudinal ridges, which fit into the interspaces of similar ridges along the lower part of the cavity. The epithelium of the protuberance is thicker than that of the rest of the cavity, concealing in a greater degree, but not wholly, the vascularity of the subjacent injected membrane: the cellulo-vascular layer uniting the mucous with the muscular coats is most abundant at the walls of the gizzard opposite the protuberance. The thickness of the muscular wall, from the upper part of the gizzard to the bottom of the protuberance, is 2 inches, that of the lower wall of the gizzard 6 lines: the difference of thickness here, as compared with the same part in the smaller Anteater's stomach, is due to the more contracted state of the gizzard in the latter animal.

On exposing the pylorus from the duodenal side, it presents the form of a crescentic aperture 1 inch in diameter, but reduced to a transverse figure by the pressure of the upper protuberance against its inferior thickened ridge: the mucous membrane of both parts is produced into longitudinal wavy rugæ. A second pylorus might be described where these rugæ abruptly terminate and where the smooth surface of the duodenum begins: this aperture presents a full oval form, 1 inch 2 lines by 9 lines, when that intestine is distended.

The length of the animal, from the muzzle to the vent, was 4 feet 7 inches; the length of the head, 14 inches; of the tail, 33 inches. The length of the intestinal canal was 34 feet, the small intestines measuring 30 feet. The ileum, with a circumference of 1 inch 9 lines, rapidly expands at its termination to form the colon, without any cæcal beginning of the latter gut. This presents a circumference of $9\frac{1}{2}$ inches near its commencement, and gradually decreases to a circumference of 6 inches at the rectum. The inner surface of the first half of the small intestines is smooth and even; the last half, or ileum, is characterized by a single continuous longitudinal fold of the mucous membrane from 2 to 3 lines in breadth, extending along the side of the gut opposite the attachment of the mesentery. The modifications of the colon and rectum were described.

The weight of the liver was 28 oz.; that of the spleen, 2 oz. 6 drachms; that of the pancreas, 2 oz.: the form and structure of these viscera and of the gall-bladder were described. The renal and generative organs were next referred to.

The disposition of the pleura in the thorax, and the form and structure of the thoracic viscera were detailed. A peculiarity was noticed in the right auricle of the heart: the entry of the inferior cava was guarded as usual by the eustachian valve, the homologue of the posterior of the two semilunar valves which guard the communication between the sinus and the auricle in the heart of Reptiles; in the great Anteater there is a narrower valvular fold or ridge on the opposite side of the orifice of the inferior cava, answering to the anterior valve in the Reptiles' auricle, and a ridge is continued from both valves in the Anteater, towards the opening of the superior cava.

Of the salivary glands of the Anteater the submaxillary pair were those most developed and modified to supply the unusual quantity of adhesive saliva with which the long, slender and moveable tongue is bedewed: these glands extended over the fore part of the neck and chest, and were upwards of 16 inches in length and 2 inches in thickness.

The parotid gland retained its ordinary proportional size and relative position. The sublingual gland was represented by an extensively diffused thin layer of follicles, opening by many small pores upon the inner surface of the mouth. The labial glands were small, as were also the tonsils.

The muscles of the jaws were described.

The cavity of the mouth is susceptible of great dilatation, and presents the peculiarity of being extended far back beyond the root of the tongue. The author accordingly defines, in his description, a postlingual and a prelingual part of the mouth. A hard longitudinal cartilaginous ridge projects downwards into the mouth from the inner side of each ramus of the jaw. The author conceives that the termites may be crushed by the action or pressure of the tongue against those callous ridges, which seem to occupy the place of teeth. A fossa descends between the epihyals, which the author called the epihyal pouch. The hyoid arch has no immediate connection with the tongue, but is situated far behind the tongue, preserving its usual relations with the larynx.

The thyroid is ossified; the cricoid and arytenoids are cartilaginous.

The total length of the nasal passages is 22 inches, the last 8 inches being muscular and membranous, and extended backwards beyond the base of the skull, where the canals terminate in most other mammals.

The antero-posterior diameter of the base of the tongue was $3\frac{1}{2}$ inches; it rapidly diminishes to a cylindrical form, with a diameter of 8 lines, and is thus continued for 18 inches, gradually decreasing to its obtuse apex, which is 1 line in breadth. This long cylindrical tongue is composed almost wholly of muscular fibres, and covered by a smooth epithelium; the only papillæ are two fossulate ones (*papillæ* *vallatæ*) on the dorsum, about 2 inches in advance of the frenum; the muscles of the tongue and their action were minutely described; also those of the larynx and pharynx.

The brain, which weighed only 3 oz., presented a narrow, elongated, depressed form, the back part of the cerebral hemispheres resting against, but not overlapping, the cerebellum. The hemispheres showed a few symmetrical convolutions; they were united by a large corpus callosum: the olfactory lobes are very large and hollow. Many plexuses and other peculiarities of the vascular system were noticed.

This memoir will appear, illustrated with numerous figures, in the Transactions of the Society.

Descriptions of Two New Tanagers in the British Museum. By Philip Lutley Sclater, M.A.

1. Chlorospingus melanotis, Sclater. *C. supra nigro-plumbeus, dorso imo brunnescentiore: alis caudaque brunnescentibus, illis penitus nigricantibus: loris et capitis lateribus cum regione auriculari nigris: subtus pallide ochraceo-rufus, mento summo nigricante; ventre medio dilutiore: rostro nigro: pedibus pallidis.*

Long. tota 5·25 poll., alæ 2·5, caudæ 2·25.

Hab. in Nova Grenada. Mus. Brit.

Obs. Species rostro et forma *Chlorospingo atropileo* similis, sed ab hoc et aliis hujus generis colore corporis inferi *ochraceo-rufo* facile distinguenda.

This little species, of which there are two examples in the National Collection, both apparently Bogota skins, differs from all its congeners in the colouring of the lower surface of the body, which is of a pale reddish buff, growing much whiter in the middle of the belly. Above the plumage is lead-coloured, with a greenish tinge superinduced towards the lower part of the back. The wings and tail are brown, with slight greenish edgings; the ear-coverts and whole side of the face are black. In the second specimen, apparently not so mature, there is a light-coloured spot on the front, just above the nostrils. The bill of this species agrees with that of *Chlorospingus atropileus*, (Lafr.), in size, but is rather straighter in form, as in *C. verticalis*, (Lafr.).

2. Tachyphonus xanthopygius, Sclater. *T. nigro-cinereus, subtus dilutior: axillis et tectricibus subalaribus albis: dorso postico citreo-flavo: rostro et pedibus nigris.*

Long. tota 5·8, alæ 3·1, caudæ 2·5.

Hab. in Nov. Grenada. Mus. Brit.

This bird seems intermediate between *Tachyphonus* and *Pyranga*, and might be placed in either of these groups. The white axillary feathers point to the former genus, the yellow rump to the latter. The bill, however, is more compressed than is usual in *Pyranga*, and agrees nearly with that of *Tachyphonus coronatus*, (Vieill.). The upper plumage has a mottled appearance, caused by the feathers being centrally black and broadly edged with cinereous. In the middle of the back is a perceptibly greenish gloss. The only examples I have seen of this as of the former species are in the British Museum, where Mr. G. R. Gray's uniform kindness affords me every opportunity of studying the collection under his care.

MISCELLANEOUS.

Bohemian Forests and Peat-bogs. By Dr. Hochstetter*.

The primitive forests on Prince Schwarzenberg's domain, viz. at Krumau, Winterberg, and Stubenbach, may at a considerable distance be easily distinguished from the cultivated and regularly cut forests by their irregular and angular outlines; whilst the cupola-shaped summits of the firs rise considerably above the pyramidal pine-tops. Seen from an elevation, the difference between the primitive forest, with its withered tops and somewhat scattered trees, and the compact and verdant cultivated forest, is still more striking.

In some localities in the interior of the forests, the trees stand in straight lines of 150 to 200 feet [= 155·55 to 207·4 English feet] in length, as if planted so. Wherever the seeds do not find in the deep vegetable soil a site favourable for germination, their growth is exclusively confined to the roots and prostrate stems in a state of decomposition. Long after these stems have completely rotted away, their original length and situation are visible from the rectilinear arrangement of the younger trees, growing in the mouldering substance of the decayed veterans. This growth of the young plant on the decaying roots and stems serves also to explain the frequent occurrence of trees supported above the ground by means of exposed columnar roots, and, as it is termed, "standing on stilts."

The age of the pines and the firs in the primitive forests reaches as much as 300 to 500 years; the pines grow occasionally to 200 feet in height, and contain 1900 cubic feet [= 2118·5 English cubic feet] of wood in their stem alone. One of the finest of the firs, 30 feet [= 31·11 English feet] in circumference at a man's height, stood in the Brandelwald, near Unter-Muldau; it was lately blown down, and it is estimated to contain 30 klafters [= 3012·03 English cubic feet] of fire-wood. Besides pines and firs, the forests in question contain beeches, maples, elms, birches, willows, and some, but very few, yew trees.

At present the extent of Prince Schwarzenberg's primitive forests is estimated at 30,000 Austrian acres [= 42,560 English acres]; and the quantity of wood in them at $6\frac{1}{2}$ millions of klafters [= 652,606,500 English cubic feet]. A large portion of the wood from these forests is consumed in the neighbourhood for the use of the glass-furnaces,

* From the Proceedings of the Imperial Geological Institute of Vienna, Jan. 23, 1855. Translated and communicated by Count Marschall.

and for the fabrication of musical instruments and touchwoods; but the major part is floated to the lower countries for timber and for fuel. Large quantities of the timber are sent annually to England and Hamburg for ship-building.

Rapacious animals, as bears, wolves, and lynxes, were formerly very abundant in the Böhmer-Wald, but have been exterminated. A bear, the last of its race, is supposed to be still haunting the Jokuswald, near Salnau.

The beds of peat or bituminous turf, locally denominated "Auen" or "Filze," may be considered in connexion with these old forests. The whole upper part of the Moldau Valley, as far up as the neighbourhood of Ferchenhaid, for an extent of 7 Austrian miles [=32·998 English miles], and with an average breadth of $\frac{1}{4}$ Austrian mile [=1·178 English mile], is one continuous peat-bed, traversed by the windings of the Moldau, whose waters assume a brownish tint by dissolving the extractive substances of the peat.

In the mountainous parts the peat-deposits are more isolated, amid surrounding forests. The dense vegetation of pumilous birches and pines covering their surfaces attests their antiquity, and points to their analogy with the primitive forests. Lakes occur in the centre of the peat-beds near Innergefild and Ferchenhaid. A swimming island, probably owing its origin to the central swelling and bursting of the peat, is seen in the last-named locality.

Cultivation is busy converting the peat-beds into forests, meadows, and arable-fields. These deposits, however, are of great importance in the economy of nature, and it may become a question of national economy how far this cultivation may proceed without injurious consequences. The climatal and meteorological influence of the peat-beds is the same as that of the forests; they even act with more energetic and concentrated effect. By acting as natural sponges in periods when water is abundant, they attract the superfluous humidity, and so prevent inundations. In seasons of drought they give up their accumulated waters. They are the real water-reservoirs in mountainous regions; generally giving rise to the rivulets and rivers, and keeping their water-level constant during every season.

OCCURRENCE OF DIODONTA FRAGILIS AT WEYMOUTH.

To the Editors of the Annals of Natural History.

Weymouth, October 23, 1855.

Gentlemen,—I beg to record Weymouth as a habitat for that very local Mollusk, *Diodonta fragilis*, having some short time since picked up a living specimen on the sands in front of the Esplanade. It measures $1\frac{1}{8}$ inch in width, and is in excellent condition. I should have announced it before, but the fact was, it had been placed in a drawer with other shells *to be examined*, and I was not aware of the prize I possessed until it was pointed out by my friend Mr. H. Adams.

I have also lately taken alive, attached to a piece of *Eschara foliacea* by a *byssus*, a fine specimen of *Galeomma Turtoni*.

Mr. Coode has also dredged a specimen of *Tritonia* (? *Hombergii*). The following were my rough notes on its appearance :—

"*Tritonia* (? *Hombergii*). A specimen 4 inches in length, taken by Mr. Coode and Mr. Stanley in fifteen fathoms water, off Lulworth. Colour marble-brown. Head-veil at times bilobed, at other times entire. The margin of veil not fimbriated, but closely set with tentacular points. Branchiæ in about a dozen tufts on each side of the back. Dorsal tentacles issuing from sheaths having their edges jagged. It appears to me to be intermediate between *T. Hombergii* and *T. plebeia*."

I am, Gentlemen, yours obediently,
William Thompson.

Description of a second species of the genus Procnias. By Philip Lutley Sclater, M.A.

I have seen several examples of *Procnias* in collections from New Grenada, and have never doubted their being different from the Brazilian species. But being aware that a second member of the genus had been described by Dr. Cabanis in the Museum Heineanum under the appellation *Procnias Heinei*, I applied that name to these birds without much inquiry. Having lately, however, had the opportunity of examining the beautiful collection which contains the type of Dr. Cabanis' description, I find that I was in error in so doing. The specimen there designated *Procnias Heinei* is a female or young male of *Calliste atricapilla*, Lafr., and belongs therefore, according to my ideas, to a different family of birds.

I therefore propose the name *Procnias occidentalis* for this new species, which may be distinguished from the older one by its smaller size, the less amount of black on the throat, and by the white belly not extending nearly so high towards the breast.

Procnias occidentalis, Sclater. *P. læte viridis : fronte anguste et lateribus capitis cum mento gulaque nigris : ventre medio crissoque albis : lateribus nigro radiatis : alis caudaque intus nigricantibus.*

Long. tota 5·0 ; alæ 3·3 ; caudæ 2·9 poll. Angl.

Hab. in Nova Grenada.—*Proc. Zool. Soc.* Nov. 14, 1854.

Descriptions of some New Species of Birds. By the Viscount Du Bus de Gisignies.

1. *Lanio auritus.* Mas. L. nigerrimus, subtus nigro-fuliginosus ; supercilio tenuissimo albo, pone oculos in penicillum auricularem rubro-igneum prolongato ; humeris et tergo flavissimis ; tectricibus alarum inferioribus, fasciculoque plumarum elongatarum axillari candidis. Rostro et pedibus nigris.

Fem. Nigro-fuliginosa, in dorso subvirescens; subtus cinereo-ardesiaca; supercilio, penicilloque auriculari nullis; tergo flavo; tectricibus alarum inferioribus, fasciculoque axillari candidis.

Total length $16\frac{1}{2}$ centim. (about $6\frac{1}{2}$ inches).

Hab. Columbia.

Only three true species of *Lanio* are yet known. The present bird appears to me to be best placed in this genus, although, in some respects, it differs a little from the other species. It is distinguished from these by a different coloration, and is especially remarkable from the superciliary streaks, which are white at their origin near the nostrils, become fiery-red on a level with the eyes, and extend backwards at the sides of the nape in the form of little tufts of somewhat elongated plumes, which the bird probably elevates at pleasure.

2. *Pipilopsis cristata.* P. supra flavicanti-olivacea, uropygio paulum dilutiore; capite cristato supra griseo, jugulo et genis griseo-canescentibus; pectore et abdomine læte croceo-flavis; remigibus et rectricibus brunneis, olivascente extus limbatis. Rostro corneo; pedibus fuscis.

Total length 17 centim. (about $6\frac{4}{5}$ inches).

This species, a native of Columbia, has somewhat the colour and form of *Arremon rubrirostris*, Lafr., by the side of which, it appears to me that it should be placed. It is larger and more robust, and its head is adorned with a crest.

3. *Buarremon latinuchus.* B. supra obscure cinereus; pileo toto et cervice rufis; lateribus capitis nigris; subtus viridi-flavus, ventre dilutiore, hypochondriis et crisso cinereo-flavidis; alis et cauda subnigris; remigum primariarum basi albida. Rostro nigro; pedibus fuscis.

Total length 18 centim. (about $7\frac{1}{5}$ inches).

This species, which I believe to be new, comes from Columbia and Peru. It has all the characters of a well-circumscribed small group of birds inhabiting those countries, including *Arremon schistaceus*, *pallidinuchus* and *albofrenatus*, Briss., and *A. gutturalis*, Lafr., as well as *Embernagra rufinucha* and *albinucha*, D'Orb. It will therefore form the seventh species* of this group, and is positively distinct from all the others, although it presents a good deal of resemblance to some of them, especially the *A. pallidinuchus*, Briss., and the *E. rufinucha*, D'Orb.

Its particular distinction from the latter is the absence of the black streak on the sides of the throat at the base of the upper mandible. It differs from the first especially in having the red of the top of the

* All the species above mentioned are well known to me. But I regret that I have not been able to procure the *Atlapetes pileatus*, Wagl., the type of its genus, and the *A. rubricatus*, Cab., which I have never seen, and which, although natives of Mexico, would appear to belong to the same genus as the seven species here indicated. If this be the case, the genus *Atlapetes* would now consist of these nine species.

head bright and uniform, and instead of being narrower, it widens in descending upon the nape and the back of the neck.

4. *Nemosia torquata.* Mas. N. supra, cum capite toto, nigerrima; semi-torque collari postico nitide flavo; interscapulio medio, tergo, jugulo, pectore et hypochondriis nitide virescenti-flavis; abdomine medio et crisso albidis; tectricibus alarum minoribus et mediis cyaneis; remigibus et rectricibus nigris, cæruleo extus limbatis. Rostro corneo, mandibulæ basi pallida; pedibus obscuris.

Total length $11\frac{1}{2}$ centim. (about $4\frac{3}{6}$ inches).

The native country of this pretty species is New Granada. It has all the characters of the true *Nemosiæ*, but with a rather more slender and very slightly arched bill. Its colours are brighter and resemble the glossy and brilliant tints which adorn some species of the genus *Calliste*, especially the *C. cyanoptera*, Sw.

5. *Euphonia longipennis.* Mas. E. nitens, viridis; semi-torque postico, uropygio et oculorum margine cyaneis; interscapulio et tergo cyaneo-maculatis; abdomine cum hypochondriis et crisso lætissime aureo-flavis; remigibus rectricibusque nigris, viridi extus limbatis. Rostro nigro, basi cærulescenti; pedibus fuscis.

Fem. Interscapulio et tergo viridibus, absque maculis cyaneis; uropygio dilute cyanescenti-viridi; epigastrio et hypochondriis flavescenti-viridibus; ventre et crisso flavidis.

Total length 9 centim. (about $3\frac{3}{5}$ inches).

Hab. Antioquia, in New Granada.

This little *Euphonia* is so nearly allied to *E. viridis*, Vieillot, that it is difficult to distinguish it, without comparing individuals of the two species. However, it appears to me to be sufficiently characterized by its small size, the difference between the two species being at least a fifth, whilst its wings and tarsi are longer in comparison, as they are of the same actual length as those of the other species. Thus in repose, the point of the longest primary feather in *E. longipennis* reaches the extremity of the tail, whilst in *E. viridis* it does not attain half the length of the tail.

The *Chlorophonia frontalis*, Bp., is also very similar to the two species above mentioned; but it is less difficult to recognize, because the forehead is always yellow, and the back is never blue.

6. *Euphonia plumbea.* E. griseo-plumbea, viridi micans; abdomine et crisso aureo-flavis. Rostro albicante, apice corneo; pedibus cinereo-fuscis.

Total length $8\frac{1}{2}$ centim. (about $3\frac{2}{5}$ inches).

Hab. New Granada.

This is one of the smallest, if not the smallest species of the genus. It is very easily recognized by its uniform grey colour, except on the belly. In this respect it resembles *E. jamaïca*, Linn., but differs widely from it in its small size, and especially in the form and proportions of the bill, which is slightly depressed, and presents a considerable resemblance to that of *E. chlorotica*.—*Bull. de l'Acad. Roy. de Belgique*, 1855, vol. xxii. pp. 153–156.

Description of a new species of Petrogale. By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

Yellow-legged Rock-Kangaroo, *Petrogale xanthopus.*

Pale brown, minutely grizzled; chin and beneath white: streak on side from the back of shoulder, and along the side of the face under the eye, whitish; dorsal streak narrow, brown; legs, feet, and tail bright yellow; end of tail more bushy and varied with brown.

Australia (Richmond River?)

This species has all the markings as in *Petrogale lateralis*, but differs in being of a much paler and yellower colour, and in the bright yellow colour of the legs and basal part of the tail. It is about the same size as *P. penicillatus*, or rather between it and *P. lateralis*.

There are two specimens of this species (male and female) procured by Mr. Strange.—*Proc. Zool. Soc.* Nov. 14, 1854.

METEOROLOGICAL OBSERVATIONS FOR SEPT. 1855.

Chiswick.—September 1. Clear and fine: cloudy. 2. Cloudy. 3. Clear: slight shower: fine. 4. Cloudy. 5. Fine: cloudy: clear and cold at night. 6. Clear: cloudy. 7. Very clear: cloudy: fine. 8. Dense fog: clear and very fine. 9. Very fine. 10. Foggy: fine: very clear. 11. Very fine. 12. Slight fog: very fine: clear: rain at night. 13. Rain. 14. Constant rain. 15. Uniformly overcast: fine. 16. Overcast: clear and fine. 17. Rain: hazy: overcast. 18. Hazy: overcast. 19. Slight haze: fine. 20—22. Foggy in the mornings: very fine. 23. Fine: cloudy: very clear. 24. Overcast. 25. Fine: cloudy: clear: frosty at night. 26. Slight haze: very dry air: frosty at night. 27. Foggy: very fine: loudy. 28, 29. Cloudy: rain. 30. Hazy: cloudy: rain at night.

Mean temperature of the month	56°·11
Mean temperature of Sept. 1854	56 ·93
Mean temperature of Sept. for the last twenty-nine years ...	56 ·98
Average amount of rain in Sept.	2·503 inches.

Boston.—Sept. 1. Cloudy: rain P.M. 2—6. Cloudy. 7, 8. Fine. 9, 10. Cloudy. 11, 12. Fine. 13. Fine: rain A.M. 14—18. Cloudy. 19, 20. Fine. 21, 22. Cloudy. 23. Fine. 24. Fine: rain A.M. 25. Cloudy. 26, 27. Fine. 28. Fine: rain P.M. 29. Cloudy: rain A.M. 30. Cloudy.

Sandwick Manse, Orkney.—Sept. 1, 2. Bright A.M.: cloudy P.M. 3. Cloudy A.M. and P.M. 4. Bright A.M.: clear P.M. 5. Showers A.M.: clear P.M. 6. Drizzle A.M. and P.M. 7. Cloudy A.M.: showers P.M. 8. Clear A.M.: showers P.M. 9. Bright A.M.: showers P.M. 10. Cloudy A.M.: showers, aurora P.M. 11. Showers A.M.: cloudy, aurora P.M. 12. Rain A.M.: clear, aurora P.M. 13. Cloudy A.M.: clear P.M. 14. Cloudy, hoar-frost A.M.: clear, aurora P.M. 15. Bright, hoar-frost A.M.: cloudy P.M. 16. Showers A.M.: clear P.M. 17, 18. Showers A.M. and P.M. 19. Cloudy A.M.: drops P.M. 20. Cloudy A.M. and P.M. 21. Showers A.M.: drizzle P.M. 22. Damp A.M.: drizzle P.M. 23. Cloudy A.M.: clear, fine P.M. 24. Clear A.M.: fine, cloudy P.M. 25. Cloudy A.M.: fine, drops P.M. 26. Drops A.M.: fine, clear P.M. 27. Drops A.M.: cloudy P.M. 28. Drops A.M. and P.M. 29. Rain A.M.: fog P.M. 30. Fog A.M. and P.M.

Mean temperature of Sept. for twenty-eight previous years ...	52°·42
Mean temperature of this month	52 ·74
Mean temperature of Sept. 1854	55 ·07
Average quantity of rain in Sept. for fifteen previous years ...	2·81 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.
1855. Sept.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	30·346	30·282	29·83	30·34	30·50	68	45	62	55½	53	nw.	n.	nw.	....	....	·04
☾ 2.	30·315	30·146	29·88	30·42	30·34	67	45	60	56½	55	n.	nne.	w.	....	·04	....
3.	30·131	30·058	29·75	30·27	30·17	71	50	60	57	54	ne.	nne.	w.	·02	....	....
4.	29·997	29·962	29·60	30·06	30·16	68	44	61·5	55	46	nw.	nne.	nw.	·01	....	....
5.	30·018	29·987	29·60	30·23	30·29	64	42	59	48	44	ne.	n.	nw.	....	....	·07
6.	30·274	30·226	29·35	30·36	30·37	62	36	52·5	51	51	ne.	nnw.	w.	....	....	....
7.	30·445	30·385	30·05	30·22	30·30	66	28	50·5	53	54	ne.	nnw.	ssw.	....	....	·02
8.	30·429	30·199	29·90	29·85	29·90	74	33	53·5	56	52½	sw.	w.	w.	....	....	·05
9.	30·164	30·100	29·65	29·96	30·05	73	33	60	54	52	w.	n.	wnw.	....	....	·05
10.	30·122	30·050	29·69	29·98	29·86	70	36	57	58	53½	e.	nw.	ssw.	....	....	·03
● 11.	30·055	30·051	29·61	29·79	29·94	72	37	55	56	53	ne.	nw.	w.	....	....	·15
12.	30·161	30·059	29·71	29·91	30·04	73	39	54	54	49	w.	nw.	nnw.	·02	....	·21
13.	29·976	29·919	29·54	30·15	30·15	69	50	59	50½	44	sw.	s.	ne.	·10	·13	·08
14.	30·007	29·926	29·55	30·06	30·02	54	45	57	49½	42	ne.	nne.	ese.	·32	....	....
15.	30·093	30·090	29·68	29·93	29·82	64	45	52	52½	50	sw.	nw.	sse.	....	....	....
16.	30·133	29·954	29·47	29·72	29·78	68	54	62	52½	51½	w.	wsw.	w.	·04	....	·21
17.	30·026	29·944	29·58	29·71	29·70	62	55	56	54½	52½	e.	wsw.	w.	·06	....	·11
18.	29·952	29·941	29·46	29·60	29·61	69	54	61	55½	51½	sw.	s.	w.	....	....	·15
☽ 19.	30·042	29·965	29·50	29·78	29·70	68	47	61	52½	53	ne.	n.	s.	....	....	·18
20.	30·130	30·112	29·58	29·73	29·77	75	44	58	56	59	sw.	sw.	ssw.	....	....	·07
21.	30·256	30·242	29·72	29·82	30·02	74	45	59	59½	55	sw.	w.	calm	....	....	·05
22.	30·274	30·237	29·80	30·12	30·32	75	41	56	59½	54	e.	n.	wnw.	....	....	·05
23.	30·250	30·229	29·77	30·46	30·55	76	55	60	53	48	e.	nne.	nnw.	....	....	....
24.	30·436	30·413	29·96	30·55	30·46	65	42	57·5	52	49	ne.	nne.	sse.	....	·03	....
○ 25.	30·430	30·305	29·96	30·27	30·14	65	27	58	52½	55½	e.	sse.	sse.	....	....	....
26.	30·247	30·091	29·70	29·99	29·98	61	26	50	53½	51	e.	sse.	wsw.	....	....	....
27.	29·972	29·752	29·50	29·82	29·58	74	51	56	54	51½	sw.	sse.	se.	....	....	....
28.	29·669	29·446	29·18	29·32	29·45	72	56	60	57½	52½	sw.	sse.	nne.	·32	....	....
29.	30·024	29·538	29·13	29·60	29·72	73	55	61·5	54	55½	se.	s.	ese.	·08	·10	·21
30.	29·505	29·423	29·04	29·75	29·70	68	47	63	56	53	se.	e.	se.	·10	....	·01
Mean.	30·128	30·031	29·29	29·992	30·013	68·66	43·56	57·7	54·30	51·18				1·15	0·30	1·74

THE ANNALS

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XXXIII.—*On the Batrachian* Ranunculi *of Britain.* By Charles C. Babington, M.A., F.R.S. &c.*

It is with much diffidence that I venture to attempt the elucidation of the Batrachian Ranunculi of Britain, for the great difficulty of the subject necessarily presses heavily upon the mind. Also, it cannot be otherwise than disheartening to feel, that however successful I may be in my own estimation and even in that of my friends, and, that although my endeavours may result in a close approach to the acquaintance with the plants that has been attained in Sweden and France, it is certain that several of the most eminent of the botanists of Britain will consider that I have been wasting my time and retarding rather than advancing science. Had the views of those learned men been generally held by persons of equal scientific rank in other countries, I should have thought it my duty to adopt them; but as several of the most distinguished botanists of continental Europe do not think that they are "idling away their time by catching at shadows," when they expend it upon an earnest endeavour to attain the most accurate possible knowledge of the plants inhabiting their respective countries, I am led to the belief that I am really doing well when trying distantly to follow their example.

It has been justly remarked, that we have no good definition of a species amongst plants, and that it is hard or even impossible to apply those which we possess. Until species can be defined, each botanist is left to judge as best he can of what ought or ought not to be so considered. In the case which is about to be

* Read to the Botanical Society of Edinburgh, Nov. 8, 1855.

presented to the reader, I have been led, or rather driven to the conclusion that the forms described below are species, by having had most of them under my observation in a growing state for several years, and finding them to continue constant in their characters when raised from seed under varying circumstances through successive generations: also, by remarking that they not only possess permanent definable distinctions, but present such differences at first sight as to enable the practised eye to distinguish them easily. Surely, in such a case, the minuteness or obscurity of the structure upon which the technical character is founded can be no just argument against the claims of the plants to be considered as entitled to specific rank. Neither can we accept as conclusive against them the fact that some eminent botanist, such as Smith (Eng. Flora, iii. 55), has combined them under two names; or, Seringe "long ago recorded his decided opinion, that all were mere varieties of one species." Neither Seringe (Mélanges Botaniques, ii. 8 & 49) nor Schlechtendal (Animadv. Bot. in Ran. 8), who is also used as an authority by those who persuade themselves that all these plants form only one species, appears to have had any knowledge of the characters that are now employed in this group of plants; and I think that no botanist of the present day lays stress upon the hairiness or smoothness of the plant or its capsules; neither would plants be considered as distinct solely on account of the presence or absence of the broad floating leaves. It is nearly certain that several of the species (as I consider them) that are to be described presently (viz. *R. heterophyllus, R. Baudotii, R. floribundus*) would each afford a series of forms, extending from a state in which there are no capillarly-divided leaves to one consisting solely of them, similar to that recorded by Schlechtendal under the name of *R. aquatilis*. The existence of such series assuredly rather tends to prove that there are several species of *Batrachian Ranunculi* than that they are all of one species. Doubtless it requires a considerable familiarity with the plants to enable a person to refer all these forms to their proper species, and mistakes are very frequently made in attempting to do so. Also innumerable errors and difficulties arise when names are required to be given to scraps, such as are often collected and preserved even by good botanists.

We are told that a series of specimens from all parts of the world proves that there is only one species of *Batrachian Ranunculus*. Doubtless it would be easy to form a series apparently justifying such an opinion, but our success in so doing does not seem necessary to prove the non-existence of several species; for it may, and I believe has, happened in many such cases that the supposed connecting links are single specimens of distinct species, which consist of multitudes of similar individuals in their native districts, although only one or two may have been preserved in the herbarium employed for study. Let the living plants be carefully examined in a country, such as Britain, where they are numerous, and if, after an unprejudiced endeavour to arrive at the truth, they prove undistinguishable, then let them be combined. But if, as my observations lead me to believe, the best known of them are quite constant in their form and habit, it does not seem to be the pursuit of truth that leads to their neglect, but rather the adherence to a preconceived theory. Take as an example the *R. circinatus*: this plant inhabits the most different situations, growing upon a muddy or gravelly bottom, in swift streams or stagnant ditches and pits, in water or on mud, and yet the well-known structure of its leaves is invariable.

Many years since it fell to my lot to attempt to controvert the opinion then prevalent in England, that the *R. aquatilis, R. circinatus* and *R. fluitans* formed one species (Ann. Nat. Hist. Ser. 1. vol. iii. p. 225–230), and I showed conclusively, as I venture to think, that the depth, motion, or stagnancy of the water in which they grow has nothing whatever to do with the size, shape or structure of the leaves, nor with the direction of them. Of course certain slight alterations are the result of the circumstances in which the plants are placed, but they are not such as to affect the characters upon which the species are founded. In doing this I was performing little more than restoring to recognition in this country species known to Ray, and defined and named according to the Linnæan method by Sibthorp. On the European continent several eminent men had already adopted them. Since that date my attention has been often turned towards these beautiful plants, and during the last few years I have made them a special subject of study. Within the same period, such men as Fries, Koch, Godron, Cosson and others, have been led to think that the *R. aquatilis* required further subdivision. Accordingly many attempts have been made to do so with greater or less success, and it is a cause of much satisfaction to me to find that, with a single exception, the British species have already been detected and described in other countries. That those botanists should have arrived at different conclusions, and even changed their opinions once or more, is certainly not a valid excuse for neglecting the study in which they have partially failed; for in this, as in all other departments of knowledge, correct results are not usually attained until after many attempts. Let it not be thought from these remarks that I claim to have succeeded; for all that I propose to myself is to make a small step towards success, and to place before those who may follow up the study a few additional facts, or an improved application of those already known.

In this group of plants we are not acquainted with any single character which may safely be stated to be always deserving of confidence; but if a combination of several characters is employed, there will rarely be any serious difficulty in identifying the supposed species, even when the structure of some of the parts has undergone change. The look of the plant is generally distinctive of the species; and the difficulties commence when an attempt is made to draw up technical definitions, or to determine the names from "specific characters." Such is found to be the case in most groups of closely allied species inhabiting the "metropolis," as it has been called, of extensive and difficult genera. We may call the plants varieties or hybrids, but, until they are proved to be such, we are only avoiding a difficulty, not stating a fact in science.

Having made these preliminary observations, I will now endeavour to point out the characters upon which we seem to have the most reason for placing dependence in preparing specific characters for the *Batrachian Ranunculi*.

It has long been known that the absence of hairs from the receptacle, and of any submersed and filiformly-divided leaves, distinguishes *R. hederaceus* and its more recently noticed ally, *R. cœnosus*, from the rest of our native species. It was pointed out by Sibthorp, that the submersed leaves of *R. circinatus* and *R. fluitans* had a different form from those of *R. aquatilis*, under which latter name he included plants which I have failed in reducing to less than eight species. In these latter plants (*i. e.* the *R. aquatilis* of Sibthorp), the submersed leaves are formed of repeatedly-dividing filiform or setaceous parts, which spread in such a manner from their first division, where the leaf trifurcates, as to take the shape of a greater or less segment of a sphere. These three divisions of the leaf are forked at very short or more distant intervals; they are fine or rather thick, rigid or flaccid, and accordingly retain their direction when taken out of the water, or collapse so as to resemble a painter's pencil.

In all the species, the floating or emerged leaves have an outline which is nearly circular, or only forms part of a circle; they are divided more or less deeply into lobes, or quite to the top of their petioles into leaflets; in some cases these leaflets have partial petioles of a considerable length, and then the circular outline of the whole leaf is not apparent. When the leaf is formed of lobes or sessile leaflets, the outer margins of the lateral lobes or leaflets, that is, the outer margins of the leaf, are either straight from their base throughout a considerable part of their extent, or their lower part is much rounded; therefore the leaflets are wedge-shaped or obovate.

In most of the species, the peduncles spring from the same nodes as both the divided and submersed, and the flat and floating leaves; but in the plant called *R. peltatus* in this paper, they are very rarely produced in the former situation; so rarely, as to have caused Fries to denominate the floating leaves "folia necessaria" in that plant. The peduncles either about equal the leaves or much exceed them, and then raise the flowers considerably out of the water. They are either equally thick throughout their length, or narrow more or less gradually towards the flower.

The petals are either broad with many veins, or narrow and usually few-veined. In the former case, the edges of contiguous petals are close together, and often overlap; in the latter, they are usually distant, and give what I have called a star-like appearance to the flower. As the flowers of the broad-petaled species advance towards decay, they acquire a slightly similar look; for the petals, which had originally a rounded form, lengthen so much that their lower part becomes wedge-shaped, and the flower rather star-like.

In two of our species, the stamens are so short as to be exceeded by the pistils, but usually they conspicuously overtop those organs.

Although the stigma varies in shape, it is not easy to apply this difference to the discrimination of the species, for it changes its form as it acquires age.

Not much dependence should be placed upon the position of the style, for apparently it generally forms a continuation of the inner, or nearly straight side of the ovary.

The carpels differ much in shape, but usually form the half of an ovate or obovate figure; the inner or upper edge is usually almost straight, but not always so, and then the carpel is often nearly ovate or obovate. On these latter forms of carpel, the persistent base of the style, or slight apiculus that represents it, nearly terminates the diameter of the carpel; but on the others it usually is connected with the straight side, being placed at its end, but forming an angle with it. The carpels are usually compressed laterally, and their coats closely enclose the seed; but in some cases they are inflated in their upper part, or slightly so throughout. These inflated carpels are, therefore, broadest at the end; but in some of the species where they are not inflated, a narrowing and flattening occurs at the end.

RANUNCULUS, *Linn.*

Section I. *Batrachium.* Fruitstalks arching. Carpels transversely wrinkled. Petals white (with a yellow claw in all our plants).

This section includes all the species which it is now proposed to consider. It constitutes the genus *Batrachium* of Fries; but I must be permitted to think, that there is no valid reason for separating it generically from the other *Ranunculi*. *R. sceleratus*, although a true *Ranunculus*, has several points in common with the *Batrachia*. It has minute seeds traversed by faint transverse wrinkles, and when growing in water its lower leaves float in a similar manner to those of the species of *Batrachia*, and very closely resemble them.

Subsection A. Submersed leaves twice or thrice trifurcate with filiform segments spreading in the form of a section of a sphere, rarely wanting. Receptacle hispid.

1. *R. trichophyllus* (Chaix); *submersed leaves* closely trifurcate, segments short rigid *not collapsing* into a pencil when taken out of the water, *no floating leaves*, peduncles not narrowing upwards about equalling the leaves, flowers small, *pet.* obovate 5–7-*nerved* not contiguous *evanescent*, stigma oblong, receptacle oblong, *carpels* $\frac{1}{2}$-ovate laterally apiculate *compressed.*

R. trichophyllus, *Chaix in Vill. Dauph.* i. 335; *Gren. et Godr. Fl. de Fr.* i. 23.
R. pantothrix, *DC. Syst.* i. 235 (in part); *Bert. Fl. Ital.* v. 575.
R. cæspitosus, *Godr. in Mém. Nancy*, 1839, 30. f. 6 (the terrestrial state).
R. capillaceus, *Lloyd*! *Fl. de la Loire Inf.* 5; *Godr. Fl. Lor.* i. 15.
R. aquatilis v. pantothrix, *Koch, Syn. Fl. Germ.* ed. 1. 11; *Sturm, Deutschl. Fl.* fasc. 67. t. 11; *Fries*! *Herb. Norm.* ix. 27 (specimen).
R. heterophyllus var. succulentum, *Fries, H. N.* xi. 33 (specimen)?
Batrachium trichophyllum, *F. Schultz, Fl. Gall. et Germ. exsic.* 805 bis & 1203; *Van den Bosch, Prod. Fl. Batav.* 5.

Stem floating, rooting at the lower joinings, obtuse-angled, hollow. Submersed leaves with filiform segments diverging slightly, and when mature so rigid as not to collapse when removed from the water: middle branch at the first fork the smallest. Petioles plane-convex, short. Upper leaves sessile. When growing upon mud from which the water has retired, the segments of the leaves are very short and thick. Floating leaves always absent. Stipules large, rounded, auricled, $\frac{1}{2}$ or $\frac{2}{3}$rds adnate. Peduncles falling short of, or slightly exceeding the leaves. Buds globular. Flowers small, star-like. Sepals ovate, very blunt, concave, green with a diaphanous margin. Petals distant, white, wedge-shaped, slightly clawed and yellow below, about twice as long as the calyx when full-grown. Nectary round, scarcely at all margined or prominent; but probably this structure is not constant, for I have seen, on what is apparently a plant of this species, a prominent bracket-shaped nectary. Stamens from about 10 to 15, exceeding the pistils. Style prolonging the inner edge of the ovary, short, curved. Stigma at first oblong, afterwards elongating. Carpels blunt, a little hairy, and slightly narrowed at the end. Receptacle nearly globose, as thick as the peduncle. Colour of the plant dark lurid green.

This plant differs from *R. heterophyllus* by its small few-nerved evanescent petals, globular receptacle, dark green dense rigid small submersed leaves; from *R. confusus* and *R. Baudotii* by its short peduncles which are equally thick throughout, its oblong not ligulate stigmas and globose receptacle, deciduous small petals, and in other respects. *R. floribundus* and *R. peltatus* are large-flowered plants that cannot be confounded with it even when the former happens to want the floating leaves. It differs from all the other species of the subsection by never having been observed to have floating leaves, nor to show any tendency to produce them. Its nearest ally is *R. Drouetii*. It is well marked by its stems, which float close to the surface of the water, being furnished with small dense rather closely placed dark green leaves, and small flowers which only just rise out of the water. No species resembles it in these respects.

Flowering in May and June.

R. trichophyllus is plentiful in Cambridgeshire, Norfolk and Suffolk, but is perhaps not very generally distributed throughout the kingdom. *R. Drouetii* is probably often mistaken for it, as is also the wholly submersed state of *R. heterophyllus*.

2. *R. Drouetii* (F. Schultz ?); *submersed leaves* rather closely trifurcate, segments rather rigid but *collapsing*, floating leaves (rare) tripartite with subsessile or stalked wedge-shaped bifid leaflets, peduncles not narrowing and about equalling the leaves, flowers small, petals obovate 5–7-nerved not contiguous evanescent, stigma oblong, receptacle oblong, *carpels* $\frac{1}{2}$-obovate sublaterally apiculate *inflated at the end*.

R. Drouetii, *F. Schultz in Gren. et Godr. Fl. de Fr.* i. 24?
R. Godronii, *Gren. in F. Schultz, Fl. Gall. et Germ. exsic.* No. 1202 (specimen).

Stem floating, rooting from the lower joinings, very bluntly angular, hollow. Submersed leaves with filiform segments which are rather short, diverge greatly at their trifurcations, less so at the bifurcate divisions: middle branch at the first fork the smallest. Petioles plane-convex, short. Upper leaves nearly or quite sessile. Floating leaves very rare, tripartite; divisions stalked, bifid, wedge-shaped, the sides being very nearly straight, except the outer side of the lateral ones, which is slightly but decidedly rounded; middle division much more shortly stalked than the others, or very nearly sessile, usually placed at an angle with the other divisions, and directed downwards, so as to be always submersed. These tripartite leaves soon decay, and the plant produces beyond them a series of filiformly-divided submersed leaves, similar to those that had preceded them. Petioles of the tripartite leaves rather long, nearly cylindrical. Stipules large, rounded, auricled, $\frac{1}{2}$ to $\frac{2}{3}$rds adnate. Peduncles falling short of, or slightly exceeding the leaves, from both kinds of leaves. Buds oblong. Flowers small, star-like. Sepals ovate, very blunt, concave, greenish, dotted with purple, especially towards the edge; the whole margin diaphanous. Petals distant, white, wedge-shaped, yellow below and slightly clawed, about twice as long as the calyx when full-grown. Nectary round, scarcely at all margined or prominent. Stamens fewer than 10, exceeding the pistils. Style prolonging the inner edge of the ovary, short, curved. Carpels blunt, more or less hairy at the end, which is a little inflated so as to have a broad flat edge; base of the style small, rather variable in position, not central nor truly lateral. Receptacle oblong, as thick as the peduncle. Colour of the plant bright green.

This plant agrees in so many respects with the descriptions of *R. Drouetii*, and with specimens of that plant obligingly sent to me by my excellent correspondent M. R. Lenormand, that I am led to consider it as belonging to that species, notwithstanding the occasional presence of floating leaves. When those leaves are absent, the English plant appears to be identical with that described as *R. Drouetii* by Dr. Godron. That botanist places much dependence upon the "style . . . . inséré presque à l'extrémité du long diamètre du pistil:" such is not the case in our plant, nor is the rudiment of the style central upon the carpel of the French specimens, on some carpels of which it somewhat approaches that position, but upon others it is decidedly lateral. There is similar variety in the position of the apiculus on the carpels of the English plant.

The presence of flat floating leaves is an apparent objection to the identification of the plants; but I think that the widening of the divisions of some of the upper leaves, indicating an approach to a floating leaf, such as is occasionally although rarely found upon our plant, may be detected upon M. Lenormand's specimens. Of this, however, I am not quite certain.

I am much indebted to my friend the Rev. W. W. Newbould for directing my attention to the floating leaves of our plant.

The *R. Godronii* (Gren.), specimens of which I have received from Dr. F. Schultz, appears similar to our plant when it is furnished with the floating leaves, but I am unable to see in what other respects it differs from the typical *R. Drouetii*. I cannot find any description of *R. Godronii*.

R. confervoides (Fries, H. N. xiii. 45) is closely allied to this species, but has long slender peduncles. *R. paucistamineus* (Tausch) may be a stronger form of *R. confervoides*.

R. Drouetii can only be confounded with *R. trichophyllus* or *R. heterophyllus*. From the former it is distinguished by its bright green colour, collapsing leaves, inflated and very blunt carpels, and much more lax habit; from the latter by its very peculiar floating leaves, fewer-nerved and evanescent petals, inflated and minutely apiculate carpels, and nearly globose receptacle.

Flowering in May and June.

I have received *R. Drouetii* from several places in Cambridgeshire, Burnham in Norfolk, Byford in Herefordshire, and Hook in Surrey.

3. *R. heterophyllus* (Fries); *submersed leaves* loosely trifurcate, segments long *collapsing*, floating leaves subpeltate tripartite with sessile or stalked wedge-shaped 3–5-lobed leaflets, peduncles not narrowing scarcely exceeding the leaves, flowers large, *petals* broadly obovate-cuneate 7–9-*nerved* not contiguous *persistent*, stigma oblong, *receptacle conical*, carpels ½-ovate laterally pointed.

R. heterophyllus, *Fries, Summa*, 140, & *Herb. Norm.* ii. 32 (specimen).

R. aquatilis α. pseudo-peltatus, *Godr. in Mém. de Nancy*, 1839, p. 25. f. 5 *c* & *g*.

R. aquatilis var. pantothrix, *Fries, Herb. Norm.* ix. 27 (specimen).

R. aquatilis, *Eng. Bot.* t. 101.

Batrachium heterophyllum, *Van den Bosch, Prod. Fl. Batav.* 8.

Stem floating, rooting from the lower joinings, prominently but irregularly angular, hollow. (A plant apparently referable to this species which grew in shallow water has a solid stem. Much stress has been laid upon such a difference, but it seems of little consequence.) Submersed leaves two or three times trifurcate, afterwards bifurcate; segments filiform, rather rigid. At the first fork the branches are divaricate and the middle one is the smallest, at the succeeding forks they are more and more approximate. Petioles semicylindrical, short. Upper submersed leaves sessile. Floating leaves usually flat, with bifid leaflets, each segment deeply lobed; when they rise out of the water, as is frequently the case, they form a nearly or quite circular disk; their outer edge is usually straight from its base, but occasionally is slightly rounded from thence. Stipules broad, adnate nearly throughout. Peduncles from both kinds of leaves. Buds globular, or slightly depressed and obscurely pentagonal. Flowers becoming star-like. Sepals ovate, very blunt, convex, brownish green towards the top with a dark irregular edge, yellowish at the base, the whole margin diaphanous. Petals sometimes with more than nine nerves, white, yellow below, fully twice as long as the calyx. Nectary round, very prominent, bracket-shaped, so as to open nearly at right angles to the plane of the petal. Stamens many, exceeding the pistils. Style prolonging the inner edge of the ovary, curved. Stigma straight. Carpels blunt with a large apiculus, slightly hairy at the end, inner edge nearly straight.

When the floating leaves are not produced, the plant is similar in all other respects. Both states are frequently to be found in the same place.

The differences between this plant and *R. trichophyllus* and *R. Drouetii* have been already pointed out. Its collapsing leaves distinguish it from the four following species. Its uniformly thick and short peduncles separate it from *R. confusus, R. Baudotii* and *R. peltatus*; its wedge-shaped leaflets from *R. confusus, R. floribundus* and *R. peltatus*. In swift streams it sometimes much resembles *R. fluitans,* but has not the structure of that plant.

Flowering from May to July; rarely flowers may be found in April and August.

I have obtained this plant from Cambridgeshire, Leicestershire, Chichester, the River Lea near Hertford, Battersea in Surrey, and Pangbourn in Berkshire. I believe it to be pretty generally distributed.

4. *R. confusus* (Godr.); *submersed leaves* loosely trifurcate, segments long rather rigid *not collapsing, floating leaves* long-stalked subpeltate *subtripartite with sessile obovate* 3–5-lobed *segments,* peduncles slender narrowing gradually exceeding the leaves, flowers large, petals obovate-cuneate 7–9-nerved not contiguous persistent, stigma tongue-shaped, receptacle ovate-conical, carpels $\frac{1}{2}$-ovate compressed and narrowed upwards.

R. confusus, *Godr. in Fl. de Fr.* i. 22.

R. Petiveri, *Koch in Sturm, Deutschl. Fl.* fasc. 82. t. 2.
R. Petiveri *a.* minor, *Koch, Syn.* ed. 2. 13.

Stem floating, rooting at the lower joinings, roundish, hollow; the upper part, when flowering, often rising out of the water. Submersed leaves two or three times trifurcate, afterwards bifurcate; segments rather thick. At the first fork the branches are nearly equal, long and divaricate, at the succeeding ones more and more approximate. Intermediate leaves with fewer, shorter and linear segments. Petioles semicylindrical, short. Floating leaves flat, marked with brownish irregular spots; segments diverging, slightly combined at the base or sessile, lateral ones much rounded at base externally; outline of the floating or emerged leaves scarcely more than a semicircle. Petioles thick, semicylindrical. Stipules oblong, much adnate. Peduncles very long, rising high out of the water, from both kinds of leaves. Buds globular, but slightly depressed and a little pentagonal. Flowers rather large, star-like. Sepals oblong, blunt, convex, green, with a broad diaphanous margin. Petals elliptic-cuneate or obovate, white, yellow and shortly clawed below, 2 to 2½ times as long as the calyx even when first expanded, their lower half much lengthened afterwards. Nectary shortly oval, strongly margined below, scarcely at all so above, forming an acute angle with the plane of the petal. Stamens about 20, exceeding the pistils. Style rather long, recurved from near its base, prolonging the inner edge of the ovary. Carpels ultimately rather acute, the inner edge nearly straight. Persistent base of the style long and conical, nearly erect. Receptacle as thick as the peduncle. Flowers strongly scented like honey.

Differs from *R. heterophyllus* by its submersed leaves not collapsing, its stem often rising out of the water, its long slender and narrowing peduncles, and ligulate stigma; from *R. Baudotii* by the obovate segments of its floating leaves, slender peduncles, half-ovate carpels compressed and narrowed at the top, and stamens exceeding the pistils.

Flowering from June to September.

I have obtained this plant from near Chichester, Dunster and Weston-super-Mare in Somersetshire, Stackpole and Tenby in Pembrokeshire, and the mouth of the Tees on both sides of the river I believe. It seems to prefer the neighbourhood of the sea, and does not object to slightly brackish water.

5. *R. Baudotii* (Godr.); submersed leaves closely trifurcate, segments rather rigid not collapsing, floating leaves long-stalked tripartite with sessile or stalked *wedge-shaped* 2–4-lobed segments, peduncles thick narrowed at the top ex-

ceeding the leaves, flowers moderate, petals 7-nerved not contiguous persistent, *stamens not exceeding the pistils,* stigma tongue-shaped, receptacle elongate-conical, *carpels* ½-obovate *inflated at the end.*

R. Baudotii, *Godr. in Mém. de Nancy,* 1839, p. 21. f. 4, and *Fl. de Lorr.* i. 12, and *Fl. de France,* i. 21; *Koch, Syn.* ed. 2. 434.
Batrachium Baudotii, *Van den Bosch, Prod. Fl. Batav.* 7.

Stem floating, rooting from the lower joinings, very bluntly angular, with a shallow furrow on two sides, hollow. Submersed leaves two or three times trichotomously divided into short filiform segments, forking like those of *R. confusus.* Intermediate leaves with fewer and linear segments. Petioles short or none. Floating leaves flat; divisions wedge-shaped regularly to their base, 3–4-lobed, or often of many linear blunt segments. Outline of the floating or emerged leaves not more than a semicircle. Petioles long. Stipules adnate nearly throughout. Peduncles long, thick, from both kinds of leaves. Buds globular, depressed (?). Flowers rather large, star-like. Sepals like those of *R. confusus* (?). Petals white, yellow below, 2–2½ times as long as the calyx. Nectary shortly oval. Stamens 15–20. Style long, recurved from its middle, prolonging the inner edge of the ovary. Carpels very many (50–100 on each receptacle), forming a globose mass. Inner edge often considerably rounded near the top; apiculus small. Receptacle thicker than the peduncle.

Owing to neglect, the above description is imperfect in a few particulars.

This plant is very nearly allied to *R. confusus,* with which species I long confounded it. *R. confusus* appears to be always a more slender and elongated plant, never to have stalked segments to its floating leaves, nor the deep lobes often replaced by broad linear blunt segments, nor the short stamens, nor the globose clusters of many rather pointed carpels with inflated tops, of this plant. Here also the segments are truly wedge-shaped, the outer margins of the lateral ones appearing to be constantly straight quite to their base. The narrowing long peduncles, tongue-shaped stigmas, many and inflated carpels, and great difference of appearance, separate it from *R. heterophyllus.*

I am much indebted to my liberal friend M. R. Lenormand for authenticated specimens of this plant; and Dr. F. Schultz has identified with it a plant gathered by Mr. Syme at Guillan, near Edinburgh, specimens of which the latter gentleman has kindly given to me.

The *R. marinus* of Fries (Mant. iii. 51; Herb. Norm. ix. 28) is closely allied to *R. Baudotii*; but he is probably correct in believing (Summa, 555) them to be distinct. In some respects it seems more nearly related to *R. confusus,* and I have suspected that they may be identical.

Flowering from May to August; but sometimes flowers may be found in April.

R. Baudotii appears to delight in slightly brackish water. I possess it from Edinburgh, Seaton Carew in the county of Durham, Burnham in Norfolk, near Chepstow in Gloucestershire and Monmouthshire, Shirehampton near Bristol in Gloucestershire, Dunster in Somersetshire, and near Cork (?).

6. *R. floribundus*; submersed leaves closely trifurcate, segments rather rigid divaricate not collapsing, floating leaves long-stalked subpeltate $\frac{1}{2}$-trifid or 3-partite with sessile obovate 3–5-lobed segments, *peduncles not narrowed* scarcely exceeding the leaves, flowers large, *petals* obovate-cuneate 9–*many-nerved not contiguous* persistent, stamens many exceeding the pistils, *stigma tongue-shaped,* receptacle spherical, carpels $\frac{1}{2}$-obovate very blunt.

Stem floating, rooting from the lower joinings, bluntly angular, hollow, often rising out of the water. Submersed leaves dark green, two or three times trifurcate, afterwards bifurcate, segments rather short filiform; intermediate primary subdivision smaller. Petioles short, semiterete. Floating leaves convex, divided more than halfway down; lateral segments bifid, each lobe bicrenate; middle segment 3-crenate; *outer edge of the leaf much rounded at the base.* Outline of the floating or emerged leaves forming about $\frac{2}{3}$rds of a circle, but the rounded outer bases often overlap. Petioles nearly cylindrical. Stipules very broad, with a free rounded end. Peduncles from both kinds of leaves. Buds slightly depressed, slightly pentagonal. Flowers star-like. Sepals ovate, greenish, with a diaphanous margin. Petals at first nearly contiguous, afterwards distant, white, clawed and yellow below, more than twice as long as the calyx. Nectary ovate, its margin thickened all round and slightly prominent below. Stamens 20–30. Style short, recurved, prolonging the inner edge of the ovary. Inner edge of the carpels nearly straight. Receptacle as thick as the peduncle.

I am unable to identify this plant with any described species. It is most nearly allied to *R. peltatus,* with which I was much inclined to have combined it. It differs from *R. peltatus* by its deeply trifid floating leaves, dark green submersed leaves with unequal segments branching at shorter intervals, peduncles not narrowing upwards, nor very long, nor almost solely springing in company with the floating leaves (in *R. floribundus* they spring as frequently with the petioles of the submersed as of the floating leaves), the ovate nectary, and depressed buds. From *R. heterophyllus* it may be known by its submersed leaves not collapsing, its floating leaves (when tripartite) with sessile segments, and not straight-sided, its ovate nectary, and depressed buds; from *R. confusus* by its floating leaves being usually convex, not spotted; peduncles not long, slender, and narrowing upwards; carpels not compressed and narrowed upwards; and by its dark colour; from *R. Baudotii* by the markedly rounded base of the outer margin of its convex leaves, its peduncles not narrowed towards their top, many-nerved petals, long stamens, and much fewer carpels.

A Sicilian specimen from Prof. Gasparrini, which he named *R. aquatilis*, appears to be *R. floribundus*.

Flowering from May to September.

I possess this plant from Hedon near Hull, Denver Common in Norfolk, and a pit by the road-side near Legge's Farm near Hatfield in Hertfordshire.

It is the most beautiful of our species; its large white flowers being so numerous as to cover the places that it inhabits with a sheet of bloom.

7. *R. peltatus* (Fries); submersed leaves loosely trifurcate, segments rather rigid divaricate not collapsing, floating leaves long-stalked subpeltate nearly half-3-5-fid with obovate 3-4-crenate segments, *peduncles narrowing* gradually *from floating leaves* and exceeding them, flowers large, *petals* round becoming obovate-cuneate 9-nerved *contiguous* persistent, stamens many exceeding the pistils, stigma club-shaped, receptacle ovate, carpels $\frac{1}{2}$-obovate very blunt.

R. peltatus, *Fries, Summa*, 141, and *Herb. Norm.* xii. 48 (specimen).
R. aquatilis *a*. peltatus, *Sturm, Deutschl. Fl.* fasc. 67. t. 7.

Stem floating, rooting from the lower joinings, bluntly angular, hollow, often rising out of the water. Submersed leaves light green, 2 or 3 times trifurcate, afterwards bifurcate; segments long, slender, filiform; primary subdivisions about equal. Petioles short, semiterete. Floating leaves convex; *outer edge of the leaf much rounded at the base.* Outline of the floating or emerged leaves forming about $\frac{2}{3}$rds of a circle, but the rounded outer bases often overlap. Petioles plane-convex. Stipules adnate nearly throughout, rounded at the end. Peduncles long, rising high out of the water, from the floating leaves; very rarely a peduncle springs with a submersed leaf. Buds globular. Flowers very large, sweet-scented. Sepals ovate, diaphanous except at the centre, where they are slightly green. Petals quite contiguous, ultimately slightly separated by the lengthening of their lower part, white, clawed and yellow below, more than twice as long as the calyx at their first expansion. Nectary oblong, its margin slightly thickened all round and a little prominent below. Stamens about 30. Style curved, short, prolonging the inner edge of the ovary. Carpels not inflated; inner edge nearly straight. Receptacle small; its shape is rather doubtful, owing to the cultivated plant perfecting few carpels, and its shape not having been observed in the wild plant when fresh.

This plant differs from *R. heterophyllus* and all the other species, except perhaps *R. tripartitus*, by its "necessary" floating leaves, for the presence of a flower springing in company with a submersed leaf is extremely rare, with $\frac{1}{2}$-trifid not tripartite nor wedge-shaped lobes, and by their being nearly always convex; by its submersed leaves not collapsing; its long narrowed peduncles; and petals contiguous except when about to fall; from *R. confusus* by its convex not tripartite floating leaves, contiguous petals, $\frac{1}{2}$-obovate and very blunt carpels; from *R. Baudotii* by its convex not tripartite leaves with obovate segments, narrowing peduncles, contiguous petals, long stamens and short receptacle.

Flowering from May to September.

I possess this plant from St. Pierre in Monmouthshire, (where it was first noticed as being a distinct species by the Rev. F. J. A. Hort), Bream in Gloucestershire, and Hoveton in Norfolk.

Sturm's figure quoted above represents the petals as not being contiguous, but is doubtless intended for this plant. Fries's specimen contained in the *Herb. Normale* is very imperfect, but leaves no doubt upon my mind of the identity of our plant with it. A specimen sent to Fries, with the name of *R. peltatus* attached to it, was stated by him to be correctly so named.

8. *R. tripartitus* (D.C.); "submersed leaves divided into capillary segments collapsing," floating leaves long-stalked subpeltate deeply trifid with cuneate-obovate 2–4-fid segments, *peduncles not narrowing falling short of the leaves,* flowers very small, petals oblong 3-nerved not contiguous, stamens few exceeding the pistils, *stigma small on a long subulate terminal style with a slender base,* receptacle globose, *carpels* unequally *obovate much inflated* with a nearly terminal point.

R. tripartitus, *DeCand. Pl. Gall. Rar.* p. 15. t. 49; *Eng. Bot. Suppl.* t. 2946; *Lloyd, Fl. Loire,* 4!

R. tripartitus α. microphyllus, *DeCand. Syst.* i. 234.

Stem floating or creeping, rooting from the lower joinings, slightly furrowed, rising out of the water. Submersed leaves (which have not yet been observed in Britain) several times trifurcate; segments long, slender, filiform. Floating and emerged leaves deeply trifid, forming about $\frac{3}{4}$ths of a circle; the lateral segments with 3, the central with 2–4 crenatures, the outer edge of the lateral segments rounded in their upper half, but straight below. Upper *stipules free*. Buds globular. Sepals ovate, dark green tinged with purple, the whitish margin diaphanous. Petals very small, slightly exceeding the sepals, rather acute, narrowed into a claw, pinkish-white, yellowish below, with 3 distant nerves. Nectary roundish, its border a little thickened only below. Stamens 5–10. Style straight, placed nearly upon the middle of the end of the ovary. Carpels very blunt, glabrous; inner edge rounded. Receptacle globose.

This plant and *R. ololeucos* (which has not as yet been found in Britain) are distinguished by having very slightly adnate stipules, much inflated carpels having a much rounded inner edge, and minute stigmas. The slender base of the long subulate deciduous style also is a mark of *R. tripartitus*. In *R. ololeucos* the style is persistent, sickle-shaped, and thickened at the base, the petals are much larger and wholly white (in all our species of *Batrachian Ranunculi* they are more or less yellow at the base), and the peduncles much exceed the leaves.

Flowering from May to August.

Mr. H. C. Watson discovered this plant on Esher Common in Surrey. I have found it between Haverfordwest and Robeston in Pembrokeshire.

It is probable that by descending the little streamlets in which this plant has been found until they increase in size and depth, the form producing submersed leaves will be found. My valued friend Mr. Borrer has given to me a specimen grown in deep water in his garden which has loosely twice trifurcate leaves with long narrowly linear segments. Such leaves are found interposed between the capillarly divided and the subpeltate leaves of several of these *Ranunculi*, for instance in *R. Baudotii*. It is scarcely necessary to remind botanists, that the form of the style is not to be seen upon dried specimens, for it shrinks so much as in the dry state to appear as if it were broadest at the base. I possess a specimen, gathered by my friend Mr. F. Townsend near Tunbridge Wells, which probably, but not quite certainly, belongs to *R. tripartitus*. It appears to have grown in rather deep water, but does not now possess any of the submersed leaves. It has no petals remaining, and may be *R. ololeucos*.

Subsection B. Submersed leaves not like those of Subsection A. Receptacle hispid.

9. *R. circinatus* (Sibth.); leaves all submersed and sessile trifurcate with repeatedly and very closely forked *rigid segments*

all placed in one roundish plane not collapsing, peduncles narrowing much exceeding the leaves, flowers large, petals obovate many-nerved nearly contiguous persistent, stamens exceeding the pistils, stigma cylindrical, receptacle oblong, carpels $\frac{1}{2}$-ovate compressed rather acute.

R. circinatus, *Sibth. Fl. Oxon.* 175; *Reichenb. Fl. excur.* 719, *et Icon. Fl. Germ.* iii. Ran. t. 2; *Fries, Herb. Norm.* ix. 29 (specimen); *Eng. Bot. Suppl.* t. 2869.

R. divaricatus, "*Schrank*," *Koch, Deutschl. Fl.* iv. 152, *et Syn. Fl. Germ.* ed. 2. 13; *Godr. Fl. Lor.* i. 15, *et Fl. de Fr.* i. 25.

R. stagnatilis, *Wallr. Sched. Crit.* 285.

R. aquaticus albus, circinatis tenuissime divisis foliis, floribus ex alis longis pediculis innixis, *Raii Syn.* ed. 3. 249.

Stem submersed, ascending, branched, angular, furrowed, hollow, rooting from the lower joinings. Leaves small, their capillary brassy-green divisions repeatedly forked, but all lying exactly in one plane, which is placed usually at right angles to the stem and has a round outline. Stipules sheathing, adpressed, not auricled. Buds obovate, depressed. Sepals ovate, blunt, greenish, tinged with purple towards the tip, the margin broadly diaphanous. Petals 2 or 3 times as long as the calyx, about 9-nerved, white with a yellow claw. Nectary roundish, small, rather strongly bordered below. Stamens 15–20. Style prolonging the inner edge of the ovary. Stigma recurved, but straight. Receptacle narrower than the peduncle both in flower and when bearing carpels. Carpels ultimately rather acute, and tipped with the recurved persistent style.

The structure of the leaves is sufficient to distinguish this plant from all known *Ranunculi*.

Flowering from June to August.

This plant is not unfrequent. For its distribution in Britain I may refer to Watson's 'Cybele Britannica.'

From the remark of Messrs. Hooker and Arnott (Brit. Fl. ed. 7. p. 7) that they "cannot believe this to be distinct from the following" (*R. aquatilis,* including the *R. heterophyllus, R. trichophyllus, R. confusus* and *R. Baudotii* of this paper), I am necessarily led to the conclusion that they have no practical acquaintance with it, and perhaps have paid no attention to it except when preserved in an herbarium. As I have on several occasions received specimens of *R. heterophyllus* under the name of *R. circinatus,* when the petioles were shorter than is usual and the leaves small, I presume that it is not so generally known to botanists as its distribution would have rendered probable. It is so constant to its characters, that, even when the water has dried up in its place of growth, it retains its distinctive structure and grows and flowers in the air.

10. *R. fluitans* (Lam.); leaves all submersed about twice trifurcate with very *long linear twice or thrice forked nearly parallel segments,* peduncles narrowing, flowers large, petals broadly obovate many-nerved contiguous persistent, *stamens falling short of the pistils,* stigma cylindrical, receptacle conical, carpels obovate inflated much rounded at the end laterally apiculate.

R. fluitans, *Lam. Fl. Fr.* iii. 184; *Reichenb. Fl. exsic.* 886 (specimen), *et Icones Fl. Germ.* iii. Ran. t. 2; *Gren. et Godr. Fl. de Fr.* i. 25; *Van den Bosch, Prod. Fl. Batav.* 6.
R. peucedanifolius, *Desf. Atl.* i. 444.
R. fluviatilis, *Sibth. Fl. Oxon.* 176; *Wallr. Sched.* 284.
R. sive Polyanthemo aquatili albo affine Millefolium Maratriphyllum fluitans, *Ray, Syn.* 250.

Stem floating, very long, branched above, nearly round, hollow, wholly submersed. Leaves together with their petioles often a foot in length. Segments thick. Petioles of the upper leaves often short. Stipules broadly lanceolate, strongly auricled, $\frac{1}{2}$-adnate. Sometimes at the end of the stem a few stalked 3-furcate leaves with short broad linear segments are found; in these leaves the middle segment is entire, the lateral ones are simply forked; they do not at all resemble the floating leaves of the other species. When the seedling plant has been deserted by the water, all the leaves are of this form. Bud shortly pyramidal, pentagonal. Peduncles thick, much shorter than the leaves. Flower often semidouble. Sepals ovate, blunt, green, bordered with purplish black and a broad diaphanous edge. Petals 2–3 times longer than the calyx, slightly clawed, 9–15-nerved. Nectary round, bordered slightly below. Stamens many, short. Style prolonging the inner edge of the ovary. Stigma straight, a little inflexed at the top. *Receptacle* conical, *slightly pilose* immediately after the flowers have fallen. Carpels with a small lateral point.

The structure of the long whip-shaped leaves is sufficient to distinguish this plant. It is also remarkable for the tendency of the flowers to produce a second imperfect whorl of petals. It does not change its form even when growing in stagnant water.

Not uncommon in rivers. Watson's 'Cybele' may be referred to for its distribution in Britain.

Flowering in June and July.

The *R. Bachii*, Wirten (Schultz, Archives de Flore, i. 292; Billot, Exsic. No. 1103!), is a form of *R. fluitans*. The form of the petals does not afford a constant character, neither does the length of the peduncle. I have observed it in the River Whiteadder in Berwickshire. It is much smaller in all its parts and more elegant, but I cannot detect any other difference. Mr.

J. Lange has sent it to me from Denmark. It has sometimes been mistaken for the *R. marinus* (Fries), with which it has very little in common.

Subsection C. No submersed leaves. Receptacle not hispid.

11. *R. cœnosus* (Guss.); leaves all roundish cordate with 3–5 rather *deeply divided lobes which widen from their base,* petals exceeding the calyx, *style terminal* upon the ovate-conical ovary, carpels unequally obovate with a terminal point.

R. cœnosus, *Guss.* "*Prod. Suppl.* 187," and *Syn.* ii. 39; *Godr. in Fl. de France,* i. 19; *Bab. Man.* ed. 3. 7.
R. Lenormandi, *F. Schultz in Flora oder Bot. Zeit.* 1837, p. 727!; *Walp. Repert.* i. 34; *Bab. Man.* ed. 2. 6; *Eng. Bot. Suppl.* t. 2930.
R. hederaceus β. grandiflorus, *Bab. Man.* ed. 1. 5.

Stem floating or creeping upon mud, branched, nearly round but with slight angles. Leaves not spotted; lobes very blunt and broad at the top, entire or with 1–3 notches. Petioles long, terete-compressed. Stipules ½-adnate, bluntly pointed, the floral ones very broad. Peduncles not narrowed, nearly equalling the leaves. Buds oblong. Flowers large. Sepals obovate, concave, greenish, tinged with purple towards the tip, with a diaphanous margin. Petals about twice as long as the calyx, narrow, obovate, 5-nerved, white with a slight tinge of pink, slightly clawed and yellowish below. Nectary round, bordered below. Stamens 8–10, about equalling or a little exceeding the pistils. Style nearly central upon the ovary (that is, the upper edge of the ovary is nearly as prominent and rounded as the lower edge) which narrows gradually into the style. Style short, thick, and slightly curved outwards. Stigma oblong. Receptacle spherical, naked. Carpels with their inner (upper) edge much rounded towards the top, inflated, tipped with the terminal although not always quite central style.

Flowering from June to August.

I possess this plant from near Coniston Lake in Westmoreland, near Sheffield, Needwood Forest in Staffordshire, Charnwood Forest in Leicestershire, near Aberystwith in Cardiganshire, near Swansea in Glamorganshire, near Haverfordwest in Pembrokeshire, near Llanberis in Caernarvonshire, Esher Common in Surrey, Tunbridge Wells in Kent, Lucott Hill in Somerset, and near Plymouth in Devonshire.

Messrs. Hooker and Arnott indirectly hint (Brit. Fl. ed. 7. p. 8) that near Glasgow this plant may be an altered state of *R. hederaceus,* for "it is principally met with in ditches where the temperature is raised by warm condensed steam," "and where formerly *R. hederaceus* only occurred." This seems to require more proof than a simple statement affords. We want

(1) to be rendered quite sure that *R. cœnosus* is the plant that now inhabits those ditches, and (2) that it was the true *R. hederaceus* alone that grew there formerly. I have most frequently found *R. cœnosus* in rather elevated situations, where no source of artificial heat could affect it.

12. *R. hederaceus* (Linn.); leaves all roundish reniform with 3–5 shallow rounded *lobes widening to their base,* petals scarcely exceeding the calyx, *style prolonging the inner edge of the ovary,* carpels $\frac{1}{2}$-oval or $\frac{1}{2}$-obovate with a lateral point.

R. hederaceus, *Linn. Sp. Pl.* 781; *Eng. Bot.* t. 2003; *Reichenb. Icon. Fl. Germ.* iii. Ran. t. 2.

Stem floating or creeping upon mud, branched, nearly round. Leaves usually spotted; lobes separated by shallow notches, widening gradually from their base to a narrow rounded end, often broadly triangular, entire or rarely with a slight notch at the top. Petioles long, semicylindrical. Stipules long, much adnate, blunt, denticulate. Peduncles not narrowed upwards, much falling short of the leaves. Flowers very small. Petals about equalling or a little exceeding the calyx, narrow, 3-nerved. Stamens 6–8. Stigma short, oblong. Receptacle spherical, naked. Carpels compressed below, blunt and inflated above, inner edge nearly straight, laterally tipped with the style or pointless.

Flowering from June to September.

This plant is probably generally distributed, but as *R. cœnosus* is often mistaken for it, I may mention that I know of its existence at Inverarnan at the head of Loch Lomond, near Llanberis in Caernarvonshire, Lanwarne in Herefordshire, Needwood Forest in Staffordshire, Tiptree Heath in Essex, Triplow and other places in Cambridgeshire, near Haverfordwest in Pembrokeshire, Ninham in the Isle of Wight, and Bovey Heathfield in Devonshire.

XXXIV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., F.L.S., Physician to the Swansea Infirmary.

[With a Plate.]

[Continued from p. 329.]

General and Minute Anatomy of Branchial Organs in the Gasteropod Mollusks.

The author is not acquainted with any English or continental researches on the subject of the present paper. While the organs and the process of breathing in the Lamellibranchiate classes have engaged the study of various able observers, no special attention has at any time been given to the minute and ultimate anatomy of these parts in the higher Mollusca. General views can only securely rest on correctly ascertained particulars. The laws which govern the structure and functions of individual organs of animals may be discovered with far greater certainty by tracing the advancing phases of their histological elements throughout the zoological series, than by following the mutations which occur in the progress of their embryonic development in one class. Comparative anatomy is still very deficient in such information. The general anatomy of organs has been ably written: their histological anatomy remains untold. The information to be drawn from the serial history of any given structural element of any given complex organ is more calculated to illustrate the homology of that organ and the architectural design under which it has been built, than any knowledge which can be attained by a descriptive account of its mere general conformation. The inmost constituent of structure may display greater invariableness of character than external outlines and the gross configuration. It is only by such a serial history that that which is essential to an organ can be eliminated from those superadded and accessory parts which are separable and non-essential. For instance, it is quite certain (see a memoir on the Serial Histology of the Liver (under the title of the Physiology of Cells) by the author, in Guy's Hospital Reports for 1848), that the same idea of the liver cannot be acquired by tracing the stages through which the organ passes in the embryo of the mammal, as that which is obtained by exhibiting consecutive pictures of the form under which it occurs in the successive links of the animal chain. There is much that is deceptive and fallacious in general resemblances and leading analogies. The ultimate and the particular must be seized before the comparison of general conditions can become correct and complete. How far-sought and really worthless it were to assert, that a single cell of the mammalian lung finds its counterpart, its prototype, in the membranous vesicle on the dermal surface of an Asterias, in which the process of respiration is carried on! In such an alleged analogy how many real deep differences are ignored! What a wide space is overleaped by simplicity and ignorance! How unsafe are generalities in science when unsupported by *ultimate* knowledge, by facts and details! On the other hand, how utterly valueless are figures, facts, and particulars, unless they form the substratum of *some* generality! To apply them to the maintenance of *any* theory invests them with life, renders them mutually coherent. Abandoned to themselves they may be likened to grains of sand, between which there is no cohesion. These few preliminary remarks are made, at once, in apology and explanation of the plan of investigation which the author has adopted in these papers. He has sought at the expense of great labour, and heavy cost in several senses, to amass such a store of minute facts as will constitute at another time the ground of an appeal in support of a wide generalization. With this explanation he will now proceed to complete the serial history of the organs of respiration in Invertebrate animals.

In a former paper it was stated, in relation to the gills of the Lamellibranchiata, that from the Tunicata to the highest mollusk of this class, there prevailed a unity of structure which acknowledged no single real exception. In every form of branchia the blood-channels were straight, parallel, and non-communicating; that at the free border of the gill they returned upon themselves in form of loops, and that thus the afferent layers of vessels became separate and distinct from the efferent; that whether these layers were two or four in number, the real architecture of the organ remained unchanged*.

These fundamental facts will be found to pervade every variety of gill to be found among the higher class of the Gasteropod and Cephalopod Mollusca. In fact, wherever there is a separately developed branchia within the range of the Molluscan subkingdom, these principles of organic construction will receive an illustration. But between the Lamellibranchiate and Gasteropod gill, several important and striking differences exist. In the former the blood-channels are of large bore; they are capable of carrying a voluminous column of fluid: such a fact implies that in the organ of respiration in this class the fluids are not minutely multiplied and subdivided, and that consequently the contact between them and the external aërating medium is less intimate and complete. Another interesting fact to be noted is, that the corpuscles of the blood of the Lamellibranchiata are

* In the paper to which I refer, I promised to show that the apparently rectangularly-arranged blood-channels of the branchiæ of the Tunicata were not *real* exceptions to the rule stated. In the collected volume of these memoirs, it will be proved beyond doubt that the ultimate vessels in the pharyngeal gills of these inferior mollusks are disposed in "parallel, straight, non-communicating order," and that the crossing which takes place between the larger and the smaller blood-channels is a mere appearance depending upon the mode in which the gill is folded in the cavity. It will then also be shown that the ultimate blood-vessels in the branchiæ of the Tunicata are bounded by hyaline cartilages which also define the channels, precisely in the same manner as is done by the corresponding cartilages in the gills of the higher Lamellibranchs.

considerably larger * than those of the blood of the Gasteropod and Cephalopod mollusks. This difference flows naturally from the greater diameter which the blood-vessels of the former present as compared with those of the latter. On another occasion and in another place, the author will show that the same differences of size distinguish the blood-corpuscles of the lower Crustacea from those of the higher. This is either the consequence or the cause of the disparities of calibre in the branchial vessels which occur in these two sections of the same classes. They are visible facts which bear most explanatively upon not only the morphic, but upon the subtler organic and chemical differences which mark the nutritive fluids of a less highly organized animal from those of another of higher standard; for it scarcely admits of doubt that the *vital standard*, the nutritive value of any given animal fluid, bears a direct ratio to the numerical amount of its floating corpuscles. As in the animal scale followed upwards, the floating globules of the blood become smaller and smaller and more and more numerous, correlatively the circulating channels gradually decrease in sectional area, become more and more subdivided and multiplied, until at length in the higher mammals the bore of the ultimate capillary exceeds little the diameter of the individual blood-corpuscle. These general views will serve to impart meaning to the minute anatomical details which are now to follow.

The *Tubulibranchiate* genera, *Vermetus*, *Dentalium*, and *Magilus*, are commonly placed at the bottom of the Gasteropod scale. For this disposition no reason can be drawn from the position and general anatomy of the branchial cavity or from the structure of the gills. M. Philippi † gives a figure which the author has copied (Pl. XI. fig. 1), in which the organs (*a* & *b*) contained in the respiratory chamber are clearly exhibited. The gills (*a*) are as perfectly pectinated, that is, they conform in figure and structure with those organs in the higher Gasteropods which are described as 'pectinate' gills ‡. They occupy

* The measurements upon which this general statement is based will be published in the next paper on the Blood in the 'British and Foreign Med.-Chir. Review.'

† Enumeratio Molluscorum Siciliæ; and Règne Animal, pl. 62.

‡ The word 'pectinate,' as will be subsequently shown, is anything but descriptive of the real figure of the branchial laminæ of the Pectinibranchiata. To describe them as comb-like is to suggest a very false comparison. If the naturalist who first coined the word had isolated a *single* leaflet from the gill of a Pectinibranch and defined its *outline*, such a word never could have suggested itself. The same ridiculous disparity between the thing and the name will be found to occur in other designations of Orders. False titles like these—terms indeed constructed upon imperfect knowledge—illustrate the difficulty which must ever attend the attempt to

the same position in the branchial sac, that is, on the roof, and distant from the rectum (*b*). One border of the leaf is strengthened by a penknife-shaped cartilage, such as that which will be defined in the Pectinibranchiates. The breathing crypt in *Siliquaria anguina* is depicted by Philippi as having the same configuration. The branchiæ differ but triflingly from those of the former genus. By this observer, these parts are sufficiently clearly delineated in the two preceding Tubulibranchs to justify the inference that the branchiæ are formed precisely on the plan of those of the Pectinibranchiata. So similar to that of the latter order is the general cavity, so analogous the contained parts, so identical in structure the branchiæ, that it is difficult to conceive why *Vermetus* should be called a Tubulibranch, and *Buccinum* a Pectinibranch. In minute anatomy, the description which at another time will be given of the branchiæ of the latter will apply also to those of *Vermetus*. When species, whose vital organs are so similarly constructed, are placed at opposite extremes of an extended scale, the *anatomist* may well exclaim,—how artificial, partial, and arbitrary is the classification of the mere naturalist!

The Branchiæ of the Chitonidæ.

A *Chiton* has a carapace like an isopod Crustacean, a dorsal vessel like an Annelid, bilateral symmetrical reproductive viscera like an acephalous Mollusk, a head and foot like a patelloid Gasteropod, a posterior anus like the Fissurellidæ, and branchiæ like those of the brachyurous Crustacea! Such manifold affinities at once unite and sever this odd group from several most dissimilar classes. Measured by the standard of its branchial organs alone, it deserves a higher rank than that accorded to it by the side of the Patellidæ. The anatomical position of these organs nevertheless allies the Chiton to the Patella. In both, they are placed in the furrow between the border of the foot and the edge of the mantle. But in structure they are totally unlike. Imagination may indeed construct ideal analogies. If a branchial cone (fig. 2) were placed on either side of the anal debouchure in *Chiton* and then simply enlarged without change of figure, the branchiæ of *Fissurella* (fig. 10) would be simulated. They are organically different from those of *Emarginula* (fig. 9) and *Patella* (fig. 5). In structural characters the gills of the last two genera bear the same relation to each other

establish a true and natural terminological system in zoology before the real structure of animals is made known. The mere naturalist can never find himself in a position to construct a consistent "terminology." This task, so important to the progress of knowledge, must be jointly undertaken by the philosophic anatomist and the descriptive naturalist.

as that which subsists between those of *Chiton* and *Fissurella*. The ultimate respiratory laminæ in the last two are bilateral, resting, that is, on either surface of a common axial plane. In *Emarginula* and *Patella* they rise from one surface only of a common basis. In *Patella* that basis is fixed, in *Emarginula* it is free. The branchial system of *Chiton* is distributed and subdivided, that of *Fissurella* is centralized in place and united in structure. In anatomical arrangement they are precisely the same. It should however be remembered, while discussing the generic affinities of the Chitonidæ, that, according to Cuvier's * dissections, the branchiæ in *Chiton spinulosus* (Linn.) are only one-sidedly laminated, resembling the arrangement of the teeth of a comb. By Forbes and Hanley † the branchiæ in the British families are defined as "forming a series of *lamellæ* between the mantle and the foot on each side." By Mr. Clark those of *Chiton fascicularis* are described as consisting of "a cordon between the mantle and the foot, composed of fifteen oblique cord-like, short, close-set, pale brown *filaments* on each side ‡." This description is calculated to mislead. The branchiæ in the Chitons are neither 'lamellæ' nor 'filaments.' They are complexly constructed organs (Pl. XI. figs. 2 & 3). Each 'filament' or 'lamella' (Forbes) is a separate and distinct fabric. Not less so than *one* of the cones of the gill in the Crab, or one of the penknife-shaped processes of the branchia of the Fish. In number these conules differ according to the species. A row of fifteen occurs in *Chiton fascicularis*, of seventeen in *C. cinereus*, of only ten in *C. asellus*, on each side of the body. They amount to eighteen in *Chiton discrepans*, to twelve only in *C. ruber*, to eighteen in *C. quinquevalvis* (Brown), and even to twenty-four on either side of the body in *C. marmoreus*. Several other species of Chitons are described in works on British Mollusca. In all, the branchiæ are overlooked. Numerous comparisons of the young with the old would be necessary to prove that in the adult state of each species these organules are *constant* characters. If they are, in descriptions of species a correct account of them, as regards number, size and position, should be included. They are well known to vary in size, apparent form, and in situation, relatively to the transverse median line of the body in different species, but in *plan* of formation or design they present no diversities. A branchia (figs. 2 & 3) in the genus *Chiton* may be typically described as a process of the mantle, consisting of a wedge-shaped axis (*b*), from whose opposite plane surfaces

* Mém. sur les Mollusques; and Règne Animal, pl. 68. vol. sur les Mollusques.

† British Mollusca, vol. ii. p. 391.

‡ British Marine Testaceous Mollusca, p. 249.

project at right angles secondary laminæ (*a*, *a*, *a*), laid flatwise the one upon the other from the base to the apex of the process. The laminæ (fig. 4 *d*; figs. 2 & 3 *a*, *a*, *a*) are largest at the root, smallest and tapering at the further free end. Each leaf (fig. 4 *d*) being attached only at one border, is capable of floating freely in the water. This is a point of immense functional advantage. The aërating current, however, is otherwise brought under muscular control. The row of gills, being disposed in an angular groove between two strongly contractile and extensile parts, namely the edges of the foot and mantle, are mechanically operated on by the current thus muscularly set in motion. Thus the laminæ are separated from one another.

The gills of *Chiton* are much more parenchymatous or fleshy than those of *Patella*. They possess an obvious power of collapsing and expanding. Muscular fibres are disposed variously throughout the entire gill. Even the borders of the leaflets are contractile (fig. 4 *d*). But the axial plane, in which the two large vessels (fig. 4 *a* & *b*) are lodged, is conspicuously fleshy and muscular. By the fibres situated in this axis the whole process may be shortened, and drawn strongly up towards the base. This power may be given in order to protect the part, or to quicken the circulation, or effectually to cleanse the gill of effete water. Each branchial process carries in its central plane two large vessels (*a*, *b*). They are connected with two main trunks which run along the edge of the mantle. They are respectively afferent and efferent. Thus far the apparatus is simple. The circulation in the laminæ is infinitely more complex (fig. 4). From the main afferent vessel (*a*, arrow) of the branchial process secondary branches (*e*) proceed. These latter run along the attached border or root of each leaflet. A similar secondary efferent vessel runs parallel to it on the other side of the same border (e'). The two vessels are connected together by means of the looped, parallel, ultimate blood-channels of the laminæ (c, c'). These latter are the true respiratory capillaries. They form in the substance of the leaflet *two layers* of vessels. The upper loops into the lower layer at the free border (*d*) of the lamina. Thus then the vital fluid flows, in horizontally parallel streamlets, of extreme minuteness, along the upper aspect of a sheet, itself flattened in the highest degree; following the direction of the loops, it curves round at the distal margin, returns in a similarly distributed stratum along the inferior face of the lamina, and reaches in the form of an arterial fluid the efferent vessel at the fixed base. Although these ultimate blood-channels are *unquestionably* separately walled conduits, they branch here and there and unite with those in the neighbourhood. This branching however so seldom occurs, that each vessel may really be defined as maintaining its individuality from the beginning to the end of its course. This fact identifies the branchiæ of the Chitonidæ with the Molluscan type, and severs them from the Crustacean. This is an anatomical character of essential importance*.

Although an ultimate leaflet from the gill of the Chiton has precisely the same *figure* as the corresponding part of the gill of a brachyurous Crustacean, its real structure is demonstratively Molluscan. The microscope is thus enabled to prove, that beneath an exterior general resemblance there lies hidden an essential identity of organization. In the Chiton, as in *all mollusks*, the *branchial* vessels are individualized channels bounded by distinct walls. In the Crustacea the blood traverses wall-less lacunose passages, and forms invariably only a single stratum in its course. These facts are beyond question. They prove that the Chitonidæ are far more intimately allied to the Mollusk than to the Crustacean. They establish a new principle in homology. They prove that conformity in the last elements of structure signifies more than the superficial analogies of outward form.

Another striking point of dissimilitude between the gill of the Chiton and that of the Crab, is that in the former the *whole lamina*, but most conspicuously the borders, is covered by a comparatively dense *ciliated epithelium*. Cilia do not exist in the Crustacea. It is possible that these vibratile appendages may exist on the branchiæ of Gasteropod Mollusks, and not on those of Crustacea, because in the former the blood moving in the ultimate vessels can be exposed to the agency of the aërating element *only on one side*; whereas, as formerly explained, in almost

* I would here confess to the naturalist who may perchance repeat these observations, that no researches in which I have ever engaged have required so much *training of the eye*, and *familiarizing of the mind* with the appearances under study, as the ultimate characters of the vascular apparatus of the gills in the Cephalophorous Mollusca. Numerous difficulties occur. The same doubtful point must be tested in very different modes, in the recent and preserved specimens, and by aid of various chemical agents. In the Acephalous Mollusks, as in the Crustacea, the ultimate blood-channels become unquestionable at the first glance. Not so in the branchiferous Gasteropods. The vessels are smaller and covered with a denser epithelium; the tissue is contractile and softer, the parts of difficult access, &c.; but notwithstanding these difficulties, I believe that the real and true anatomy of these parts is faithfully given in the present memoir. It is the first occasion in comparative anatomy on which an attempt has been made to unravel the *ultimate character* of any part of the circulating system of the Mollusca. I am disposed to attach importance to what is true of the branchiæ in this sense, since it may hereafter prove of service in deciphering the last vessels of other tissues and organs. I would only in this place and at present venture to observe, that the *lacunar* theory of Milne-Edwards is incontestably in every sense more applicable to the Crustacea than to the Mollusca.

every Crustacean the extreme blood-passages are equally exposed on both sides of a single current to the action of the surrounding medium. Thus the area of exposure being the same, the functional value of a Crustacean gill may be equal to that of a Molluscan, albeit the circulatory system of the latter may be incomparably more perfect and elaborate than that of the former. A curious fact may here be mentioned, as connecting the branchial operations with the position of the cloaca: that in the Chitonidæ the effete current of water flowing in the respiratory groove between the edge of the mantle and that of the foot sets *backwards* towards the anus—in the Patellidæ it sets forwards, towards the common position of the mouth and anus.

To recapitulate: it may be stated that in figure the gill of the Chiton is the counterpart of that of the Crab; in the ultimate arrangement of its vessels it conforms with the type prevalent throughout the branchiferous Gasteropods; in its fleshiness, the denseness of its epithelium, and in the presence of minute follicles on its surface, it allies itself with the branchiæ of the Nudibranchs. Nothing is more easy than to *prove* the presence of epithelium over the entire surfaces of the laminæ. The waving of the cilia is visible throughout the whole extent of the surface. The cilia which are situated on the free margins (fig. 4 *d*) are much larger,—supported by correspondingly larger cells than those distributed over the flat face. Opportunities will afterwards occur for considering the question, *why*, in the organs of branchial breathing, *ciliary* epithelium should almost always clothe even the *ultimate* vessels, and *why* they should be as constantly wanting on the corresponding parts of the pulmonary or air-breathing series.

Branchial System of the Patellidæ.

It is proposed here to take the branchiæ of the genus *Patella* as the type of those of the remaining genera of this order. But it will be shown that the Fissurellidæ, Emarginulidæ, and Haliotidæ, &c., differ strikingly both in the special and in the general characters of the branchial system from the Patellidæ. Though there may exist *other* features which in the judgement of the malacologist may justify the marshalling of these several genera under one and the same order, estimated by the branchial apparatus, the Patellidæ ought unquestionably to stand apart and alone. The author is deeply persuaded that minute *ultimate* histological questions will *some day* in the history of science exercise a far more potent sway over the minds of classifiers than they have hitherto done. Unity and uniformity reign with greater constancy in the small than in the great productions of nature. The cell or the fibre, which the wondrous microscope only can reveal to human ken, is no less fixed and invariable in its structure than the huge bone or the stupendous brain.

In the Patella the heart stands in the geometrical centre of the body. It is situated above and behind the head. It is not perforated by the intestines as it is in the Bivalves. It is an elongated sac dividing in front into two main pallial trunks. These latter distribute arterial blood throughout the mantle*. From the mantle and the viscera it returns into the branchiæ and thence into the heart, to be redistributed over the body. This apparatus can be detected with perfect clearness in the uninjected subject.

In *Patella* the branchiæ (fig. 5 *a, a*) form a *circle,* which is interrupted only by a small notch for the admission of water. That is, the lamellæ are neither deficient behind nor before. The "cordon" is continued over that portion of the margin of the mantle which is situated in advance of the head. Thus, in *Patella* the branchiæ neither arise from, nor are in any way attached to, the neck of the animal. They are developments of the mantle alone. This point is one of specific importance. It proves that the *figure* used by the late Prof. E. Forbes was unphilosophical, because unsupported by anatomy. He said that the branchiæ of *Patella* were really only those of *Fissurella* and *Haliotis, fixed* to the mantle and extended all round, instead of being *free* plumes as in the latter. But it is at once obvious, that not only the branchiæ themselves, but the anatomical relations of them are radically different in *Patella* and *Fissurella* and *Haliotis* for example. If, indeed, the latter genera have no better title to a rank in the Patellidan group than that which is furnished by the branchiæ, they should receive at once a summary sentence of exclusion.

The branchial organ of *Patella* consists of a *double* row of leaves (fig. 5 *a, e*) oblong in shape (fig. 8), standing vertically on, and at right angles with the plane of, the mantle (fig. 5 *c, c*). They constitute a special apparatus distinct from that papillose, ciliated fringe (*d*) with which the extreme edge of the mantle is ornamented. They extend over the entire circumference of the pallial border. They are not attached to any part of the body of the animal. The outermost row of leaflets (*a*) is a little larger

* So clear and water-like are the fluid contents of these vessels in a fresh specimen, while expanding itself in the struggle to get out of its shell, that they may most readily, but most erroneously, be mistaken for *aquiferous canals.* As on a future occasion I shall have a great deal to say on the ill-understood subject of the aquiferous system of Mollusks, at present I only desire to indicate a source of misconception which has led many an acute naturalist into error.

than the innermost (*e*). By a poetical stretch of fancy it might be said that, being composed of two sets of laminæ, though situated on the same side of the same base, they may justly be likened to the oppositely-placed laminæ of the plumose free gills of the other Patelloid orders. But such a comparison would be indeed far-sought.

The branchiæ of the vulgar Limpet, to the careless looker-on on Nature's marvels, appear so contemptibly familiar, that to subject such objects to a grave and minute philosophical examination must prove a severe trial to his patience and common sense. Alas! how short is the range of human sight! Beneath the familiar exterior of these common objects there lies an undiscovered machinery of startling beauty and perfection! These little organs will serve to unite the branchial systems of the two great groups of Mollusks, the Acephalous and Encephalous. Through their aid it will prove practicable to establish a *unity of branchial type* coextensive with the entire Molluscan series. They will convince the zoologist that Nature never changes either the plan of her action, or the design of her architecture, by senseless and ludicrous transitions. Her incomparable, unequalled skill lies in adapting a single principle to the most varied ends.

Of the two rows of laminæ in *Patella* as just stated, the inner is composed of smaller leaflets than the more external. The smaller and larger leaves occur alternately in the series. Both are precisely the same in minute structure. Expert manipulation is required in order to obtain a complete view of the gill-processes *in situ*. The whole ring of the mantle to which they are attached should be removed. Every portion of the loose edge and fringe should then be cut away, leaving only so much as will hold the laminæ in position. A small segment of this circle should be then placed in the cell of an object-glass, floated with water and covered with a slip of thin glass. The position of the laminæ may now be changed at will, by slackening or extending the portion beyond the edge of the glass.

It will now be remarked, that each lamina (fig. 8) is a separate and distinct process, resting on, or proceeding from, a distinct base; that it is *not* a simple vertical sheet like the leaf of a book, of equal thickness at every part, at the edge and at the base; that it is not, what seemed certain to the naked eye, a compactly-structured *single* sheet. A far more intricate arrangement discovers itself. First, each lamina, as it stands in its place and *unstretched*, forms a concavo-convex outline (fig. 8). It bulges out (*a*) like a sail in the wind on one side; it is hollow on the other (*b*). This figure is due to the fact that the free border (*c*) is denser and less extensile than the intermediate membranous portion. Many advantages are secured by such an arrangement. The individual laminæ of the series mutually support one another by a more exact and rapid adaptation of the *vis-à-vis* surfaces. They are less liable to fold and wrinkle by the rapidly varying degrees of distension to which they are exposed by the action of the margin-muscles of the mantle. But the free border of each leaflet is further so constructed as to realize a great degree of elasticity (figs. 7, 6). On looking sideways, that is, directly down upon the edge of the leaflet, the eye discovers with perfect clearness an arched or vaulted outline (fig. 7 *c*; fig. 6 *e*) formed by the *curving* round of the blood-channels of one half or layer of the sheet, in order to run into those of the other half (fig. 7 *a, e, b*). It is by this method of viewing the object that the anatomist may convince himself that each gill-plate is really composed of two distinct and separated layers (figs. 6 & 7 *a, b–a, b*), united only at the margin (*c, c*), in exact accordance with the pattern of the *single* gills of the Lamellibranchiate Acephala.

The satisfactory determination of this point of structure is of great importance in this inquiry. It possesses all the power of a key as regards the after-stages of the investigation. So extraordinary is the uniformity of the *plan* on which the respiratory organs of the branchiferous Gasteropods are formed, that it may be inferred with perfect certainty that what is clearly proved to be true of one grade in the series will apply with essential accuracy to all the others. Extremely difficult therefore though it may be to unravel the minute structure of the gill-laminæ of *Patella*, from the key-like power of the information thus only to be acquired, it is worthy of all the patience which the student can command.

Two facts of structure are then determined:—1st. That the plate is composed of two layers; 2nd. That those two layers are united by a looped arrangement at the margin. Now it may be proved with exact certainty, that each layer is composed of straight or wavingly parallel channels (figs. 6 *a, b*, and 7 *a, b*) laid on the same horizontal plane (fig. 6 *a*, as far as *i*), such that a *membrane* is formed. Although these channels are far less individually distinct than those of the gills of the Lamellibranchs, they are unquestionably blood-vessels, united together into a membrane-like series by delicate intervening fibres or membrane. Various kinds of proofs might be adduced in support of this interpretation.

The cilia follow the outline of each vessel (fig. 7 *a, b*) in a line-like manner. The vessels present a linear bulge like a tube. They can be seen to be filled with rows of corpuscles, clearly distinguishable from the fixed cells and epithelia which form the solid substance of their walls. Traced carefully in the direction of the distal margin, they become more and more separated from one another (fig. 6 *d*). The interposed substance becomes more and more pellucid, until at length at the margin the vascular loops (*c*, *c*) stand out in unmistakeable eminence. So microcosmic is the mechanism however, that it is impossible by *direct* view to state whether these vessels are separated by a water-fissure, such as that which exists in the gills of the Lamellibranchs, or whether they are joined by an intervascular membrane. In the former case, water would penetrate into the space (fig. 7 *e*) between the two constituent layers of the lamina; in the latter this space would be entirely closed from the external element. On a superficial view this point may appear very insignificant. On a deeper insight it becomes pregnant with functional and homological meaning. If the water could find a ready entrance into the interlaminar space (fig. 6 *e*, *g*), the column of blood flowing in each afferent and efferent blood-vessel (*a*, *b*), that is, in the trunks bounding that space, would be aërated on both sides, and the respiratory value of the organ would at once be doubled. It is almost certain that it does not and cannot. If the external water cannot and does not penetrate into this interlaminar space, then it must be filled by the vital fluid of the animal; for the space exists beyond doubt. If this latter supposition be true, it is quite certain that this fluid must be distinct from that which circulates in the laminar or proper branchial vessels. This doubt must for the present be left undetermined. Whether it be soluble or not, enough of the essential structure of the gasteropodan gill has been demonstrated to establish between it and the branchiæ of the Lamellibranchs an extraordinary resemblance; not a mere outline-similarity, but a closeness, almost amounting to an *identity* of constructive plan. If everything else in the patelloid organism exhibited the same degree of similitude to the system of the Lamellibranch as that which obtains in the branchial apparatus, the naturalist would not hesitate to define the Patella at once as the highest Acephalan and the lowest Encephalan. It must however be admitted, that the judgement of the classifier should not be swayed exclusively by special affinities. The question now arises, if these minute branchial leaflets of *Patella* really consist each of two layers, how are these layers tied together? They are fixed to one another by an intermediate system of threads (*trabeculæ*) crossing each other in such a manner as to afford the most effectual mutual support (fig. 6 *h*; fig. 7 *g*). The points (fig. 6 *f*; fig. 7 *d*) to which these connecting fibres or bands (fig. 7 *f*; fig. 6 *h*) are attached to the vessels are swelled into nodules (fig. 7 *d*), which present a singular resemblance to the fleshy nodules on the branchial bars of the Mussel. Of course they are much less visible than they are in the latter case, but in anatomical characters and relations they are in both cases most remarkably analogous. Now the interval between the two layers which is crossed by the threads just described, is indubitably filled with *some* fluid. What that fluid is, it is impossible at present to say.

The water-currents excited by cilia on the flat surfaces of the branchial laminæ set, from the fixed, in the direction of the free border. The cilia which are distributed over the flat faces of the leaflets are very much smaller than those which fringe the margins. The exact position to which the former are attached in relation to the lines of the blood-channels cannot therefore be clearly defined. This, however, is an unimportant point, since the *aggregate* action of the cilia, as indicated by the setting of the current, may be easily proved.

The epithelium which lines the flat surfaces of the laminæ forms undoubtedly a *continuous membrane*. It is consequently impossible that there can take place any water-currents between the individual blood-channels, such as those which figure so prominently in the mechanism of the Lamellibranchiate gills. The water-passages being wanting, it results that, in *this* Gasteropod, the branchia *is not penetrated by the aërating medium*. This fact should be regarded rather as a criterion of superior than of inferior organization. It signifies an increasing subdivision of the blood-streams. The blood-vessels being smaller, and the parietes being less dense and cartilaginous, exposure to the oxygenating medium *on one side only* suffices for the purposes of respiration. It is important in this place to remark, that if the *interlaminar* space of the branchial leaves of *Patella* could be *proved* to be filled with water and not with blood, *some* ground would be afforded, as will again be shown, for supposing that in these Mollusca the *external* water is actually admitted into the *penetralia* of the organism, forming an *aquiferous system*, and that it circulates like a nutritive fluid throughout the entire body. This, however, is a *fancy* as yet at all events totally unsupported by fact.

It is difficult to leave this part of the present inquiry without once more drawing attention to the homologous significance of the branchiæ of *Patella*. They are composed of two layers of vessels, opposed face to face, and joined at the margin. They are invested by a ciliated epithelium which is restricted to the *exterior* aspect of the organ. The constituent layers are separated by an intermediate space. In these several items of mechanism these branchiæ approximate most wonderfully closely to the type which is normal to the Acephala. If there be no meaning in this approximation, there can be no *unity* in the organic system of nature, and the philosophic anatomist may indeed well abandon his studies in despair. In conclusion it should be remembered, that between a single leaflet of the gill of *Patella* and a single lamina of the *same form and figure*, taken from any small brachyurous Crustacean, the extremest difference exists. The Crustacean gill is far less perfect, more rude in every sense, as a purposive machinery. Carrying a single stream of blood, whose corpuscles are considerably larger than those of *Patella*, and which runs in irregular passages lying between two sheets of epithelium tied together only by means of accidentally distributed islets of fleshy tissue, it contrasts strikingly with the double-vessel system with the contractile and highly ciliated elements of which the Patellan gill is woven.

For reasons derived from other sources than those of the branchiæ, the genera *Emarginula*, *Fissurella* and *Haliotis* are placed by malacologists in the Patelloid group. The branchiæ of *Emarginula* (fig. 9 *a*, *a*) approach much nearer than those of *Fissurella* (fig. 10 *a*, *a*) to the type of these organs as they exist in *Patella*. The gills of *Emarginula* are attached to the base of the cervical cavity (fig. 9 *d*) on either side of the outlet of the intestine. They project *forwards* in form of tapering processes (*a*, *a*) on either side of the head of the animal. They are chiefly fixed at the base, but a slender membranous *frenum*, proceeding from the median line of each, connects them to that portion of the mantle which covers the roof of the cavity of the shell in which the head and rectum are situated. They are thus held in one position. They possess notwithstanding a slight power of expanding and collapsing. They are foliated only on *one* side (*a*, *a*) of a base. They are more comb-like than plume-like. In this particular of configuration they approach closely to the branchiæ of *Patella*. If the latter were seated on a free instead of a fixed base, the resemblance would be very near. Occupying a position on either side of the notch (*b*) in the shell, the latter should be regarded as playing as important a part in providing a fresh current of water for the branchiæ, as in conveying away the excreta.

The ciliary movements observable in this region both in *Emarginula* and *Fissurella* point to the same inference. Examined separately under the microscope, a single leaf taken from the gill of *Emarginula reticulata* presents an outline not unlike that of *Patella*. It is, however, more lancet-shaped. In ultimate minute structure it corresponds exactly with the aptellidan model already figured. Its vessels run in parallel columns, looping at the free margin and covered by a ciliated epithelium. The interlaminar space, so unquestionable in the gill-leaf of *Patella* (fig. 6 *e*), is here however much more contracted and less distinguishable. In other words, the layers are so intimately soldered together as almost to obliterate the intervening space. The layers nevertheless carry separate and distinct planes of blood-channels. In *Fissurella* the organs of breathing (fig. 10 *a, a*) consist of two plumose tapering processes (*a, a*), projecting forwards (when fully expanded) to a considerable distance under the anterior vault of the shell. They are capable, like the arms of a Brachiopod, of being coiled up on themselves. They are distinguished from those of *Emarginula* in having a double system of leaves. These gills therefore present rather a pinnate than a pectinate figure. They stand at the sides of the chamber, the roof of which is perforated by the opening at the apex of the shell. This orifice admits fresh water into this space; it also conveys externally all refuse excretions. In the disposition of the vessels, in the character of the ciliary epithelium, in the fact of two planes of vessels, the branchiæ of *Fissurella* conform to the standard of the Patellan gill.

The branchial plume of *Acmæa testudinalis* extends to a great distance beyond the limits of the shell. It is fixed to the neck of the animal at the root of the right tentacle. It is bisymmetrically foliated; each lamina in its ultimate anatomy follows the Patelloid type. The gills of *Propilidium ancyloide* consist of two small feathery processes attached to the dorsal surface of the neck of the animal. They incline in a parallel direction to the right side of the cloacal cavity. They are free processes, and furnished with a double series of leaves, supported by an axial base, in which the afferent and efferent branchial vessels are lodged.

In *Puncturella noachina* the gill is non-symmetrical. It occupies a special and spacious chamber on the left side of the neck and foot. It is a pinnate structure highly ciliated, the lamina being large.

Judged by the structure and relations of the branchial system exclusively, the Fissurellidæ are undoubtedly placed in their true serial position by Forbes and Hanley, namely intermedially between the Limpets and Haliotidæ. They are Scutibranchiate. This cannot be said of *Acmæa* and *Propilidium*. The branchia here is not shielded by a fold of the mantle. Nor are they Cyclobranchiate, for the branchial processes are free plumes. If affinity is to be decided by structure rather than position, both *Acmæa* and *Propilidium* should be classed with the Scutibranchs.

The branchiæ in *Haliotis* (fig. 11) are sufficiently large to enable us to trace satisfactorily the distribution of the larger blood-channels. They will suffice to illustrate the circulatory apparatus of the gills in all the other Scutibranchs. The author's account is drawn from an examination of a specimen preserved in spirit, aided by the successful injections of Milne-Edwards.* *Haliotis tuberculata* is a typical Scutibranch. The branchiæ (fig. 11 *a*, *a*) are lodged in a spacious enclosure of the mantle on the left side of the body. They are attached at the base by means of the vascular trunks; on the inferior surface to some extent of their length, by means of a membranous *frenum*. They are doubly laminose; that is, between two parallel trunks (*b*, *b* & *c*, *c*), a vein and an artery, which run from the base to the apex of each gill, there lie transversely two series of leaves (a, a', a, a') which are traversed by the blood of the afferent vessel (*b*) on its path to the efferent vessel (*c*). Here again, as in all the Gasteropod Mollusks, the gills are observed to conform in *general* structure to those leafy piles which fill the thoracic cavity of the Crab; but how totally different in the minute parts of their organization! In *Haliotis* the heart (*e*) is *systemic*. The blood, freshly arterialized, returns directly from the branchiæ into the auricles (*d*, *d*); from the ventricle (*e*) it is driven into the systemic aorta (*f*). At the roots of the branchiæ the venous blood converges into capacious, but not lacunose, afferent trunks (*b*, *b*), along which it is conducted to the branchial laminæ. The vascular system of the laminæ (fig. 12) is the same in every respect as that already described and figured in *Chiton* and *Patella*.

Each lamina carries two layers of horizontally stratified, uniformly diametered tubes, united to one another laterally, and to those of the opposite venous stratum by transverse threads. Each leaflet consequently consists of two layers or planes of blood-channels, joined together at the free margin, and covered on their external surfaces by a ciliated epithelium. A thin film of water moves wavingly from the fixed to the free borders: it is sustained in motion by the vibration of the cilia. Such an arrangement proves that not only the blood to be aërated, but the water which aërates, is required in the act of respiration to be divided to the utmost degree. As far as this inquiry has proceeded, it must have been observed, that although the plumose or pinnate form of gill is constantly adopted as the most convenient figure in accordance with which to construct the respiratory organs both in Mollusca and Crustacea, the resemblance never proceeds beyond the exterior conformation and the disposition of the larger vessels. Beyond and deeper than this limit the microscope establishes an irreconcilable difference between the Crustacean and Molluscan gill. It exemplifies the supreme value of this instrument in zoological research. But apart from these physical considerations, a chemical ground of dissimilarity be-

* Annales des Sciences Naturelles, tom. viii. 1847.

tween the branchiæ of these two classes exists. The horny chitinous epithelium of the Crustacean contrasts obviously with the fleshy, soft, and ciliated covering with which the Molluscan structure is invested. In the latter the blood-movement is aided by muscular and vascular contractions. In the Crustacean the flow of the blood is due almost exclusively to the action of the heart, whose beats can be clearly read by the eye at the farthest periphery of the circulation in the saltatory motion of the floating corpuscles. In the *walled* contractile vessel of the Mollusk no such evidence is discoverable.

EXPLANATION OF PLATE XI.

Fig. 1. Respiratory chamber of *Vermetus elegans* laid open, after Quoy. *a*, branchiæ; *b*, excretory ducts.

Fig. 2. A single branchial conule of *Chiton* much magnified and viewed on its broad side. *a, a, a*, leaves; *b*, base.

Fig. 3. The former viewed edgewise, showing the axis (*b*) and the lateral leaves (*a, a, a*).

Fig. 4. A transverse section of the gill near the base, so as to exhibit the main trunks artery (*a*, arrow) and vein (*b*, arrow) in section. *e, e'*, secondary afferent and efferent trunks running along the fixed border of the ultimate laminæ (*d, d'*), in which the ultimate vessels (*c, c'*) are laid out, in parallel series.

Fig. 5. A portion of the mantle of *Patella vulgata* detached and magnified, showing the gill-laminæ, *a, a, e*, resting on a thickened ridge of the mantle (*b*); *d*, tactile papillæ; *c, c*, line of the mantle.

Fig. 6. A *portion* of the free edge of one of the branchial leaves, viewed partly sideways in order to display the space (*e, g*) by which the sheets of vessels *a, i* and *b* are separated; *h*. are the delicate threads or *trabeculæ* by which the component vascular layers are held together; *f*, the fleshy nodules to which the latter are affixed.

Fig. 7. expresses the *course* of a single ultimate branchial blood-channel from the fixed border (*a*) of the lamina, round the free border (*c*), back to the fixed border (*b*), proving the independence and continued individuality of the vessel; *e*, the space circumscribed by the loop (*c*); *d, f, g*. are the connecting thread and nodules.

Fig. 8. exhibits one branchial leaf of *Patella in situ*; it has a vaulted figure. *a*, convex part; *b*, concave; *c*, the thickened border; *d*, the row of fleshy nodules next to the free border.

Fig. 9. Outline sketch of the branchial system of *Emarginula huzandi* (Cuv.). *a, a*, branchiæ foliated on one side only; *b*, notch in the shell; *d*, base to which the branchiæ are attached; *c*, rectal intestine.

Fig. 10. Outline sketch of the branchial system of *Fissurella græca*. *a, a*, branchiæ foliated on both sides of the supporting axis; *b*, perforation in the apex of the shell; *c*, rectum.

Fig. 11. Branchial and cardiac systems of *Haliotis tubercula*. *a. a', a, a'*, branchiæ doubly foliated; *b, b*, the afferent trunks; *c, c*, the efferent; *d, d*, the double auricles; *e*, the single ventricle; *f*, the aorta; *g*, the rectal intestine.

Fig. 12. Transverse section of the former.

[To be continued.]

XXXV.—*On the Genera of Mollusca, and on the Genus* Assiminia *in particular.* By Dr. J. E. Gray, F.R.S. &c.

To the Editors of the Annals of Natural History.

Gentlemen,

I am induced to forward the following observations, occasioned by Mr. Clark's reply to my note on the genus *Assiminia*, more on account of their general application, than as simply bearing on Mr. Clark's paper. Mr. Clark must, I think, be almost the last remaining member of the Montaguan school of British malacologists who have done so much to increase our knowledge of the Mollusca of our shores. Unfortunately, however, he is not, like most of his colleagues, satisfied simply to describe and record the structure and habits of the species falling under his own observation, but wishes, without taking the trouble to study those found in other parts of the world than our own little island, to form a system of his own; to decide on the manner in which the *Mollusca* of all the world should be arranged; to give an *ex cathedrâ* opinion as to the propriety and value of groups of species of which he has probably only seen a single small and perhaps aberrant example; and to determine on the validity of a specific distinction by the observation of a collection of small extent, collected in a single locality. Malacologists must, however, always be thankful for the labours of the describer of the animal of *Cæcum, Dentalium,* and several other interesting genera, although it may be permitted them to wish that he would not publish his descriptions until he had made up his own opinions as to the accuracy of his observations, and not correct them, and then have to correct his corrections back to his old statement, as is to be found in more than one instance in his papers and work.

There can be little doubt that distinct kinds (or as we generally call them, *species*) of animals exist in nature. It is the chief occupation of a naturalist to observe the external characters, the anatomical structure and the peculiarities in the habits and manners of each of these kinds or species, and to compare them with each other, both as individuals and as collected into groups. It is equally indisputable that certain kinds, or species, have important characters in common, and it has been the custom from the earliest times to collect such kinds as have such common characters into groups, and to divide these great groups into smaller and smaller groups by such characters as are common to each; and these groups, according to their relative importance, have been called classes, orders, families, genera and subgenera; but few naturalists, I believe, regard the lower at least of these divisions as more than assemblages formed for general convenience, and not having any absolute existence in nature. I think this is sufficiently proved by the facts,—first, that there still exist, or have formerly existed, some species which are confessedly intermediate between two or more of all these divisions; and secondly, that species which are placed together even in the smallest groups frequently present some character which shows either an analogical or a special affinity with the species of several other groups. Naturalists have availed themselves of this method of grouping animals together for several reasons, but principally for the following purposes:—

1. To abbreviate the accounts of the different species or kinds.

2. To enable students, by the examination of a few striking characters, to discover the name of the animal under examination.

3. To enable them to show the relations which the different groups bear to each other and to the general scheme of creation.

If this course were not adopted, it would be necessary, in the description of every animal, to describe at length every characteristic of form, structure and habit, even those which are common to many thousands of kinds, instead of mentioning only those which distinguish it from the few most nearly allied to it; repeating under every species what are now condensed in the characters of the genera, families, orders and classes of animals, which are as a matter of course considered to be common to all the animals which make up each of these groups, and are understood to be present in each of the species referred to them. It is a further advantage of this system of classification by groups, that the minute attention requisite to make out the characters of these groups produces also great minuteness and nicety of observation, which otherwise might not exist. In the same manner, if this system of division did not exist, whereby to lessen the labour of discovering the name of any animal, we should have to go through the interminable operation of reading without order the full descriptions of all the animals which have ever been described, instead of first looking for the class, order, family and genus of the species, and then comparing it with the descriptions of the few species that compose the smaller groups, and are necessarily most allied to it.

It has therefore been the custom to consider that person as the best zoologist, who has been able, by the extent of his studies and the analytical power of his mind, to seize on and neatly describe the most invariable characters of the different groups of species, as by so doing he enables other naturalists to acquire with greater facility the knowledge they require; and the accuracy and minuteness of his own studies ought also to enable him to form more correct views as to the affinities which exist between the different species of the larger and smaller groups, and thus obtain a more clear insight into the relations which the animals bear to each other and to the rest of the creation.

In proportion as the number of animals known to naturalists has increased, by the extension of the study, the more careful researches of collectors, and the more minute examinations into the structure and habits of the different kinds, the number of groups into which they have been divided (whether called genera or subgenera) have been and are continually increasing also. For if the number of species in a group is inconveniently large, the object in forming the group has been overlooked; hence a group containing 600 or 700 species is found to be of comparatively little use in Natural History, and I must consider that a naturalist who proposes to reduce well-established groups, and to refer the species to such large groups, is evidently retrograding instead of advancing scientific objects. Such considerations sufficiently prove that it is an advantage "that a genus should be restricted in the number of its species *;" and there cannot be a doubt "that such notions are held (almost universally) by modern zoologists," although Mr. Clark may not have been "before aware" of it.

Every day's experience confirms me in the opinion which I have often expressed, that in the distinction of the larger and smaller groups of *Mollusca* the characters derived from the animal, the shell and the operculum, which all have a mutual relation to each other, are of equal value and constancy, care being taken to select such parts of them as depend on organic structure and are not liable to accidental variation. This care in selection is equally necessary in relation to the animal, as it is to the shell and operculum. Such was the idea of Lister and Adanson; but while some authors, like Lamarck, profess to arrange the *Mollusca* according to the supposed structure of the animal (but in fact took all their characters from the shell, as only so few animals were known in their time),—others, as Férussac, have declared that the form of the shell should be disregarded, and that no genus is good that is not founded on the structure of the animal. By the remark of Dr. Philippi, appended to the part quoted by Mr. Clark, he appears to have been of that opinion when he wrote the paragraph, though I believe he has since modified it; and Mr. Clark, in some of his

* I am aware there are some genera, as *Conus* in Malacology and *Solanum* in Botany, which contain very many species; but this arises from permanent characters not having yet been found by which they may be divided, and not from any disinclination on the part of naturalists to divide them.

observations, appears to regard the shell as of minor importance, the operculum as of still less, and the dentition, because it offers many forms, as of none, in a generic point of view.

I believe these notions to have arisen from these authors not having had sufficient opportunities of studying the animals with the shells, or the operculum and teeth with them both, and of seeing how thoroughly they depend on each other, and what excellent and permanent characters they afford, both separately and in combination with each other.

For these reasons, although the ancient authority of Dr. Philippi or even any more modern authority may be quoted against me, I must persist that I cannot believe animals such as *Truncatella* and *Assiminia* should be placed together in the same group, for the following reasons :—

Truncatella	*Assiminia*
1. Has a very short foot and large lips, and walks like a "looping" caterpillar.	1. Has moderate-sized lips and a large foot, and walks like a *Littorina*.
2. Has large eyes furnished with a broad white iris, sunk into the superior and nearly terminal point of short rectangular tentacula.	2. Has moderate-sized black eyes on the top of short, nearly cylindrical tentacula.
3. Has according to Dr. Philippi a "non-spiral" operculum.	3. Has a distinctly spiral operculum of few whorls.
4. Has an animal which, in its young state, forms a very slender elongated shell, then suddenly enlarges its diameter, and when it has increased its larger shell to a certain size, suddenly withdraws its body from the upper more slender part, forms a septum across the cavity behind it, and throws off the slender tip, leaving a truncated end.	4. Has an animal which forms a conical shell, which gradually increases in even proportion from its birth to its death, and always retains the shell of its young state on the tip of the older one.
5. The *Truncatellæ* live in the sea.	5. The *Assiminiæ* live in rather brackish water often far from the sea.

Let it be understood, that these are peculiarities which do not belong to a single species of each genus, as Mr. Clark appears to believe, but to each of the several species which form these groups. All the several *Truncatellæ* found in general collections of shells have these characters; and I have seen the animals of four or five species of the genus *Assiminia* from different parts of the world, and there are in collections several species of shells, which from their characters are believed to belong to the same group.

I am amused at Mr. Clark's quoting an opinion expressed by my excellent friend Dr. Philippi in 1841, as a reply to my observation in 1855. I feel assured that if he were in this country, he would be the first to repudiate such a use being made of his name. He is undoubtedly the most enlightened of the continental conchologists. Since that period he has much extended his knowledge of the animals of shells, and is now personally engaged in examining the species found on the coast of Peru; and in his most recent work he regards *Assiminia* and *Truncatella* as distinct genera belonging to different families! (See Handbuch, 173, 263.) Thus his latest work contradicts Mr. Clark's views instead of supporting them.

At the same time I may observe, that the mere external forms of the animals of several genera are exceedingly similar; and unless they are very particularly examined by a person well versed with their peculiarities, what prove to be important characters may easily be overlooked, especially if the animals are of a small size, such as can only be seen by the aid of a microscope. For this reason I am not inclined to place much reliance on Dr. Philippi's determination as to the animal of the species which he has referred to the genus, when he informs us that the animals are all hyaline, that the shell of one of them, *Truncatella littorina,* is three-quarters of a line in length, and the discoidal shell of the other, *T. atomus,* is scarcely a quarter of a line in diameter, and that he was obliged to magnify it sixty diameters to observe it.

I think I need only quote the various genera, to which those who have examined the animal of the only British species of *Truncatella* have referred it, viz. *Cyclostoma, Paludina,* and lastly *Rissoa* (to which Dr. Philippi referred it even after he had figured it), to show that naturalists who consider the animal as the only basis of a generic character, are more unstable in their opinions than those who regard the shell and operculum as of similar value in a scientific point of view. I may add, to show how comparatively imperfect was Dr. Philippi's idea of this mollusk, in the account of the animal quoted by Mr. Clark as published in 1841, and again in 1844, that he considers it necessary to point out how it differed from the terrestrial genus *Cyclostoma,* and the fluviatile *Paludina,* both belonging to very different families according to his present views.

Mr. Clark would have quoted his authorities more correctly, if he had stated,—first, that Dr. Philippi referred his third species (t. 24. f. 4) to the genus with a mark of doubt!—as he never examined the animal. It is the figure of this species which Mr. Clark thinks "may be intended to represent our *Truncatella Grayana*." On this head it is only necessary to observe (and showing, at the same time, the dependence to be placed in Mr. Clark's quotation of synonyma), that as Dr. Philippi found this species very frequently in the sea at Palermo, it is to be supposed that he had observed it in all its ages; and he describes "the shell as half a line high, and one-third of a line broad, subturrited, blunt, the whorls rounded, the last not ventricose"—which does not very exactly fit our *Assiminia Grayana*, as the latter lives in brackish water, often at such a distance from the sea, that, after rains, the ditches are nearly fresh—measures one-third or more of an inch in length, is of a conic shape, acute at the top, and with scarcely raised whorls, the last somewhat angular in front. I could as soon believe that the littoral *Purpura Lapillus* and the pelagic *Buccinum undatum* were the same species, as they do not differ in more important characters; and I feel assured that Mr. Clark proposes to unite in his work many species from superficial examination and incorrect comparison.

Secondly, Mr. Clark might also have stated, that Professor Forbes and Mr. Hanley have removed one of the species (*T. atomus*), which Dr. Philippi had described as belonging to the genus *Skenea*; and that Mr. Clark himself, in his 'Mollusca,' p. 386, refers this species to the genus *Truncatella* with doubt! And while on this species I may observe, that I must beg to doubt the accuracy of Mr. Clark's observation, when he states that this species, which has a circular mouth to the shell and a cylindrical body to the animal, has an "operculum which is precisely of the same grossly spiral character and sculpture as in *Truncatella Montagui* and *Truncatella littorea*"—which have an ovate mouth to the shell, and the body of the animal compressed; such a combination of characters being directly at variance with all my experience. I am assured that *T. atomus*, on the contrary, has a circular multispiral operculum like *Trochus*, which, according to Mr. Clark's most extraordinary theory, ought to remove it from *Truncatella* to quite a different order in his sexual system of Mollusca. It is to be regretted that Mr. Clark observed the operculum of this species so superficially, when he professes to have been able to see a white pupil on the eye of a dried specimen of the animal, which animal in its entire state is scarcely a quarter of a line in diameter!

I adduced as one of the reasons proving that *Assiminia* is not a *Truncatella,* that it had not the white pupil which Mr. Clark has shown to be one of the characters of the group; on which Mr. Clark observes, "I do not understand the logic of this; the point in question is a mere specialty; one may with as much reason say that a man with a red iris or pupil, for example an *albino,* is not of the genus Man, because he has not the usual dark or grey iris; so, it is equally absurd to infer that *A. Grayana* is not a *Truncatella,* because the white iris or pupil was not detected." Surely Mr. Clark must know the difference between an accidental *lusus,* like an *albino* man or woman, and a character common to all the specimens of a species, and all the hitherto-observed species of a group. The argument objected to may be "illogical" and "absurd," though I own that I do not think it so; but at any rate I am not answerable for its use, for in Mr. Clark's 'Mollusca,' p. 386, occurs the following passage, referring to *Truncatella atomus*: "moreover, the eyes in the dried animal are perfectly visible, and show the *characteristic* white pupil of what may now be safely termed its *congener.*"

In explanation of Mr. Clark's pertinacity on this head, we must bear in mind that his character as a soothsayer or prophet is dependent on his proving that *Assiminia* is a *Truncatella*; for before he had seen the animal, at page 385, and again at page 521 of his 'Mollusca,' he predicts, "that when the animal is better known, it will belong to the latter genus."

This is a good illustration of what I consider one of the principal defects of Mr. Clark's work. From some important observation, or from some *à-priori* theory, he picks up a crotchet, such as that the water does not enter by the lower siphon of the Bivalves, that the teeth are not good generic characters, that all the animals with a multispiral operculum are unisexual, &c., &c.; and forthwith he proceeds to examine specimens, apparently not with the desire to discover if the idea is founded in fact, but to prove the truth of it; and it is astonishing how his power of observation appears to adapt itself to his preconceived theory, and enables him to see just what he wishes, though to other observers the facts are clearly contrary. In the same manner, it appears to me that when he reads a work, some of the observations of the author seem to take possession of his mind, and after a time he appears to forget that they are not founded on his own observations, and puts them forth as his own discoveries. Thus his new system itself is (unwittingly perhaps) only copied from the works of Blainville and Leach, and his referring the genera *Skenea* and the elongated *Cerithia* to *Rissoa*, are derived from an observation of Lovèn, who did not, however, regard them as species of those genera, but only intended to show that an affinity existed between them, as far as the outer form of the animal was concerned.

I am, Gentlemen,
Your obedient Servant,
J. E. Gray.

XXXVI.—*A few Remarks on the* Brachiopoda. By Thomas Davidson, Esq., F.G.S. &c.

[With a Plate.]

1. *On the Systematic Arrangement of Recent and Fossil Brachiopoda.*

Shortly after the publication of the *General Introduction* to my work on 'British Fossil Brachiopoda,' to which Prof. Owen and Dr. Carpenter each contributed most valuable chapters, M. Deslongchamps and his son proposed to make a French translation of the third chapter treating especially of *Classification*, which the Linnæan Society of Normandy had in the most liberal manner offered to publish in the tenth volume of their Transactions. About the same period I received a similar offer from M. Suess and Count Marschall of Vienna with respect to a German translation. But although highly flattered by such liberal propositions, I felt that much could be done to improve the original by corrections, as well as by considerable additions, both in text and illustrations. I therefore entirely revised my English work, printed in 1853, before it went through the process of translation, and owing to the exertions of my friends, I am happy to say that both editions are now printed, and I trust will be ready for issue by the end of the present year.

As stated in my English work, we are not yet in a condition to offer a really complete and permanent classification of the numerous species composing the class; for to be able to do so effectually, one would require to be still better acquainted with the recent animals as well as with the interior of many obscure fossil species; and it is therefore of the greatest importance not to allow ourselves to be led into proposing *genera* or *subgenera* on trifling modifications or unimportant details which exist only in certain abnormal forms *.

* For example, the genus *Seminula* (M'Coy) is founded on the more developed state of the dental plates, while otherwise the shells in question possess all the essential characters of Lhwyd's original genus *Terebratula*.

The following is an improved Table of Families and Genera as published in the Foreign editions of my "Introduction": —

Families.	Genera and Subgenera.	Author.	Date.	Examples.	Geological distribution at present known. Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
I. TEREBRATULIDÆ ...	TEREBRATULA	Lhwyd	1699	*vitrea, maxillata, diphya, hastata, &c.*	?	*	*	*	*	*	*	*	*
	Subgenus *Terebratulina*	D'Orb.	1847	*caput-serpentis, substriata, gracilis*	...	...	...	...	...	*	*	*	*
	— *Waldheimia*	King	1849	*flavescens, ornithocephala, cardium*	...	...	...	...	?	*	*	*	*
	— *Meganteris*	Suess	1855	*Archiaci*	...	*	...	...	...	...	...	...	...
	TEREBRATELLA	D'Orb.	1847	*Chilensis, dorsata, Coreanica*	...	...	...	...	...	*	*	?	*
	Subgenus *Megerlea*	King	1849	*truncata, lima*	...	...	...	...	...	...	*	*	*
	— *Kraussia*	Dav.	1852	*rubra, cognata, Lamarckiana*	...	...	...	...	...	...	...	...	*
	— *Magas*	Sow.	1818	*pumila, orthiformis, Davidsoni*	...	...	...	...	...	...	*	...	...
	— *Bouchardia*	Dav.	1849	*tulipa*	...	...	...	...	...	...	...	...	*
	— *Morrisia*	Dav.	1852	*Anomioides, Davidsoni*	...	...	...	...	...	...	...	...	*
	ARGIOPE	Deslong.	1842	*decollata, megatrema, cistellula*	...	...	...	...	...	?	*	*	*
	Subgenus? *Zellania*	Moore	1854	*Davidsoni, liasiana, Laboucherei*	...	...	...	...	...	*	...	...	...
	STRINGOCEPHALUS	Defrance	1828	*Burtini, giganteus*	...	*	...	...	...	...	...	...	...
	THECIDIUM	"	"	*radiatum, digitatum, sinuatum*	...	...	...	...	*	*	*	*	*

II. SPIRIFERIDÆ	SPIRIFERA	Sow.	1815	*striata, alata, Archiaci, glabra*	*	*	*	*	*	...	...	...	...
	Subgenus *Spiriferina*	D'Orb.	1847	*rostrata, cristata, Münsteri, Tessoni*	...	...	*	*	*	*	...	...	...
	—— *Cyrtia*	Dalman	1827	*trapezoidalis, Murchisoniana*	*	*	*	...	?	...	...	...	...
	—— *Suessia*	E. Desl.	1854	*costata, imbricata*	...	...	...	...	...	*	...	...	...
	ATHYRIS (= *Spirigera*, D'Orb.)	M'Coy	1844	*concentrica, pectinifera, Roissyi*	*	*	*	*	*	*	...	...	...
	Subgenus *Merista*	Suess	1851	*Herculea, scalprum, tumida*	*	*	?	...	...	...	...	...	...
	—— ? *Retzia*	King	1849	*ferita, Adrieni, serpentina*	*	*	*	...	*	...	...	...	...
	—— *Uncites*	Defrance	1828	*gryphus*	...	*	...	...	...	...	...	...	...
	ATRYPA	Dalm.	1827	*reticularis, marginalis, Prunum*	*	*	...	...	...	...	...	...	...
?	KONINCKINA	Suess	1853	*Leonhardi*	...	...	...	...	*	...	...	...	...
	Subgenus *Anoplotheca*	Sandberger	1855	*venusta*	...	*	...	...	...	...	...	...	...
III. RHYNCHONELLIDÆ	RHYNCHONELLA	Fischer	1809	*loxia, acuminata, psittacea, Wilsoni*	*	*	*	?	*	*	*	*	*
	CAMAROPHORIA	King	1844	*Schlotheimi, multiplicata, globulina*	...	?	*	*	*	...	...	...	...
	PENTAMERUS	Sow.	1813	*Knightii, galeatus, carbonarius*	*	*	*	...	...	...	...	...	...
IV. STROPHOMENIDÆ	PORAMBONITES	Pander	1830	*æquirostris, reticulatus, Ribeiri*	*	...	...	...	...	...	...	...	...
	ORTHIS	Dalman	1827	*rustica, elegantula, Bouchardi*	*	*	*	...	?	...	...	...	...
	Subgenus *Orthisina*	D'Orb.	1849	*ascendens, anomala*	*	*	*	*	...	...	...	...	...
	STROPHOMENA	Rafin.	1820?	*planumbona, alternata, rhomboidalis*	*	*	*	...	...	...	...	...	...
	Subgenus *Leptæna*	Dalman	1827	*transversalis, Davidsoni, oblonga*	*	*	*	?	*	*	...	...	...
	DAVIDSONIA	Bouchard	1849	*Verneuili, Bouchardiana*	...	*	...	...	...	...	...	...	...
V. PRODUCTIDÆ	CHONETES	Fischer	1837	*sarcinulata, comoides, armata*	*	*	*	...	...	...	...	...	...
	PRODUCTUS	Sow.	1814	*semireticulatus, Martini, horridus*	?	*	*	*	...	...	...	...	...
	Subgenus *Strophalosia*	King	1844	*excavata, Morrisiana, Gerardi*	...	*	*	*	...	...	...	...	...
	,, *Aulosteges*	Helmersen	1847	*Wangenheimi* (=variabilis)	...	...	...	*	...	...	...	...	...
? ?	CALCEOLA	Lamarck	1809	*sandalina*	...	*	...	...	...	...	...	...	...
VI. CRANIADÆ	CRANIA	Retzius	1781	*Brattenburgensis, anomala, costata*	*	*	*	*	*	*	*	*	*
VII. DISCINIDÆ	DISCINA	Lamarck	1819	*lamellosa, striata, Cumingi*	*	*	*	*	*	*	*	*	*
	Subgenus? *Tremalis*	Sharpe	1847	*terminalis*	...	*	...	...	...	...	...	...	...
	SIPHONOTRETA	Verneuil	1845	*unguiculata, verrucosa, anglica*	*	...	...	...	...	...	...	...	...
	Subgenus *Acrotreta*	Kutorga	1848	*subconica, disparirugata*	*	...	...	...	...	...	...	...	...
VIII. LINGULIDÆ	LINGULA	Bruguière	1789	*anatina, Dumortieri, Beanii*	*	*	*	*	*	*	*	*	*
	OBOLUS	Eichwald	1829	*Apollinis, sculpta, Davidsoni*	*	...	...	...	...	...	...	...	...

This arrangement, although still imperfect in some respects, will I hope be found to possess advantages over the one published in 1853, being more simple and perhaps nearer to the truth. In the first place, we have got rid of all the subfamilies; the genera are located into eight families; that of *Calceolidæ*, which formed the ninth, being suppressed, on account of the great uncertainty still existing, as to whether or not *Calceola* is a true Palliobranch. M. Suess seems to believe that it is not so; but as much doubt remains as to where the shell should be located among the Mollusca, we have left the name provisionally in the Table, and must refer the reader to the German edition for more ample details on this point. Mr. S. P. Woodward, in whose knowledge on all appertaining to the Mollusca the greatest reliance may be placed, has also adopted eight families in his excellent 'Manual of the Mollusca,' and the only difference in opinion between us is whether the fourth family should be termed **Strophomenidæ** or **Orthidæ**. I adopted the first name simply on account of priority, but quite agree that my friend is right when he states that the names of families should be formed from those of the typical genera; the only question which might arise in the present case being, which of *Orthis* or *Strophomena* is in reality the typical genus.

Among the *genera* and *subgenera* we have proposed the following changes:—

1. **Terebratulidæ.** *Kraussia, Magas, Bouchardia* and *Morrisia* have been placed among the *subgenera* of TEREBRATELLA, as this last may be considered the great typical *genus* to which the subgenera mentioned are more nearly related than to that of any other group. *Trigonosemus* we have consented to erase on M. Suess's proposition, as it possesses all the essential internal characters of *Terebratella*, of which it is only a synonym; the largely developed cardinal process of *T. elegans* is not found in all the other forms which had been located with *Trigonosemus*, nor has the beak always the peculiar shape of the last-named species. *Lyra* (Cumberland) = *Terebrirostra*, D'Orb., appears to be composed partly of shells belonging to *Terebratella* and perhaps *Waldheimia*, and as the greater or lesser length of the beak is of very little generic importance among the Brachiopoda, that *section* can be advantageously dispensed with. *Stringocephalus* and *Thecidium* have also been admitted into the present family, which seems to be their most natural resting-place.

2. **Spiriferidæ.** The changes we have made in this family consist in re-establishing Prof. M'Coy's genus ATHYRIS as typified by such shells as *T. concentrica, lamellosa*, &c., and adopting the subgenus *Merista*, Suess, for *T. Herculea, scalprum, tumida*, and other such shells. This last mode has been adopted by Mr. S.

P. Woodward,—the name *Spirigera,* D'Orbigny, will therefore require to be considered a synonym of Athyris; but I must also mention that continental palæontologists seem more disposed to prefer D'Orbigny's denomination, on account of the zoological contradiction attached to that published by Prof. M'Coy in 1844. It has also been found desirable to reduce the value of Defrance's genus *Uncites* by placing it among the subgenera depending upon Athyris.

The family and place of the genus Koninckina (Suess) is to my mind still uncertain; some would place it among the **Spiriferidæ**, others among the **Strophomenidæ**; but I prefer to leave the question open for the present; and may say the same relative to Dr. Sandberger's newly proposed genus Anoplotheca, which has been considered both by the author and by M. Suess to be nearly related to Koninckina.

3. Among the **Rhynchonellidæ** I can propose no changes.

4. **Strophomenidæ.** To this family I have added Pander's genus Porambonites, and placed *Orthisina* as a subgenus of Orthis; but it may also perhaps be advisable to retain as a subgenus of *Orthis* Prof. King's section *Streptorhynchus* for such shells as *S. pelargonatus,* Schloth.;—*Leptæna* filling a similar position relative to Strophomena. The genus Davidsonia is also admitted into this group; and I must here express my regret at not being able to coincide with my friend M. de Koninck, who has in his last paper (1855) on the subject considered it as a genus of the family **Productidæ**: it does not possess the reniform impressions (supposed to be vascular) of the last-named family, but agrees in this particular and in several others with the **Strophomenidæ**, among which it had been already located both by Professor King and Mr. Woodward.

5. **Productidæ.** Here I have effected no further change than that of placing *Strophalosia* as a *subgenus* of Productus; but I must add, that I consider Prof. M'Coy greatly mistaken in removing *Strophalosia, Aulosteges* and *Chonetes* from the **Productidæ**, and placing them among the **Strophomenidæ**; nor can I agree for the same reasons with M. Semenow, who has also lately proposed to remove Fischer's genus *Chonetes,* as had been done by Prof. M'Coy before him. By following such a system the clearly defined characters appertaining to the present family are destroyed, and the great similarity of the interior, and particularly that of the reniform impressions, common to *Productus, Aulosteges, Strophalosia* and *Chonetes,* completely lost sight of, as this last character has not hitherto been observed in any of the shells which belong to the **Strophomenidæ**. If those genera or subgenera require to be removed, Productus will require to

follow, and the family to which this last-named genus gives its name be completely dispensed with.

In the sixth, seventh and eighth families we have made no further changes than to entirely expunge D'Orbigny's genus *Orbiculoidea*, there existing at present no valid grounds for its adoption.

It is difficult to see much order or interdependence in the succession of groups. It seems that the hingeless genera, *Lingula, Obolus, Crania, Discina* and *Productus*, which commenced in the earliest æra, soon attained their climax, since only three of them, *Crania, Discina* and *Lingula*, have passed the limits of the palæozoic age. They are also least unlike the Lamellibranchs (*e. g. Anomia, Hippurites, Spondylus*). Of the hinged genera those provided with calcareous spires were certainly developed first, no example having as yet been found above the lower portions of the Jurassic strata; while, on the contrary, the genera provided with loops become important in the Jurassic period and continue up to the present time. For in all the Palæozoic epoch we are acquainted with but few species which possessed loops, and until M. Suess's discovery of the interior of *T. Archiaci* no species with a *long* loop had been discovered, if we except *Stringocephalus*.

Thus taking our present Table as a basis for our conclusions, we find the genera and subgenera distributed in time as follows:

In the *Silurian* 20. In the *Devonian* 25. In the *Carboniferous* 19. In the *Permian* 12. In the *Triassic* 12. In the *Jurassic* 14. In the *Cretaceous* 12. In the *Tertiary* 10. In the *Recent* 14.

These details vary but little from those published in 1853, but it is to be expected that future discoveries will still slightly modify our statistics, as there are many obscure forms which have hitherto resisted our investigation.

It would take up too much space to enter here upon the numerous additions made to the two foreign editions, but we cannot pass in silence the interesting discovery of the perfect interior of that shell known under the name of *Rhynchora Davidsoni* (De Koninck), and of which the *Anomia spathulata* of Wahlenberg is another similar form, this last being the second type of Dalman's objectionable genus *Rhynchora**. During the

* Dalman proposed his genus *Rhynchora* in 1827, with the following diagnosis :—" Smaller valve truncated at its base, larger valve with a nearly straight? elongated beak : *Rhynchora costata* (Wahl.), *Rhyn. spathulata* :" but it is certain that neither of those shells has a lengthened beak like *Lyra*; and if Dalman intended to refer his species to Cumberland's genus (as Hisinger would lead us to believe), he was there again in error, as it is certain that they do not even belong to the group.

minute and elaborate investigations made by M. Bosquet for his fine work (now in the press) on the Brachiopoda of the Cretaceous beds of Maestricht and its vicinity, that able palæontologist discovered that the interior of the shell in question (apart from its peculiar hinge-plate) was exactly similar to *Magas,* and with his kind permission we have reproduced (in fig. 4) the drawings kindly forwarded by the Belgian author. That the genus *Rhynchora* should be expunged there can remain but little doubt, since it was based on no valid characters, and those which have been supposed to exist have proved incorrect.

We will now revert to the principal object of this communition, which was intended to call attention to certain interesting observations published abroad, but which appear unknown to, or to have been overlooked by British naturalists.

2. *On the Claims to Priority in the discovery of the peculiar function of certain Muscles in the opening and closing of the Shell of* Terebratula.

Prof. Sedgwick in pages xi and xii of his Introduction (British Palæozoic Rocks and Fossils, October 1855) still appears to consider the merit of the above-mentioned discovery to be due to Prof. M'Coy, since we find stated in the work quoted, "I avail myself, however, of this occasion to state *why* I believe that Prof. M'Coy was the original discoverer of the peculiar muscular action on a leverage supplied by what he calls the 'entering valve,' which, in the absence of the cartilage, enabled the Brachiopoda to open their shells 'in a manner unexampled in Lamellibranch Bivalves'" (p. 191). He however admits that Mr. Woodward had discovered and published this remarkable fact (in his Manual) a year before Prof. M'Coy's 2nd Fasciculus was out of the press, but seems to base the Professor's claims on the statement of his having found it out in 1848 or '49, and *mentioned* the circumstance to Mr. Hopkins and Mr. Morris, but who nevertheless did not communicate on the subject with any other person with whom I am acquainted. Knowing the high value Prof. Sedgwick attaches to historical statements, and his wish to see justice done to every one, I will add a few details which I trust will help to clear up and terminate this subject. It will not be necessary here to repeat what I published in the Introduction to my work on British Fossil Brachiopoda, pp. 54 and 55, 1853, any further than to say that I believe it was there demonstrated, *that Prof. M'Coy could not claim priority on this point;* but at that period I was myself unacquainted with Prof. Quenstedt's still more ancient claims, which I found out shortly after, while reading Dr. Gratiolet's paper entitled "Note sur les muscles des Térébratules, et en particulier de la *Terebratula australis*" (Académie des Sciences, Paris, 11 July 1853), but printed some short time after our Introduction had gone through the press. My object not being to enter upon a detailed account of the muscles, which have been fully described elsewhere, I must refer the reader to the French author's paper*; contenting myself with reproducing in this place a translation of that portion only which relates to the subject under discussion. After referring to the different opinions advanced by authors as to the mode in which *Terebratulæ* open their shell, Dr. Gratiolet states that "all these hypotheses are more or less ingenious, but do not satisfy a severe investigator. Prof. Quenstedt alone seems to me to have arrived at the true explanation (Wiegmann's Archiv, vol. ii. p. 220, 1835). This able anatomist, founding his views on very precise reasons derived from the mode of articulation of the valves, was the first to point out *two orders of muscles, of which the one closed, while the other opened the valves.* Unfortunately Prof. Quenstedt's paper is both short and without plates" (this last statement is not strictly correct, since we find three diagrammatic figures), "so that the opinion of this clever author did not make way, and is not even alluded to in MM. Siebold and Stannius's Manual, which is otherwise so complete. This unjust forgetfulness has appeared to me worthy of being noticed; besides which, among the descriptions which have been given of the muscles of the *Terebratulæ*, not one is to my mind intelligible, and I have therefore deemed it useful to revert again to a subject so interesting." After having read the above, I lost no time in procuring a copy of the paper so highly spoken of by the French savant, and of which I now offer the entire translation.

On the mode in which Brachiopoda open and close their Shell. By Prof. QUENSTEDT †. Pl. X. figs. 6, 7, 8.

"Prof. Owen's anatomy of several *Terebratulæ* has excited the greatest interest ‡. In general we may place the utmost confidence in the researches of that author, on account of his beautiful works and investigations on other subjects. But when,

* In the explanation of the Plate I have reproduced the names given by M. Gratiolet to the muscles, also those by Prof. Owen, and those used by myself.

† Ueber das Oeffnen und Schliessen der Brachiopoden. Wiegmann's Archiv, vol. ii. pp. 220–222. pl. 4. f. 4, 5, 6, 1835.

‡ Prof. Quenstedt means Prof. Owen's first paper published in the Transactions of the Zoological Society. 4to. Vol. i. 1835.

in his theoretical considerations, he is of opinion that the elasticity of the calcareous appendages [of *Terebratula*] is sufficient to enable the animal to raise the reflected portion [of the loop] so as to force open the opposite valve, it must be remarked, that he has himself demonstrated that in the greater number of cases this explanation is not applicable. I believe, moreover, that in the instances indicated, the calcareous appendages had no other function than to protect the soft internal organs, and that they can hardly furnish the proper means of opening the shell.

"If we examine the non-perforated or ventral valve (*dorsal* of Owen*) of any *Terebratula* whatever, we immediately remark that the inner and incurved extremity of the beak (*umbo*) is entirely hidden under the deltidium of the dorsal valve (*ventral* of Owen). On opening the shell this extremity is deeply sunk (or hid) under the deltidium, since the points of attachment on which the ventral (*dorsal*) valve is moved are formed by the two lateral teeth of the dorsal (*ventral*) valve; these teeth are perfectly established at the height of the auricular expansions, and correspond with the sockets of the ventral (*dorsal*) valve. Since this point of support is placed on each side towards the middle of the beak, it follows, that a force applied to this beak must open the valve as a lever would do. In effect we remark also at this extremity two well-defined muscular impressions, which lead us to suppose the presence of muscles which must often have been largely developed, so as to have transformed the extremity of the beak into a large surface. These muscles direct themselves from thence towards the large anterior impressions of the dorsal (*ventral*) valve, and by the most direct road, without crossing each other. These contractions must, therefore, have determined *the opening of the shell*, and it is with justice that they have received the denomination of *opening* muscles (*Oeffnungsmuskeln*). The double muscular impression situated on either side of the dorsal line (*septum*) might be easily explained, inasmuch as each of the two *opening muscles* divided itself into two bundles or branches in order to obtain a larger surface of attachment.

"The *closing muscles*, on the contrary, direct themselves from the ventral (*dorsal*) valve under the point of support towards the bottom of the beak, so as to *produce the closing of the valves* by their contraction; they also divide themselves each at its point of attachment to the ventral (*dorsal*) valve into two branches. *Terebratulæ* therefore possess *two closing muscles* and *two opening*

* Prof. Quenstedt makes use of the old system of calling the perforated valve the *dorsal* one, &c. I have placed within brackets Prof. Owen's (and now generally admitted) mode of denominating the valves.

ones, each of which is divided into two bundles or branches after leaving its points of attachment, towards the middle of the shell. They unite the valves by direct means, and we find moreover some muscles which intersect or cross each other, but these last have rather for function the movement of the portions of the body than those of the valves. The perfectly dried condition of the muscles generally permits of these being distinguished in specimens preserved in collections, and are so disposed that we are enabled to follow their mechanism with the eye. *This mode of opening constitutes for the Brachiopoda a most suitable and proper distinguishing character, and renders needless any other more complicated definition for them.*

"If nature has thus meant to furnish the *Terebratulæ* with a mechanism so suitable, then Cuvier's opinion that *Lingula* opened its valves by means of these fleshy oral arms, using them as a wedge, is no longer tenable. If things had so operated, the arms would constantly find themselves in a constrained position from the compression of the valves, and would become inconvenient organs. It seems to us much more evident, that both valves in the animal (*Lingula*) must not bear the same denomination, since the dorsal (*ventral*) valve possesses (as in *Terebratula*) a longer beak, and its sides present equally a kind of auricular expansion, so that these are situated low enough to allow that the ventral side may separate from the dorsal one on the principles of a lever.

"Cuvier also expressly points out that we find at the summit of the hinge a muscle which unites the valves in the most direct manner: it is probably the *opening muscle*. On the contrary, the two muscles which unite the valves towards the middle of their length have for function the closing of the valves.

"It is probable that in *Crania* and *Orbicula* (*Discina*) the mechanism is more difficult to explain: however, it is certain that it must be analogous, since those animals possess so many analogies."

This evidence is so clear, that no comment will be required to demonstrate that it is to Prof. Quenstedt *the merit devolves* of having *first discriminated and published what Prof. M'Coy now claims*—no doubt from not having been acquainted with the paper of which we have given a translation; but had even these observations, published in 1835, not existed, I still maintain that the claims of the author of the 'British Palæozoic Fossils' *could not* be maintained.

I have added in Plate X. fig. 5. a reduced copy of the improved diagram illustrating the muscular system in *Terebratula* by Mr. Hancock, to help those who are not so familiar with the subject to better understand the position of the muscles than can be made out in Prof. Quenstedt's diagrammatic figures. Before quitting the subject of the muscles, I may likewise remind the reader, that Mr. Hancock has objected to the hypothesis of "the sliding action of *protractor* and *retractor* muscles;" he regards the decussating muscle as a "compensator for the want of teeth at the hinge; a means of keeping the valves opposite to each other:" he says, "The valves would appear to be opened somewhat in the manner of the Bryozoa by the aid of fluids. The *posterior adductor* contracts, the anterior relaxes; the fluids are pressed forwards, the valves separate. The protrusion of the arms will also help."—Hancock, MS.

The justness of these remarks, at least in *Crania*, would appear to be confirmed by Mr. Barrett's observation, "that the valve opens by moving upon the straight side, as on a hinge without sliding the valve."

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3. *On the Sexes and Ova of the Brachiopoda.*

In the first chapter of the Introduction to my work on the British Fossil Brachiopoda (p. 21), Prof. Owen adds many interesting observations he had made on the "*Generative System;*" it will therefore not be devoid of interest to give here a translation of what Prof. Oscar Schmidt has also published on the same subject*.

"From his examination of the animal of *Terebratula* preserved in spirits of wine, Prof. Owen arrived at the conclusion that the sexes were separate, and lately M. J. Müller † has brought forward a similar supposition. I had also become certain of this point after my examination of the living *Terebratula* which I obtained in the Oexfjord during my journey to Norway in the summer of 1850, and I have already published these observations in the second edition of my 'Comparative Anatomy,' p. 314, 1852, as well as in p. 295 of my 'Manual of Zoology,' 1854. The sexual glands are found in the mantle, and their shape varies according to individuals (Pl. X. fig. 9). In the species of *Terebratula* examined by myself ‡ the testicles

* "Die neuesten Untersuchungen über die Brachiopoden von Owen, Carpenter und Davidson, mit einigen Zusätzen." (Printed in the Zeitschrift für die gesammten Naturwissenschaften, p. 327, pl. 11, 12. May 1854.)

† "See the reports of the meetings of the Naturforschende Freunde of Berlin."

‡ "This species was often obtained by myself in the Oexfjord, and is not mentioned in Lovèn's 'Index der Scandinavischen Mollusken.' From the structure of the shell it can hardly be distinguished from the *Waldheimia australis*.

"The *Terebratulæ* from the septentrional shores of Norway, according and ovaria resemble each other; the zoosperms are in the shape of a thread with a small head (fig. 10). Prof. Owen was likewise able to observe the first commencement of the development of the ova in the *Lingula* (fig. 15); the embryos, first of an elliptical shape, form a stem a little later, without any change having been effected in the ulterior organization or development. The embryos of the said *Terebratula* differ from this very considerably (fig. 11); they resemble a *Euastrum* composed of two unequal halves (for instance, the *E. gemmatum* or *ansatum*, Focke); the rounded portion seems to be the anterior; the posterior part is a little wider, and is prolonged into two points. What is the following development? In none of the ovaries observed by myself—for it is there that the embryo is found—was the development more perfect. Considering our total ignorance relative to the development of *Terebratula*, every observation must prove acceptable."

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4. *On certain calcareous Plates found in the mantle, oral arms, and cirri of* Terebratulina caput-serpentis.

In the same paper, Prof. Schmidt observes, "that the mantle, oral arms and cirri in *Terebratulina caput-serpentis* contain an innumerable number of calcareous plates, generally flattened, dilated and irregularly denticulated, situated in close vicinity to each other, as seen in the examples figs. 12, 13 & 14. It is easily conceived that these calcareous masses stiffen the parts which contain them, and seem particularly to serve this function in the hollow cirri, thus preventing their sides from sinking down. In the Norwegian *Terebratula* I examined they are not to be found, nor have I obtained any in *Terebratella dorsata*; but further investigation conducted on a larger number of species will show whether they are or are not peculiar to the *T. caput-serpentis*."

We may here mention that M. E. Deslongchamps has observed a somewhat similar occurrence in his new species of *Morrisia*, for we find stated in a note he has added to my description of *Morrisia* (French edition): "Having placed in water during several hours a *Morrisia*, which contained in its larger valve a portion of its cirriferous arms, as well as their desiccated membrane, we were able, after their immersion, to extend them more than before: in placing these remnants under the microscope we saw that they contained irregular scattered granulations

to M. Lovèn, are the *Ter.* (Rhynchonella) *psittacea*, *T. caput-serpentis*, *T. cranium*, and *T. septigera*. Mine answers better to *T. septigera* than to the others, but it does not possess the characteristic septum in the smaller valve."

touching each other by their angles, but which left here and there free spaces. After having dried up these remains of the animal on the slide of the microscope, their granulations had not changed in appearance, but seemed to us of a calcareous nature: one may compare these membranaceous parts furnished with calcareous granulations to the skin of certain star-fish, but the granulations in *Morrisia* do not present regular shapes, nor are they symmetrical in their arrangement."

These facts are of great value (as justly stated by M. Suess) in helping us to understand that beautiful calcareous network which is observed in the interior of many species of *Thecidium.*

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5. *Waldheimia septigera,* Lovèn, sp. Pl. X. f. 1.

Terebratula septigera, Lovèn, Index Moll. Scand. p. 29, 1846.
Waldheimia septigera, Catalogue of the Mollusca in the British Museum, p. 59. 1853.

Shell inequivalve, tumid, ovato-triangular or somewhat obscurely pentagonal, truncated in front; colour almost white, subpellucid, smooth, marked only by a few lines of growth. Beak moderately produced, slightly incurved and obliquely truncated by a circular foramen of moderate dimensions, partly completed by and separated from the hinge-line by a deltidium in two pieces; beak-ridges well defined. The smaller or *dorsal valve* is not so deep as the opposite one, the convexity originating at the umbone continued by a gentle curve until it attains about the centre of the valve, when the remaining half declines more rapidly, and especially when approaching to the front, producing a slight medio-longitudinal convexity, with a moderate depression on either side; the two lateral portions of the valve presenting more elevated rounded curves. The larger or *ventral valve,* on the contrary, is biplicated, the mesial *concavity* corresponding with the median *convexity* of the opposite valve. The simple attached reflected loop extends to about three-quarters of the length of the shell; a median septum exists along the bottom of the valve, whose presence is betrayed by a dark line on the outer surface of the valve. Length 12, width 9, depth about 7 lines.

Hab. Norway: Finmark.

Obs. This remarkable shell (named by Lovèn in his Index Moll. Scand.) does not appear to have been hitherto figured or sufficiently described. It seems rare, since the only example with which I am acquainted, and from which the above description and illustrations are taken, was originally in the possession of Mr. Hanley, who, in the most liberal manner, added it to Mr. Cuming's unique collection of recent species. Messrs. M'Andrew and Barrett have also informed me that during their two months' dredging along the Norwegian coast last summer they never had the good fortune of seeing it, although much looked for, while *Waldheimia cranium* (fig. 2) was obtained several times during that period. I therefore thought it useful to figure this interesting form, which presents more than ordinary interest on many accounts.

It appears the reverse of *Terebratula biplicata,* having the biplication on the larger or *ventral valve* instead of on the *dorsal* one, as in Brocchi's species. It also approaches much in shape to some fossil oolitic species, and especially to one termed *Leufroyi* by M. E. Guérange in his 'Répertoire Palæontologique du Dép. de la Sarthe" (1853).

It resembles also somewhat the figures of the *Ter. septata* of Philippi (Mon. Sicil. ii. p. 68. t. 18. p. 7, 1844), and Prof. O. Schmidt moreover states that he believes he met with it during his dredgings at Oexfjord in 1850.

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6. *Terebratella Spitzbergensis,* Dav. 1852. Pl. X. fig. 3.

A description of this shell was published in the Proceedings of the Zoological Society of London for May 25, 1852, but the illustrations were omitted. I therefore avail myself of this opportunity to repair that deficiency.

Shell ovate, slightly pentagonal, longer than wide; valves almost equally convex; beak produced, incurved, and truncated by a middle-sized foramen; deltidium in two pieces, partly surrounding the aperture; beak-ridges not very sharply defined; smaller valve slightly depressed near the front; surface smooth, strongly punctate, and marked by a few concentric lines of growth; colour light yellow; apophysary system composed of a central longitudinal septum, extending to a little beyond half the length of the shell, in the form of a narrow plate somewhat elevated at its extremity, to which and to the hinge-plate are attached the calcified riband-like reflected lamellæ forming the loop. Length 4, width 3, depth 2 lines.

Hab. Spitzbergen.

Obs. This small *Terebratella* seems distinguishable from all the other recent forms of the genus, by its dimensions, regular ovate shape, thinness of shell, and comparatively short doubly attached loop, which does not exceed half the length of the valve. I have hitherto been able to examine but one specimen, presented by R. M'Andrew, Esq., to Mr. Cuming's collection.

7. *On a new species of* Morrisia. By Eugène Eudes Deslongchamps.

Morrisia Davidsoni, E. Desh. Pl. X. figs. 20, 20 *a, b, c, d*.

Shell thin, subpellucid, of a light yellowish colour, varying in shape, but generally transversely oval and irregular. Structure largely punctate, exterior surface covered with small spinose asperities, which are particularly visible near the edges of the shell, and marked by lines of growth. Larger or *ventral* valve convex, with a straight hinge-line and narrow area; deltidium very small, edging only the very small portion of the foramen existing in this valve. Smaller or *dorsal* valve almost flat, assuming the shape of the objects to which it lies in close contiguity, and deeply notched at the umbo by a large circular aperture, which constitutes by far the greatest portion of the foramen. Valves articulating by means of minute teeth and sockets. Apophysary system consisting of two lamellæ originating at the base of the sockets, and united to a small elevated process or septum which arises from near the centre of the valve. Length 3, width 5 lines.

Hab. Found adhering to large specimens of the *Caryophyllia ramea*, probably derived from the coral fisheries near Tunis.

Obs. This species is at once distinguished from the *Morrisia anomioides* of Scacchi (fig. 19) by its larger dimensions, transversely oval shape, and the flatness of its *dorsal* valve, as well as by the minute spinose asperities which cover its surface; the foramen in the present form also encroaches to a much larger extent on the *dorsal* valve than on the *ventral* one, or than is the case in Prof. Scacchi's species, which is, besides, almost circular, smooth, with both valves moderately convex. In *M. Davidsoni* the smaller valve is also at times very irregular, occasioned by the shortness of the peduncle, which forces the shell to lie in close contiguity with the objects to which it is moored, and take more or less the impress of their irregularities.

From a superficial examination of the animal in its dried-up condition, my father and myself were enabled to convince ourselves, that in the species under description the oral arms seem to be connected with the apophysary system by a kind of very delicate calcareous network, reminding one of the descending apparatus of *Thecidium*, which in some species is formed in its upper portions by a calcareous network freely suspended above the visceral cavity. MM. O. Schmidt and Suess have already recognized the tendency to a disposition somewhat similar in the subgenus *Terebratulina*. This important fact will, in all probability, at a future period help to identify the different parts of the calcareous processes in *Thecidium* with the corresponding portions in the other genera of the family *Terebratulidæ*.

I limit myself at the present moment to the simple announcement of this point, not having as yet sufficiently studied the question, but which I shortly intend to do more fully, when entering upon the internal details of the apophysary system of the *Morrisia Davidsoni* in a paper now in hand, and which also relates to other new Brachiopoda to be published in the Memoirs of the Linnæan Society of Normandy.

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8. *Description of a new species of recent* Rhynchonella. By S. P. Woodward, Esq., F.G.S.

Rhynchonella Grayi, n. sp. Pl. X. fig. 16.

Shell light horn-colour, dull, trigonal, depressed; sides rounded; front truncated; beak small, acute; valves smooth, obscurely marked by lines of growth, and strongly plaited near the margin with four central plaits and three or four on each side, the furrows obscurely striated; margins of the valves sinuated in front and strongly toothed; foramen minute, completely tubular. Long. 15, lat. 13, alt. 8 mill.

This interesting and at present unique shell was sent with other natural-history objects from the Feejee Islands by J. M'Gillivray, Esq., Naturalist to the Surveying Expedition under Capt. Denham of H.M.S. Herald. No particulars as to its habitat have been received; it differs from both the known species of living *Rhynchonella* (figs. 17 & 18) in its lightness of colour, the others being black; in the plication of the borders of its valves, which reminds us of the fossil *Rh. subplicata* (Mantell) and *Rh. lineolata*, Phil.; and especially it differs in having a foramen quite separate from the hinge-line by the development and union of the two elements of the deltidium, in this respect agreeing with the ordinary adult condition of the fossil *Rhynchonellæ*. Were it not for the remains of the pedicle and traces of the mantle in its interior, we might have taken it for a pliocene fossil, being exactly similar in its colour and dull translucency to the specimens of *Rh. psittacea* found in the Crag at Norwich. The muscular impressions are like those of the type, and the interior has traces of unsymmetrical vascular markings.

If only the recent species were known, the genus *Rhynchonella* might be thought a remarkable exception to the law of *continuity of generic areas*, but like many other widely scattered types, its distribution is rendered intelligible by the knowledge of the existence of so many fossil forms in the wide intervals between the localities of the living species.

EXPLANATION OF PLATE X.

Fig. 1. *Waldheimia septigera,* Lovèn, sp.
Fig. 2. —— *cranium,* Müller, sp.
Fig. 3. *Terebratella Spitzbergensis,* Dav.
Fig. 4. *Magas* (*Rhynchora*) *Davidsoni,* De Koninck, sp. Interior of the dorsal or smaller valve, from drawings by M. Bosquet of Maestricht. 4 *a,* longitudinal section of both valves; P, pedicle muscular impressions; *t,* sockets.
Fig. 5. *Waldheimia australis,* muscular system, from an improved diagram prepared by Mr. Hancock.
A. Adductor (*adductores longi,* Owen), attached to the ventral valve.
A′. Adductor (*adductor longus posticus,* Owen. *Muscle adducteur principal,* Gratiolet).
A″. Adductor (*adductor longus anticus,* Owen. *Muscle adducteur principal,* Gratiolet).
R. Cardinal muscle (*adductor brevis,* Owen. *Muscles diducteurs principaux,* Gratiolet).
R′. Accessory cardinal muscle (*cardinales,* Owen. *Muscles diducteurs accessoires,* Gratiolet).
P. Ventral pedicle muscles (*retractor inferior,* Owen. *Muscles du pédoncule paire supérieure,* Gratiolet).
P′. Dorsal pedicle muscles (*retractor superior,* Owen. *Muscles du pédoncule paire inférieure,* Gratiolet).
P″. Pedicle sheath.
Z. Capsular muscle (*capsularis,* Owen).
M′, mouth; *i,* intestine; L, loop; L″, reflected portion of the same.
Fig. 6. *Dorsal valve* of a *Terebratula*: *a,* the sockets; *b,* the *opening muscles*; *c* & *d,* the muscular impressions. (Figs. 6, 7 & 8 are taken from Prof. Quenstedt's paper.)
Fig. 7. *Ventral valve* of the same *Terebratula*: *a,* the lateral teeth; *b,* the muscular impressions; *c* & *d,* the two bundles of the *closing muscle* (adductor). The letters correspond to those in fig. 6, so that by the inspection of the following one—
Fig. 8. seen in profile—the mechanism of the *opening* and *closing* of the valves may be easily understood.
Fig. 9. The male sexual glands of a *Terebratula.* Figs. 9, 10, 11, 12, 13 & 14 are taken from Prof. Schmidt's paper.
Fig. 10. Spermatozoa of the same.
Fig. 11. Embryo of the same *Terebratula,* magnified.
Figs. 12, 13 & 14. Calcareous structure (or plates) from the mantle and brachial cirri of *Terebratulina caput-serpentis.*
Fig. 15. Embryos removed from the ovarian cavity in the pallial sinus of *Lingula anatina*: magnified 120 diameters (Owen).
Fig. 16. *Rhynchonella Grayi* (Woodward). 16 *c,* enlarged.
Fig. 17. —— *psittacea.*
Fig. 18. —— *nigricans*; these are the only three recent *Rhynchonellæ* at present known.
Fig. 19. *Morrisia anomioides,* Scacchi, sp. 19 *a,* enlarged.
Fig. 20. *Morrisia Davidsoni,* E. Deslongchamps. 20 *a, b,* enlarged. 20 *c, d,* enlarged views of the interior of the smaller or *dorsal* valve, part of the lamellæ being broken off; *f,* foramen; *t,* sockets; M, departure of the crural lamellæ; N, broken lamellæ attached to the summit of the septum, S.

XXXVII.—*On the Phænomena of the Reproduction of the Chitons.* By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Norfolk Crescent, Bath, November 1855.

The Chitons have long been a source of difficulty to naturalists with respect to systematic position; the most distinguished names, Cuvier, Blainville, Milne-Edwards, and Prof. Forbes, are at variance on this point, which to the present time has not received a satisfactory solution. Cuvier alone considers them true Mollusca; Blainville refers them to the Annelidan Articulata; Forbes speaks doubtingly; and Milne-Edwards admits that they are Gasteropoda, but hesitates to acknowledge them Mollusca.

I trust the following observations, though not so complete as I could wish, will throw some light on their reproductive *status* and natural position.

The present paper has originated in a suggestion of the late Prof. Forbes and Mr. Hanley, who in their 'British Mollusca,' vol. ii. p. 390, "trust that some active observer resident by the coast will occupy himself with studying the development of the Chitons, and endeavour to ascertain the form they assume in their larval condition. Whoever does so will make an important discovery, and do more towards fixing the true position of these anomalous creatures than all cabinet examinations of them have yet enabled us to effect." And I have stated in my late work on the 'British Marine Testaceous Mollusca,' p. 248, "that I propose, if practicable, to carry out this idea, though the attempt will be attended with uncertainties which need not at present be alluded to."

Chiton cinereus, Linnæus.

Chiton cinereus, Brit. Moll. vol. ii. p. 402.
Chiton marginatus, variorum.

On the 23rd July 1855, I obtained several examples of the above species fixed on small pebbles from their natural habitat; these were carefully removed into saucers of sea-water and sedulously examined every hour for many following days. In the afternoon of the day of capture my attention was suddenly attracted by observing one of the animals in the act of discharging ova—not in volleys, but by one or two at every second for at least 15 minutes, forming a batch of 1300 to 1500; there were a thousand or more that remained in the ovarium, perhaps not sufficiently maturated for parturition; they were pale yellow, and of subglobular form, being a little compressed or oblate at what may be termed the axes; each appeared about 100th of an inch in diameter. I may here remark that the animal now mentioned was the only one that deposited ova.

The animal, previous to the exclusion of the ova, had moved from the flat position it occupied on the stone to its edge, and elevating by reflexion the posterior portion of the coriaceous skin in which the valves are imbedded, poured out for several minutes a continuous stream of flaky white matter like a fleecy cloud, which proved of a glutinous nature, and probably proceeded from the organs which M. Cuvier and authors have conjectured to be a pair of symmetrical oviducts, but which they failed to trace to an external outlet: I rather think that they are glands, and that their use is to provide the material for the capsule or membranous envelope that contains the mass of each ovum, and also to entangle by its tenacity the congeries of ova which followed its emission to prevent them being washed away by the water, as when I attempted to remove one or two, I found they were slightly retained by adhesion: it is probable that the cloudy vapour when condensed into fluid serves for a nidus until the young are prepared to emerge from their cells. I did not succeed in ascertaining if the viscosity issued from an organ, or pair of organs, or glands distinct from the oviduct: I can only say that the ova as well as the thin smoke-coloured matter were excluded from under the centre of the coriaceous integument of the posterior terminal valve, in a similar manner as I have described them to be discharged from the posterior extremity of *Dentalium*.

I carefully inspected the ova throughout the 24th July; they remained inert at the bottom of the saucer; but on the morning of the 25th I was greatly surprised to find that all had become detached from their nidus, or position, and *swam* with *great vivacity* through every part of the water, sometimes at the surface, sometimes in the middle, and at others at the bottom; these minute objects moved with extraordinary speed, crossing a large breakfast-saucer in 30 or 40 seconds.

As soon as motion had commenced, the ova lost the subglobular figure, and assumed that of a subelongated oval approaching the Chiton shape. It has already been stated that each ovum was imbedded in a pale yellow membrane, but when the rapid swimming action took place, only half of the animal was liberated from the capsule, the anterior skin being reflexed or withdrawn on the still adhering posterior portion, forming a ridge that divided the animal into two sections. With a power of 300 linear I could see the elements of the four anterior valves, as well as the buccal depression and head: this very early stage of development showed no metamorphosis that I could perceive.

On the 26th July the animal was evidently more detached from its cell, as the five anterior valves were distinctly marked and the fringe margin was detected; the three posterior valves were still covered by the enveloping skin, but traceable through the diaphaneity of the membrane. The animal still swam with unabated vigour. On the 29th and 30th it had altogether cast off the embryonic covering and exhibited the complete form of the Chiton. During these phases of development every point posteally and anteally appeared destitute of accessories, except the usual circumferential fringe; no antennæ, tentacula, eyes, caudal appendage, articulated feet, bristles or filaments were discoverable, nor any other exserted organ. At this period nearly all natatory motion had ceased, the animal remained apparently fixed at the bottom of the saucer, and only a slight change of place was perceptible with a good lens.

The animal in its phase of rapid movement often rolled itself into a ball, which led me to think there might be some alliance between it and the crustaceous Articulata, particularly with the *Oniscus entomon,* as I have often seen adult Chitons involve themselves in a somewhat similar globular form. Notwithstanding these traits of relationship with other tribes, it cannot admit of doubt, from M. Cuvier's dissections and our own detailed account of the animal, that the Chitons are far nearer to the Mollusca than to any other class; for though we may observe some traces of approach to certain sections of the Crustacea in the segmental disposition of the hard parts, still this condition does not obtain in the soft parts of the body, which are inarticulate or molluscan; and we may add that the testaceous pieces are not connected by articulation, but merely overlap each other. The supposed relation to other divisions, the annelidan and cirripodan Articulata, is still slighter, and does not with the former, as to external organs, extend much beyond the marginal fringe, which may have an equivocal assimilation with the feet, bristles and tufts of hair of that vermiform tribe; and with the latter there is some community by the somewhat similar division of the cone into distinct pieces.

These *quasi* alliances may perhaps induce us to admit that the Chitons may be the immediate precursors or the stage of transition from the Articulata to the Mollusca, which of course takes precedence of all the divisions of the Articulata; that is, the order of natural position in the ascending scale should be: Annelida, Crustacea, Insecta, Mollusca.

It is difficult to account for or explain the propelling power of the rapid natation of the Chitons; it may probably be due to the vermicular action of the body and foot, which is doubtless much aided by the segmental disposition of the hard parts. It is also possible that the fringed margin may act as a paddle, as well as being subservient to a very opposite action, that of increasing the tenacity of suctional adhesion. As to the bristles that are sometimes seen at the sutures of each valve above the margin, I believe they are accidental or ornamental, and have no particular use in the animal œconomy; they only appear in one British species, the *C. fascicularis*.

The singular fact of the almost instantaneous rapid natation of the animal before it is even entirely freed from the capsule, leads to a fair presumption that the oviparous germs of all the bivalve and gasteropodous Mollusca have, as they emerge from their larval condition, the power, for a limited time, of locomotion, which is accorded them by nature apparently for the purpose of seeking out and conveying themselves to their respective peculiar habitats; and we learn by the present case that, as soon as a rapid locomotion has accomplished its objects, it ceases, and the animal adopts the phase of progression that is ordained for it.

I regret that circumstances prevented the examination being carried on beyond the 31st July, but I cannot believe that, after that time, any metamorphosis would have presented itself. During the eight days of inspection no unusual aberrations of form were visible; nothing appeared but a gradual increase of the organism until it had assumed the figure and attributes of a completed Chiton, which, in the interval I speak of, had attained the length of $\frac{1}{20}$th to $\frac{1}{30}$th, and breadth $\frac{1}{45}$th of an inch.

It appears, then, that M. Cuvier's determination is correct, that the Chitons are cyclobranchiate Mollusca.

I am, Gentlemen,

Your most obedient servant,

William Clark.

XXXVIII.—*Note on* Linaria sepium, *Allman*. By Charles C. Babington, M.A., F.R.S. &c.*

Early in the summer of 1855 I succeeded in obtaining seeds of this plant from roots growing in the Cambridge Botanical Garden which had been originally sent to it by Dr. Allman from Bandon. These seeds were sown in a pot, and produced many plants which flowered in the August and September following. The produce thus obtained shows that my former

* Read to the Edinburgh Botanical Society, Nov. 8th, 1855.

idea concerning *L. sepium* is correct, and that it is not a distinct species, but a hybrid between *L. repens* and *L. vulgaris*. Four forms were raised from the seeds of *L. sepium*: (1) *L. sepium*, (2) a plant closely resembling *L. repens*, (3 and 4) slightly differing forms of *L. vulgaris*.

L. repens is growing on the same bed in the garden as the *L. sepium* from which these seeds were obtained, but *L. vulgaris* grows in quite a different part of the garden. Similarly at Bandon, I learn from Dr. Allman that *L. repens* and *L. sepium* grow together, but *L. vulgaris* is not found within a mile of *L. sepium*.

Since the above note was written, I have received from Bandon, through the kindness of Dr. Allman, a series of specimens quite connecting *L. sepium* and *L. repens* which he had gathered in their native place. The result derived from cultivation is thus, to a great extent, confirmed by observation of the wild plants.

BIBLIOGRAPHICAL NOTICES.

Catalogue of the Genera and Subgenera of Birds contained in the British Museum. By G. R. Gray, F.L.S. London: 1855.

This is one of the latest and most valuable additions to the excellent series of British Museum Catalogues now in course of publication. It is, in fact, a new edition of Mr. G. R. Gray's well-known 'List of the Genera of Birds,' which has contributed so much to the reform of ornithological nomenclature. During the eleven years which have passed since the issue of the last edition of this work, great progress has been made in ornithology as in other branches of natural science. Books, pamphlets, and periodicals in all parts of the civilized globe contain the labours of naturalists vying with each other for precedence in establishing new genera, new species, and new arrangements among the members of the Class *Aves*; and though there has been some complaint, and not without foundation, that ornithology has hitherto been rather a neglected branch of natural science, it would seem that the present activity, if continued, bids fair to advance our knowledge of this interesting subject to at least a par with that of the other classes of the animal kingdom.

As regards however the *genera* of Birds, the subject of Mr. Gray's work, we fear that the ornithologists of the present day are advancing rather too rapidly. Mr. Gray's list of 1844 contained upwards of 1100 distinct types which had then been raised to the dignity of genera. By the present work it appears that since then the number has been more than doubled—those given in the present Catalogue and Appendix amounting to no less than 2400—and we believe that since its publication many others have been created to swell the list. Now, considering that, according to the most recent estimate, the known species of birds cannot be calculated to exceed 8000, it seems that we have already split up the genera to such an extent that they contain on the average only about three species apiece. And as it is requisite that in any natural system the genera should have as nearly as possible the same amount of difference *inter se*, and these new genera have been created much more abundantly in some groups than in others, it follows that, in order to reduce all the generic divisions to a uniform standard, a vast number of further genera must be created, and we shall ultimately have not more than two or perhaps one species in each genus.

Such a result would, we suppose, be condemned by every naturalist, but it cannot be avoided if the present system is much longer pursued. The fact is that a large proportion of the recently established so-called genera are founded upon such slight differences, that it would be quite impossible to draw up generic characters for them. These modern genus-makers do not hesitate to coin a new appellation for any two or three allied species that resemble each other in colouring and form what may be called a homochroous group, without reflecting that each of the other numerous isolated idiochroous species of the genus have equal claims to similar distinctive separation*.

But though it cannot be denied that style of colouring is often an excellent guide to affinities, we maintain that generic names are only to be employed where there are real differences in structure, and not where merely the plumage is dissimilar. The appellations applied to these minor groups should be either altogether unnoticed, or merely placed in any arrangement of the species at the head of each group, in the manner shown by Mr. G. R. Gray in the more lately published Catalogues of the British Museum.

Even more lamentable than the rapid increase of these generic subdivisions is the fact that many of them have received three or four and even more synonymous appellations from different authors, and some of them more than one from the same author! In spite of the '*stern law of priority*' now professed to be submitted to by the whole scientific world, several individual writers seem to think little of changing names that they have themselves imposed. Thus we find *Strophiolæmus* (1853) and *Iolæma* (1854) proposed by the same author for the same genus of *Trochilidæ*, *Galbalcyrhynchus* (1845) and *Jacamaralcyonides* (1849) for the same genus of *Galbulidæ*, *Cyanopolius* (1849) and *Cyanopica* (1850) for the same genus of *Corvidæ*, and *Chlorochrysa* and *Calliparæa* in the same year for the same genus of Tanagers, without any apparent excuse for the creation of the second names, unless it be forgetfulness that the first-given had ever been proposed. It is to be hoped that Mr. Gray's Catalogue,

* In resolving many natural genera into species, it will be found that groups of threes or fours often show great similarity in plumage, and are what may be called '*homochroous*' (*ὁμόχροος, similem colorem habens*). These are generally distributed over different geographical areas, and represent each other in their respective localities. Other individual species have peculiar colouring of their own, and may be termed *idiochroous* (*ἴδιος, peculiaris*, et *χρόος, color*).

and the sight of the four or five thousand names contained in the Index thereto, will render naturalists rather more careful in further increasing the already too gigantic proportions of the '*Corpus Generum Avium.*'

Another fruitful source of useless synonyms is, that there are still one or two writers on ornithology who reject a generic name unless it be formed classically and out of pure Greek or Latin. It is hard to refuse one's sympathy to those who recoil from such odious names as *Smithiglaux*!, *Kaupifalco*!!, *Graydidascalus*!!!, *Corythaixoides*!!!!, and *Strigymhemipus*!!!!!; but it has been now universally agreed that *barbarism* is not sufficient excuse for superseding already established names by new ones, and we fear that Dr. Cabanis' and Professor Reichenbach's classical alterations of even such names as these will be placed in all future catalogues of Bird-genera (as in Mr. Gray's) among the mass of useless synonyms. On the other hand, the present work goes quite in the opposite extreme from those of the last-mentioned writers. If, from the ignorance or mistake of the proposer of a genus, the name happens to be wrongly spelt, there seems to be no reason whatever why such an error should be retained *in perpetuum*. That would indeed be unnecessary stickling for the law of priority. Yet Mr. Gray appears to hold, that right or wrong we are bound to adopt the spelling originally given by the proposer of the genus, and to allow of no corrections or emendations even of faults due to typographical errors only. Now it must be recollected, that we profess to use the *Latin* language in our present system of nomenclature, and we ought to follow its rules as closely as possible. In such names therefore as *Thryothorus*, *Pycnosphys*, *Scotornis* and the like (where there is no doubt of what the creators of the names intended by them), it seems ridiculous that we should be called upon to continue such palpable errors as to write them *Thriothorus*, *Pycnosphrys* and *Scortornis*. Mr. Gray has—we think, unnecessarily—increased his already sufficiently laborious undertaking by attempting to quote every variety of reading to every generic name which the ignorance of authors or the mistakes of their printers have caused. Of what good can it be to perpetuate the fact that somebody has been stupid enough to write *Nyctidromus Nyctydromus*, and *Oreotrochilus Oriotrochilus*? What benefit can we derive from being reminded that *Eulampis* has been misprinted *Culampis*, and *Selasphorus Selosphorus*? Surely it would have been better to have left such inaccuracies unnoticed and forgotten.

Again, we fear that confusion is likely to be caused by the introduction of the French names which Mr. Gray has permitted in some parts of his List, and which in some cases he seems to give a preference to over the corresponding Latin terms. It may be true that M. Lesson was the first to indicate the genera *Chrysuronia* and *Crossopthalmus* under the French names *Les Chrysures* and *Les Picazores*, but that is no reason why these last names should be introduced into a scientific list of genera, where Latinity is or ought to be a first condition to any claim for recognition. If we once open the door to non-Latin names, we shall be deluged with those of Buffon, Azara, Levaillant, and a host of others, who established many very excellent genera, but have necessarily lost the credit of their discoveries owing to their having neglected to employ for the designation of them the one language recognized by the world of science.

There are one or two other points in which we think the principles adopted by Mr. Gray in the present edition of his List do not work well. In the preface it is stated that the synonymy commences with the edition of Linnæus's 'Systema Naturæ' published in 1735. Now Linnæus had not at that time invented his binominal system, and it is therefore neither correct nor necessary to commence our present nomenclature from so early a period. The question, what edition of the 'Systema Naturæ' we ought to begin with, has been already discussed in a previous review of a former edition of Mr. Gray's book in this Magazine *, and Mr. Gray has himself acknowledged, in the preface to his List of 1844, that the '*invaluable principle*' of the binominal system was not established before 1758; but in his present work he always begins by quoting the edition of 1735, and seems even to give that and the other earlier editions an occasional preference over the subsequent and more perfect publications. At the same time he takes it for granted, that the first species on the list of each of these editions was intended to be the type of the genus,—a point which appears to admit of much argument. The adoption of these principles in the present edition has caused some rather important changes in the types and names of certain well-known genera; changes in zoological nomenclature, where the maxim '*quieta non movere*' ought to carry more than ordinary weight, and in which, we think, other naturalists will be rather loth to follow. For example, *Alca* is now referred to the Puffins (*A. arctica*) instead of the Great Auk, and *Chenalopex*! (a term always hitherto appropriated to the *Anas ægyptiaca*) is proposed to be used for the *Alca impennis*, as having been so applied by Moehring in 1752! The type of the genus *Tanagra* is altered, because the *T. episcopus* (always hitherto considered as such) does not stand first in Linnæus's list. Now the very fact that Linnæus placed first one and then another species at the head of his genera seems conclusive against the *necessity* of invariably adopting the first species as the type. Indeed Mr. Gray has not ventured to carry out these rules throughout to their legitimate result. Had that been done, he must have used *Strix* for the Horned Owls (*Bubo*), and *Falco* for the Eagles (*Aquila*), and besides that have introduced a variety of other equally objectionable changes.

Again, although it cannot be questioned that the *same name* ought not to be used in zoology for two different animals, and there are also strong reasons for an alteration when names even *closely resemble* one another, Mr. Gray's changes on these grounds occasionally go beyond what seems absolutely necessary. *Harpactes* certainly ought not to be liable to be mistaken for *Arpactus*, or *Lophūra* for *Lophy̆rus*, and we hope therefore Mr. Gray will not be imitated in

* See Mr. Strickland's article in the 'Annals and Magazine' for 1851.

his rejection of these names in favour of *Hapalurus* and *Macartneya*, or in other similar changes.

We also regret that Mr. Gray has not thought fit to adopt the very simple rule given in the British Association Committee's Report for the formation of the names of the families and subfamilies in *idæ* and *inæ*, and from which a very desirable uniformity would have ensued. As it is, we have *Steatorninæ* instead of *Steatornithinæ*, *Podagirinæ* instead of *Podagrinæ*, *Coraciadæ* instead of *Coraciidæ*, *Arainæ* (!) instead of *Arinæ*, and so on.

A catalogue of the unabbreviated names of the authors of the different genera, and of the chief works in which they have published them, would have been a very useful addition to Mr. Gray's List, though one which would have doubtless involved a certain amount of extra labour; for even the professed ornithologist will be puzzled to find the place where some of the names given in the List were first promulgated. The fact is that certain authors are in the habit of publishing names used by other persons only in MS., or for the labels of Museum specimens, and which cannot therefore be recognized previously to such publication. For example, Dr. Schiff of Frankfort-am-Main, to whom several genera among the *Piprinæ* and elsewhere are attributed, has, we believe, never *published* anything on the subject of ornithology. Prince Bonaparte has, however, introduced Dr. Schiff's MS. names into some of his recent lists of genera, and they have consequently been included in Mr. Gray's Catalogue. It would have been better had Mr. Gray in this and similar cases given the name of the *publisher* of the genus as well as that of the supposed originator.

Lest the foregoing remarks should be thought to be rather in blame than in praise of Mr. Gray's book, it is right to conclude by repeating the commendation bestowed upon it at the beginning of our notice. We regard it as a most valuable contribution to natural history, and quite indispensable as a work of reference to the student of scientific ornithology. Mr. Gray deserves the warmest thanks of all naturalists for the great labour he has bestowed upon the collection of such a vast mass of materials from so many different sources, and for the care with which he has reduced them into arrangement. We may also repeat our hope that his book will not only be a useful guide through the perplexing mazes of ornithological synonymy, but also have some effect in checking those naturalists, who, instead of following Mr. Gray's example and endeavouring to assist others in clearing the way, are rather increasing difficulties by useless additions to the already enormous catalogue of Bird-genera.

Descriptive and Illustrated Catalogue of the Histological Series contained in the Museum of the Royal College of Surgeons. Prepared for the Microscope. Vol. ii. London. 1855. 4to.

The previous volume of this valuable work was devoted to the structure of the harder tissues of plants and invertebrate animals;

the present one contains illustrations of the minute structure of the skeleton of the vertebrate animals as developed by the microscope, and is a catalogue of that not less valuable portion of the College collection belonging to histology. The present volume bears the similar impress of care and research as the former one, and like it, if we may judge from the greater importance of the subject-matters, will share the same complimentary fate, of being speedily out of print. It is however to be hoped, that the Council of the College, under whose auspices these volumes are prepared, will issue a new edition, to which, we doubt not, Prof. Quekett can furnish many important additions in vegetable and invertebrate structures, and which would supply a desideratum to many investigators, who have not had the good fortune to procure the first volume of the series. In speaking of this work, it will be unnecessary, as well as useless, to enlarge upon the value and importance of microscopical research. The microscope has not only ceased merely to gratify our curiosity or excite our wonder, but has become a source of high intellectual amusement and of great practical value.

"Time was," says Prof. Owen in the recently published Lectures on the Invertebrata, "and not many years ago, in this country, when that term, Microscopical Anatomy, was almost regarded as synonymous with the anatomy of the imagination; but the numerous and highly important discoveries which have been made and confirmed by observers in almost every European state, by means of the greatly improved microscopes at their command, have placed the value, the indispensability, of that instrument to the anatomist, beyond the necessity of vindication."

This remark of the Hunterian Professor is not only corroborated, but strengthened, in the publication of the volume before us, by his colleague, Prof. Quekett. In a general notice, the value of this work may be stated under two principal heads,—firstly, that of presenting us with a series of terms of comparison of the differences which obtain in the minute structure of the endo- and exo-skeleton of the four classes of the vertebrate type; and, secondly, in furnishing us with numerous and accurate illustrations of the more important genera and species in all those classes of Vertebrata.

Independently of the comparative value to the anatomist of the variations existing in the minute structure of bone, or the tissues or the dermal covering of different parts of the same animal; the differences in the minute structure of the skeleton in the four classes become more interesting when such are known to exist. That these differences can be fully shown, it is only necessary to consult the admirable plates appended to this volume, drawn as they have been by an experienced artist, from the microscope, by means of the camera lucida. To those who, like the geologist, have always to appeal to the comparative anatomist for the determination of the remains of the fossil vertebrata, any further aid, especially when a minute portion is concerned, as to the class-affinity of the fragment, becomes of extreme value; and this the microscope fortunately yields us. Those who remember the animated discussions respecting the mammalian affinities of the Stonesfield remains, of the Pterodactyles of the chalk, or the Birds' bones of the Wealden strata, will feel the force of the above remark. And now, when every year bids fair to unveil to us new, or hitherto unlooked-for, forms amidst the earlier, or even earliest, scenes of the earth's physical history; and the old coast-line or ancient estuary yields traces of footsteps belonging to some unknown beast, perhaps seeking shelter from the storm (its impress still remaining), or tracing its way on the rippled sands left moist by the receding tide—footsteps so numerous as to lead us to infer some corresponding solid skeleton; a fragment of bone might guide us along the path of discovery, as to its nature.

Prof. Quekett has, as is well known, been already engaged on some of these points of original investigation. In inquiries of such-like character, this volume would be an indispensable requisite, containing as it does a description of 945 preparations, of which 385 belong to the skeleton of Fishes, 103 to that of Reptiles, 60 to that of Birds, and the remaining 397 to that of Mammalia. Of the most important and striking specimens of these preparations, 432 have been selected for representation, all of which, with but two exceptions, were drawn by means of the camera lucida. And with a view of rendering the work more useful to the student, in comparing the minute structure of the bones of the four great classes of animals, the greater part of the sections have been drawn under two powers, one of 95, the other of 440 diameters, it having been ascertained that the size and arrangement of the lacunæ are frequently of the greatest importance in determining the true nature of fragments of recent and fossil bone, when other characters are wanting. The numerous preparations above noticed consist of sections of the tissue of the endo-, exo-, and splanchno-skeletons of Fishes; the endo- and splanchno-skeletons of Birds; and the endo-skeleton of Reptiles and Mammals; the term splanchno or visceral skeleton being applied to the hard bony tissue found in certain viscera and organs of sense, as in the heart of the Hog and most old Ruminants, and the eyes of Fishes and Birds. A short introduction is given, in which the principal structures of bone are enumerated and described, as the Haversian canals and interspaces, the laminæ, lacunæ, canaliculi, &c. The body of the work is chiefly occupied by elaborate descriptions of the figures; a few notes, however, explanatory of the principal points of interest, precede each division.

In describing the bone of Mammalia the minute structure is stated to be nearly uniform throughout the whole class, each Haversian system being surrounded by a series of concentric laminæ with lacunæ placed between them, and giving off numerous canaliculi in a radiating manner. It is a remarkable fact, however, that those Mammalia which resemble Birds in their habits or internal anatomy, approach most nearly to these animals in the minute structure of their bones; such is the case in the Ornithorhynchus, Echidna, Sloth, Kangaroo and Bat.

Copious details are given of that singular animal, the Lepidosiren, forming the connecting link between Fishes and Reptiles. Fourteen preparations are here described, which, together with four others published in the previous volume, afford us an intimate knowledge of the minute structure of the endo-skeleton of this interesting form. Prof. Quekett states that the structure of its bone, as well as those portions of its skeleton which do not become ossified, are more closely allied to the corresponding tissues of the Batrachia than to those of any Fish yet examined; and as it undoubtedly possesses many characters peculiar to Fishes, a subdivision of the order Batrachia has been proposed for it, and that of Ichthyo-Batrachia appears to be most expressive of its peculiar affinities.

To the anatomist, palæontologist, and geologist engaged in microscopical research, this volume is of inestimable value, superseding as it does the necessity of obtaining a costly series of objects for examination and comparison. Few persons could have undertaken the preparation of a work requiring so much labour and nice manipulation of the numerous specimens illustrative of the various subjects, with any fair chance of equivalent remuneration. By the publication of this Catalogue, the Council of the College have afforded a boon to microscopical science, prepared as it has been by an author who has devoted so much time to, and prosecuted with such zeal and success, the practical bearings of histology.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 25, 1854.—John Gould, Esq., F.R.S., in the Chair.

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

Family Sturnidæ.

Subfamily Sturninæ.

Genus Pastor.

Pastor Roseus, Temm. The Rose-coloured Pastor.

This bird visits the Deccan in immense flocks to feed on the grain called *jowaree* which begins to ripen in the month of November, and is cut about March. The arrival of these birds is uncertain, in some years being earlier, in others later. On referring to notes made at the time, I find that in the year 1848 the first Rose-coloured Pastor was seen on the 28th of November, and the last on the 5th of April 1849. The first which I observed in the autumn of that year, was on the 16th of November. In the year 1850, I saw a large flock as early as the 24th of August; I transcribe the note: "August 24, 1850. Saw a large flock of the Rose-coloured Starlings with their broods to-day feeding in an open field, evidently on insects, as they were constantly in chase of them, flying." I never saw this bird so arly as it was that year, and they arrived long before the jowaree was ripe. This grain when ripe, and before it is ripe, is their staple food. After it is cut and housed, I have observed them busily feeding on the flowers of the leafless Caper, a shrub very common in many parts of the Deccan, especially on the banks of the larger rivers. I have made many, but hitherto ineffectual attempts, to ascertain where these birds breed; that they do breed somewhere on the continent of India, there can be no doubt, as the young birds which I saw on the 24th of August 1850, were in brown plumage, and appeared as if they had not long left the nest. I was informed by a clever and well-informed Mharatta, who seemed to have considerable knowledge of the habits of various birds, that the Rose Starling retires to the Ghauts to breed. On visiting those mountains in 1849, I made many inquiries of the hill people, but was unsuccessful in getting any information from them. However, I think it very probable that these birds, after leaving the Deccan in March and April, break up into pairs, and retire to the ravines and forests in the Ghauts to breed. Like the common Starling, these birds congregate in immense flocks before going to roost, and it is a curious sight to watch their movements as they fly in clouds over their night haunts. Towards sunset they begin to collect from the grain-fields, and fly off in detached parties, at first containing only a few individuals. These soon amalgamate, and form large masses, which, as they dash, now upwards and now downwards, now in circles, at one time almost disappear, at another look like a rapidly passing cloud. As soon as the sun is down, they retire to the babool brakes that clothe the banks of the streams and rivers. These birds collect in such numbers on the small bushes and trees on the outskirts of the grain-fields, as to make them appear as if loaded with rich, rosy blossoms, and to make one wonder that the tree is not broken down with their weight.

Family FRINGILLIDÆ.

Subfamily COCCOTHRAUSTINÆ, Swain.

Genus EUPLECTES, Swain.

EUPLECTES (BENGALENSIS?).

I forwarded a paper on the nidification, habits, &c. of this little bird, together with specimens of the skins, nests and eggs, in the year 1852. The paper was read, and the specimens exhibited at the meeting of the Society on July 27th, 1852. Repetition therefore is needless.

Genus AMADINA, Swain.

Subgenus SPERMESTES.

SPERMESTES CHEET, Sykes.

This is a very common little bird, living in flocks, to be found in hedges and low bushes, and is, I believe, partial to those of the leafless Caper. It breeds, I conclude, twice in the year, as I have found its nest in the months of November and March. The nest in two instances was formed of the flower-stems of the silk-grass, which is abundant in the beds of streams; it was lined with feathers and the silky seeds of the grass; its shape was that of a hollow ball. The largest number of eggs I have found was six, but I see that Col. Sykes found as many as ten. The eggs are very small and of a pure white colour, rather more than $\frac{6}{10}$ths of an inch long by $\frac{5}{10}$ths of an inch wide. These little birds are often to be seen on the ground picking up grass-seeds, and so close together that several may be killed at a shot: they do not take long flights, but merely from bush to bush. I saw numbers of them in the leafless Caper on the banks of the river Bheema.

Subfamily Fringillinæ.

Genus Pyrgita, Swain.

Pyrgita domestica. House-sparrow.

Common enough in India. It breeds during the monsoon. I saw them building in the month of August, and its habits, mode of building its nest, &c., are similar to those of the Sparrow at home.

Pyrgita flavicollis, Frankl. Yellow-necked Sparrow.

Of the time of breeding or nesting habits I know nothing, but Dr. Jerdon in his Catalogue says, "It is said to breed in holes of trees. The egg is of a greenish-white, much streaked and blotched with purple-brown: I obtained one from the body of a female."

Genus Emberiza.

Emberiza melanocephala, Jerdon.

This handsome Bunting is very common in the Deccan when the grain crops are becoming ripe. The Patel or headman of the town of Jintee, near the river Bheema in the Deccan, assured me that these birds, or some of them, remain to breed in the thick babool copses that clothe the banks of the river near that town, but I did not obtain the nests or eggs. I believe that the greater part migrate much about the same time as the Rose-coloured Pastor.

Subfamily Alaudinæ.

Genus Alauda.

Alauda deva, Sykes.

I have some eggs which I believe to be those of this lark, though on account of the similarity of the two or three species that inhabit the Deccan it is very difficult to state this positively. I obtained the eggs on the 11th of September; the nest was composed of a few stems of grass collected together, and forming a very slight receptacle for the eggs. Birds of this species breed twice during the year; I have obtained their eggs during the months of May, September, and October. They lay but two eggs, of a pale mottled brown colour, with a band of the same round the larger end; they are rather more than $\frac{7}{10}$ths of an inch long by nearly $\frac{6}{10}$ths of an inch wide.

November 14, 1854.—John Gould, Esq., F.R.S., in the Chair.

On the Bones of the Leg of Dinornis (Palapteryx) struthioides and the Palapteryx gracilis. By Prof. Owen, F.R.S., F.Z.S. etc.

In my memoir of 1843*, I described two femora of birds from tertiary deposits in New Zealand, agreeing in size with that bone in the Ostrich, and referred them to a species called *Dinornis struthioides*; one of these specimens however consisted only of the shaft; the other and more perfect specimen, figured in pl. 21. fig. 3, was mutilated at both its extremities. I have since received, through the kindness of the Rev. Mr. Colenso, M.A.†, and the Rev. William Cotton, M.A., three entire specimens of femora, ranging between 11 and 12 inches in length, and the shaft of a fourth specimen, of the same species, confirming very satisfactorily that species, and completing our knowledge of the anatomical characters of the bone.

The head is rather more than a hemisphere, more prominent than in the Ostrich, and with a smaller proportion cut off, as it were, from the upper and outer part, and roughened for the attachment of the strong 'ligamentum rotundum.' From the upper part of the base of the head, an almost flat, slightly concave surface ascends, expanding, as it rises, to the broad semicircular ridge which crowns the great trochanter. In the Ostrich that process does not rise beyond the level of the head of the bone. In the *Din. struthioides* the upper trochanterian platform is broader proportionally than in the *Din. casuarinus*‡. The anterior surface of the trochanter is also extensive through the continuation outwards of the great process: it is slightly concave, sculptured by muscular impressions with intervening ridges, and by a defined oval rough tract between the head and the base of the trochanter. The outer convex expanded surface of the trochanter is more strongly marked by the insertions of powerful tendons, surrounding an irregular smooth tract near the centre of the surface. The back part of the upper end of the femur in two of the specimens presents two or three small holes leading into the superficial cancelli, by which it is possible a little air may have been admitted to these cavities; but this is a very feeble representation of the wide orifice and canal at the same part of the Ostrich's femur which conducts directly to the large air cavity in the body of that bone.

The shaft of the entire femur of the *Din. struthioides* repeats the characters described and figured in the memoir above cited. The fore-part of the external condyle begins to rise from the level of the shaft, about one-third from the distal end of the bone, and bends outwards, forwards and downwards, increasing in breadth and convexity, and forming the outer boundary of the characteristic broad rotular surface. The convex fore-part of the inner condyle forming

* Zool. Trans. vol. iii. pp. 247, 249. pl. 21. fig. 3.

† The specimen contributed by this gentleman is cited in the table of admeasurements. Zool. Trans. vol. iii. p. 329.

‡ *Ibid.* pl. 46. fig. 2.

the inner boundary of that surface is shorter, and rises more abruptly. The deep oval fossa, above the vertical broad groove for the fibula, behind the outer condyle, is well marked. The orifice of the medullary artery is at the middle of the back part of the shaft of the femur in two of the specimens.

With regard to the metatarsus of the *Dinornis struthioides*, the same satisfactory confirmation of the species has been received, as in the case of the femur, by the addition of three specimens repeating the characters of the original bone described at p. 240, and figured in pl. 27. fig. 2. of my memoir of 1843. One of these specimens, kindly sent to me by J. R. Gowen, Esq., F.G.S., Sec. H.S., was discovered in the tertiary deposits at Waikawaite, Middle Island of New Zealand, and has the two extremities more entire than in the original specimen figured. The middle of the distal trochlea is impressed by a shallow groove running its whole length, and becoming more shallow as it approaches the contracted back part of the trochlea, which terminates abruptly, projecting beyond the level of the back part of the distal end of the bone.

A second of the additional specimens of the metatarsus of the *Din. struthioides* was obtained by the Rev. Wm. Cotton, M.A., at Tarawaite, in the North Island of New Zealand: a third specimen was discovered by Governor Sir George Grey, in a cave in the district which lies between the river Waikate and Mount Tongariro, in the North Island.

From the same cave Sir George Grey likewise obtained and very liberally transmitted to me, with a most valuable collection of other bones of *Dinornis* and *Palapteryx*, an entire tibia agreeing with the portion of shaft, which, from the dimensions given at vol. iii. p. 329, I was induced to refer to the *Dinornis struthioides*, differing in its size and proportions from all the tibiæ previously described and referred to other species, but presenting similar relations of size to the femur and metatarsus of the *Din. struthioides*, which the previously described tibiæ have presented to the other bones of the leg of the respective species to which those tibiæ have been referred.

I conclude, therefore, that in the tibia transmitted with the metatarsus of the *Din. struthioides* by Sir George Grey, I possess the bone, which I have been so long desirous to obtain in order to complete the leg of the *Din. struthioides*. Like the metatarsus above-cited, it is from the left side, and they appear to have belonged to the same individual bird.

	in.	lin.
The length of this bone is	22	0
The breadth of the proximal extremity	5	6
The breadth of the distal extremity	3	2
The circumference of the middle of the shaft ..	5	0
The fibular ridge extends down	10	0

This ridge begins, as in the tibiæ of other species of *Dinornis*, below the expanded end of the tibia near the middle of its back part, inclining to its outer side.

In its slender proportions, and the relative positions of the procnemial and ectocnemial ridges, the tibia of the *Dinornis struthioides* agrees with that of the *D. dromioides*.

Description of the Bones of the Leg of the Dinornis gracilis.

The advantage of additional specimens, as confirming, by the repetition of the same characters, a species previously defined, is still greater in respect of the ground which they afford for the discrimination of a distinct but nearly allied species. Notwithstanding the well-marked differences observable between the femur of the *Dinornis struthioides* and the *Dinornis gracilis*, I might have deemed them due to differences of sex or individuals, had I not had evidence of the fixity of the specific characters of the *Dinornis struthioides* by the successive arrivals of additional specimens of its bones. Attending the hoped-for confirmation from such arrivals, it appeared to be most prudent to refrain from announcing a new species of the rapidly increasing family of the great wingless birds of New Zealand until further confirmation might be obtained by corresponding differences in the tibiæ and metatarsi of the two species.

Having had the good fortune at length to obtain these additional illustrations of the *Din. gracilis*, I no longer delay communicating descriptions and figures of them to the learned Society, in whose Transactions my former Memoirs have appeared and have been so liberally illustrated.

Femur.

The following are the chief dimensions of this bone:—

	in.	lin.
Length	11	2
Breadth of proximal end in the axis of the neck	3	10
Breadth transverse of distal end	4	0
Circumference of middle of shaft	4	8

A small portion of the upper ridge of the great trochanter has been broken off: when entire, the femur of the *Din. gracilis* presents the average length of that of the *Din. struthioides*, but it is more slender in proportion, the head is smaller, and is supported by a better-marked constriction or neck, especially at its under part. The upper platform of the trochanter is narrower, the anterior border of the trochanter not being extended so far forwards and outwards. The angle between the upper and fore surfaces of the trochanter is a right one, and they meet at a sharp ridge. The rough oval surface between the head of the femur and the base of the trochanter is smaller than that of the *Din. struthioides*. The outer irregular surface of the trochanter is of much less breadth in the *Din. gracilis*. The muscular impressions at the sides of the shaft meet and form a longitudinal ridge along the back part of the middle third of the shaft: they are separated by a tract of half an inch in the *Dinornis struthioides*, and terminate below in two tuberosities. The corresponding ridge formed by the meeting of the vasti-muscles along the fore part of the shaft is shorter in *Din. gracilis* than in *Din. struthioides*.

The most marked distinction, however, is presented by the distal extremity of the bone, which is not only relatively less expanded in the *Din. gracilis*, but the rotular groove is narrower, and is bounded laterally by condyloid eminences of more nearly equal length; the external one not rising so high up, nor describing the sigmoid curve in descending, as in the *Din. struthioides.* The rotular groove in the *Din. gracilis* is impressed by a transversely oval rough depression, at its upper part, with sharp lateral borders; which depression does not appear in any of the femora of the *Din. struthioides.* The popliteal space is triangular and better defined in the *Din. gracilis*; the fibular groove is shorter and less angular, and the rough deep pit above it is smaller. The tibial surface on the inner condyle is relatively smaller.

Tibia.

The same character is repeated on the proximal end of this bone, where the surface applied to the inner condyle is absolutely smaller than in the *Din. struthioides*, although the entire bone, as shown in the subjoined admeasurements, is longer in the *Din. gracilis*: it is also, as the name of the species implies, more slender in proportion to its length.

	D. gracilis.	
	in.	lin.
The entire length of the bone is	23	6
The transverse breadth of its proximal end	5	2
The transverse breadth of its distal end	2	10
The circumference of the middle of the shaft ..	4	6
The fibular ridge extends down the shaft	9	6

But this ridge commences nearly 3 inches below the back part of the proximal end of the bone, nearer the outer side than in the *D. struthioides*: it is interrupted by an oblique smooth tract at the point indicated in the admeasurement, where the medullary artery penetrates the bone; it then reappears about one inch and a half below the interruption, and soon gradually subsides. This second lower part of a fibular ridge is better marked than in the *Din. struthioides.* The relative size and position of the procnemial and ectocnemial ridges are much the same as in the tibia of the *Din. struthioides* and *Din. dromioides.*

Metatarsus.

The difference between the *Din. struthioides* and the *Din. gracilis* is more obvious at first glance in a comparison of their metatarsi than in that of the above-described bones; especially to an eye accustomed to the comparison of the metatarsi of the different species. The superior length and slenderness of that bone in the *Din. gracilis* would at once prevent its being confounded with the metatarsus of the *Din. struthioides.*

The following are the chief dimensions of the bone in question: those of the extremities being approximative by reason of their worn margins:—

	D. gracilis. in.	lin.
Length of the tarso-metatarsus	13	0
Circumference at the middle of the shaft	4	3
Transverse breadth of proximal end	3	4
Transverse breadth of the distal end	4	3
Breadth of the middle of the shaft	1	7
Thickness or antero-posterior diameter of ditto ..	1	2

The depressed surface for the back toe is better marked than in the *Din. struthioides*.

MISCELLANEOUS.

SHROPSHIRE MOLLUSCA.

To the Editors of the Annals of Natural History.

58 Montagu Square, London,
12th Nov. 1855.

Gentlemen,—In the fourth volume of your excellent publication (for 1840) is contained a contribution by Mr. Eyton, under the title of "An Attempt to ascertain the Fauna of Shropshire and North Wales." It may be interesting to your subscribers and readers in that district, as well as to those naturalists who are desirous of elucidating the question of geographical distribution, if Mr. Eyton's list of Mollusca were made more complete; and this I have had lately the opportunity of doing, by a month's residence in the picturesque locality of Stretton in Shropshire. I subjoin a list of species then found by me, but not mentioned by Mr. Eyton:—

Pisidium pulchellum.
Zonites alliarius, and *var.* alba.
—— crystallinus.
—— nitidus (Bomere).
—— nitidulus.
—— purus, and *var.* alba.
—— radiatulus.
Helix aculeata.
—— fulva.
—— fusca.
—— pygmæa.
Pupa umbilicata.
Vertigo edentula.
—— antivertigo.
—— pygmæa.
—— substriata.
Clausilia nigricans.
Zua lubrica.
Physa fontinalis (Bomere).
Planorbis albus.
Limnæus truncatulus.
Carychium minimum.

Being altogether 22, in addition to 32 species of land and fresh-water shells previously recorded by Mr. Eyton as Salopian. The entire list of British species probably contains double the number, or 108.

I may add, that I also found a single specimen of that local species, *Limnæus glaber*, at Bomere.

I am, Gentlemen, yours faithfully,
J. Gwyn Jeffreys.

Arrested Development of the Tadpole of the Common Frog.

To the Editors of the Annals of Natural History.

British Museum, Nov. 21, 1855.

Gentlemen,—Not being aware if the arrested development of the tadpole of the common Frog is of frequent occurrence, I have forwarded you the following instance, should you think it worthy of notice in the 'Annals.'

Early in the spring (about the latter end of March) I placed some frog spawn in a glass containing Vallisneria and Confervæ, and in due time I had a little colony of about two dozen tadpoles, most of which gradually grew into frogs, with the exception of two individuals, whose further progress was arrested after having attained a middling size; their hind legs commenced budding, but made no progress; the fore legs were never developed. They were active and lively during the summer, but in the autumn became sluggish, moving but little about the glass, mostly lying in the Confervæ, seldom at the bottom. Their inactivity gradually increased until their death. One died in the latter part of October, the other in the second week of November.

I am, Gentlemen, yours obediently,

W. Davies.

List of Species of Mollusca obtained by Prof. Goodsir *from Spitzbergen.* By R. M'Andrew, Esq.

Terebratulina caput-serpentis.
Terebratella Spitzbergensis, Dav.
Crania anomala (dead).
Astarte elliptica, Br.
—— *crebricostata*, Forbes.
—— *Warhami*, Hancock?
Leda caudata.
—— *pernula* (*rostrata*, Mart.).
Yoldia navicularis, Gould?
Pecten Islandicus, var. (small and thin).
—— *Grœnlandicus.*
Dentalium, sp. ined.
Patella (*Lepeta*) *cæca.*
Cancellaria (*Admete*) *viridula*, O. Fabr.

Note.—This list is the more interesting since visits to Spitzbergen have become so rare. Capt. Phipps enumerates the following species in his 'Voyage towards the North Pole,' Lond. 1774:—

Ascidium rusticum and *gelatinosum.*
Synœcium turgens, Phipps.
Clio helicina and *limacina* (Arctic Sea generally).
Chiton ruber.
Mya truncata. } Smeerenberg Harbour.
Saxicava arctica. } Smeerenberg Harbour.
Buccinum undatum, var. } Smeerenberg Harbour.
Turbo helicinus. } Smeerenberg Harbour.

Four other Spitzbergen shells are mentioned by Dr. Wm. Leach in the Appendix to Sir John Ross's 'Voyage of Discovery,' ed. 2. 8vo, Lond. 1819. The specimens were probably obtained by Capt. Buchan, as a few Spitzbergen shells are in the Museum cases with his name attached:—

Pandora glacialis, Leach (Brit. Mus.).

Macoma tenera, Leach (*Tellina balthica*, L.).

Crassina semisulcata, Leach (Brit. Mus.) = *Astarte lactea*, Brod. and Sby.

Nicania Banksii, Leach. (Specimens answering to Leach's description are in the Museum cases; the authors of the 'British Mollusca' have hesitated to include this with the smooth variety of *Astarte compressa*, Mont.)

There is a tablet of small specimens of *Crania anomala*, labelled "Spitzbergen, Capt. Buchan," which is now confirmed by Prof. Goodsir's specimens. The species does not range to Finmark on the Norwegian coast.

Dr. Lovèn mentions *Trophon scalariformis* and "*Yoldia hyperborea*" as occurring at Spitzbergen; and *Saxicava arctica*, *Buccinum glaciale*, and *Fusus despectus* and *deformis* have also been collected there.—S. P. Woodward.

METEOROLOGICAL BSERVATIONS FOR OCTOBER 1855.

Chiswick.—October 1. Fine: showery: fine. 2. Foggy: cloudy: foggy: rain. 3. Dense fog: rain. 4. Densely clouded: heavy rain. 5. Fine: heavy rain. 6. Very fine: cloudy: rain. 7. Fine: foggy at night. 8. Rain: very fine. 9. Foggy: very fine. 10. Fine. 11. Rain. 12. Cloudy and boisterous: rain. 13. Very fine. 14. Foggy: cloudy. 15. Dense fog: fine. 16. Very fine: rain at night. 17. Rain, with fog. 18. Overcast: fine. 19. Light clouds and fine. 20. Fine: cloudy: fine. 21. Cloudy. 22. Foggy: very fine: cloudy. 23. Foggy: uniformly overcast. 24. Fine: clear: fine. 25. Cloudy and boisterous. 26. Very boisterous: overcast: fine. 27. Exceedingly fine. 28. Very clear: fine. 29. Rain: drizzly. 30. Constant heavy rain. 31. Rain: cloudy: rain at night.

Mean temperature of the month	50°·28
Mean temperature of Oct. 1854	48 ·20
Mean temperature of Oct. for the last twenty-nine years ...	50 ·00
Average amount of rain in Oct.	2·686 inches.

Boston.—Oct. 1. Cloudy. 2. Cloudy: rain A.M. 3. Cloudy. 4. Rain A.M. and P.M.: heavy thunder-storm. 5. Fine: rain P.M. 6. Fine. 7. Cloudy: rain A.M. 8. Foggy. 9. Cloudy: rain P.M. 10. Fine. 11. Rain A.M. and P.M. 12. Cloudy. 13. Fine. 14. Cloudy. 15. Foggy: rain P.M. 16. Fine. 17. Cloudy: rain A.M. 18. Fine. 19. Cloudy: rain P.M. 20. Fine. 21. Cloudy: rain P.M. 22. Cloudy. 23. Cloudy: rain A.M. and P.M. 24. Fine. 25. Cloudy. 26, 27. Rain A.M. and P.M. 28. Fine. 29. Foggy: rain A.M. and P.M. 30, 31. Rain A.M. and P.M.

Sandwick Manse, Orkney.—Oct. 1. Fog A.M.: clear P.M. 2. Drizzle A.M.: damp P.M. 3. Showers A.M.: rain P.M. 4. Rain A.M. and P.M. 5. Clear A.M. and P.M. 6. Bright A.M.: cloudy P.M. 7. Rain A.M. and P.M. 8. Hazy A.M.: drizzle P.M. 9. Cloudy A.M.: sleet-showers, aurora P.M. 10. Cloudy A.M.: dry; rain P.M. 11. Showers A.M. and P.M. 12. Showers A.M.: clear P.M. 13. Fine A.M.: clear, fine, aurora P.M. 14. Fine, hoar-frost A.M.: clear, fine, aurora P.M. 15. Fine, frost A.M.: clear, fine P.M. 16. Sleet-showers A.M.: clear P.M. 17. Showers A.M.: rain P.M. 18. Showers A.M.: sleet-showers, aurora P.M. 19. Drops A.M.: clear, fine P.M. 20. Rain A.M.: drizzle P.M. 21. Showers A.M.: clear P.M. 22. Cloudy A.M. and P.M. 23. Rain A.M.: sleet-showers P.M. 24. Hail-showers A.M.: sleet-showers P.M. 25, 26. Rain A.M.: showers P.M. 27. Snow-showers A.M.: clear, aurora P.M. 28. Clear, frost A.M. and P.M. 29. Cloudy A.M.: hazy P.M. 30. Bright A.M.: clear P.M. 31. Bright A.M.: cloudy P.M.

Mean temperature of Oct. for twenty-eight previous years ...	47°·64
Mean temperature of this month	45 ·72
Mean temperature of Oct. 1854	46 ·39
Average quantity of rain in Oct. for fifteen previous years ...	5·08 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.
1855. Oct.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·529	29·496	29·00	29·62	29·57	64	40	59	54	50½	sw.	ssw.	ese.	·02	....	·01
☾ 2.	29·641	29·564	29·10	29·63	29·77	66	40	57	50½	44½	w.	n.	e.	·12	·03	·01
3.	29·707	29·517	29·25	29·71	29·56	62	50	58	46	52	s.	se.	ne.	·36	....	·03
4.	29·369	29·284	28·86	29·34	29·08	68	47	59	50	53	sw.	s.	se.	·70	·25	·22
5.	29·351	29·331	28·86	29·09	29·10	56	50	54	55	49	sw.	ssw.	se.	·82	·28	·30
6.	29·351	29·282	28·92	29·16	29·28	65	50	52·5	51	53½	s.	ssw.	ese.	·11	·10	....
7.	29·370	29·250	28·76	29·28	29·36	64	39	57·5	54½	53½	s.	sw.	e.	·03	·20	·47
8.	29·546	29·467	29·00	29·48	29·53	67	36	50	53½	52½	sw.	calm	nne.	·09	....	·45
9.	29·512	29·488	29·04	29·58	29·61	62	41	49·5	46½	41	w.	w.	nnw.	....	....	·12
10.	29·786	29·678	29·26	29·56	29·28	58	39	41	43½	46	nw.	nw.	ssw.	·02	·17	·08
● 11.	29·697	29·573	29·14	29·20	29·17	61	52	52	46½	47	sw.	w.	w.	·25	·20	·30
12.	29·644	29·590	29·14	29·24	29·27	62	37	52	47	42	sw.	w.	calm	·33	·12	·16
13.	29·649	29·585	29·20	29·37	29·39	60	39	45	47	38½	w.	w.	calm	·01	....	·07
14.	29·502	29·448	29·10	29·36	29·36	58	31	46·5	41	38½	nw.	calm	calm	·01	....	....
15.	29·597	29·412	29·05	29·35	29·37	59	32	39·5	40	43½	s.	calm	sw.	·09	....	....
16.	29·733	29·703	29·32	29·44	29·70	58	38	39·5	45	39½	sw.	sw.	n.	·56	·15	·15
17.	29·841	29·705	29·40	29·56	29·38	60	38	48	44	50	ne.	e.	w.	·10	·05	....
☽ 18.	30·012	29·863	29·45	29·34	29·58	64	41	42·5	51	46	w.	wsw.	wnw.	....	·04	·19
19.	30·134	30·045	29·60	29·67	29·87	63	39	49	46	41	sw.	w.	s.	....	....	·06
20.	30·177	30·123	29·68	29·50	29·56	61	50	50	48	52½	sw.	sw.	w.	....	·02	·44
21.	30·169	30·088	29·50	29·50	29·83	62	45	59	53	48	sw.	sw.	w.	·01	....	·33
22.	30·188	30·045	29·74	29·86	29·63	66	46	48	50½	50	sw.	w.	s.	....	·02	·04
23.	29·966	29·841	29·40	29·22	29·33	61	40	55·5	52	41	sw.	ssw.	ssw.	....	·03	·14
24.	30·052	29·901	29·40	29·17	29·51	55	33	46	38	40	w.	wsw.	nw.	....	·02	·47
○ 25.	29·961	29·545	29·47	29·03	28·69	55	50	46	42	49	sw.	ssw.	ssw.	·38	....	·42
26.	29·202	29·121	28·64	28·52	28·93	56	31	50	42	40	sw.	ssw.	nw.	·28	·32	·49
27.	29·639	29·344	29·00	29·30	29·74	54	26	43	37	36½	sw.	nne.	n.	....	·12	·33
28.	29·714	29·685	29·40	29·78	29·70	53	40	42	33½	33½	n.	nw.	se.	·03	·03	....
29.	29·523	29·210	29·22	29·59	29·81	52	46	42	44	44	ne.	nw.	e.	·63	....	....
30.	29·217	29·083	28·80	29·92	29·86	53	46	50	44	43	ne.	n.	nne.	·98	·80	....
31.	29·528	29·300	29·05	29·87	29·89	47	34	44	42½	37½	n.	n.	n.	·22	·75	....
Mean.	29·687	29·567	29·18	29·427	29·732	59·74	40·83	49·2	46·40	45·04				6·15	3·70	5·28

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END OF THE SIXTEENTH VOLUME.

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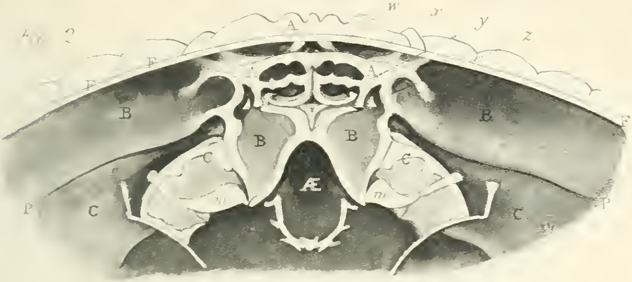
Fig. 1.

Fig. 2.



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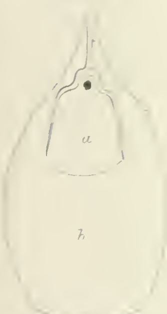

Fig. 5.

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Fig. 6.

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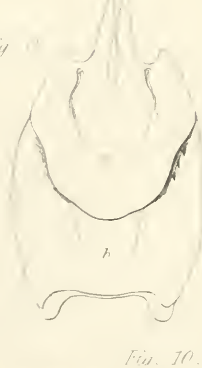
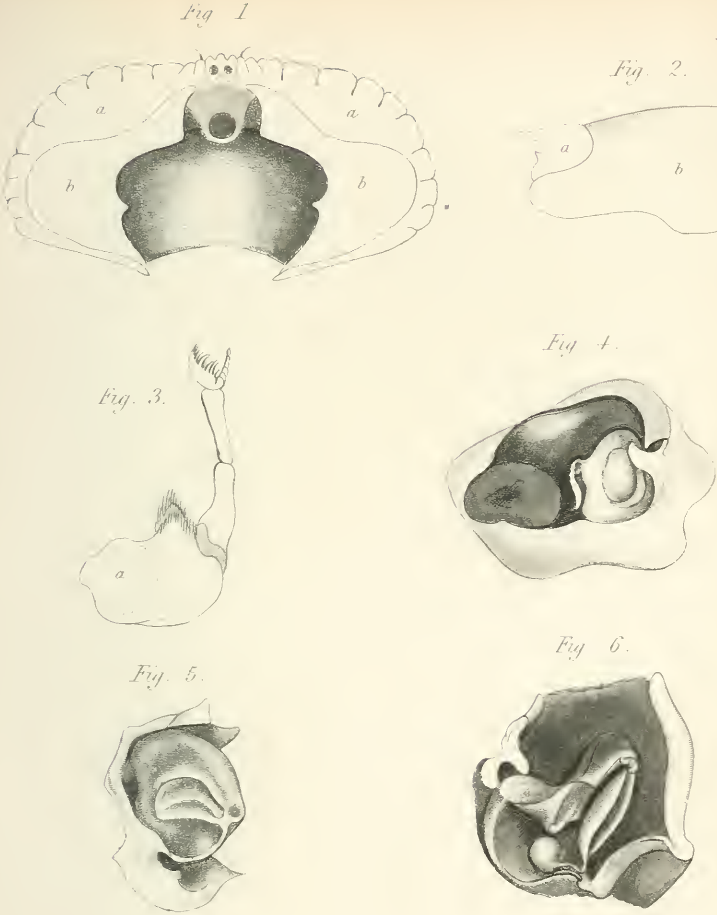


Fig. 9.

Fig. 10.



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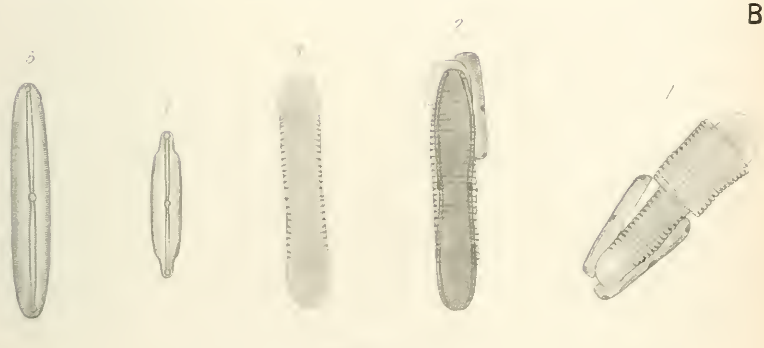

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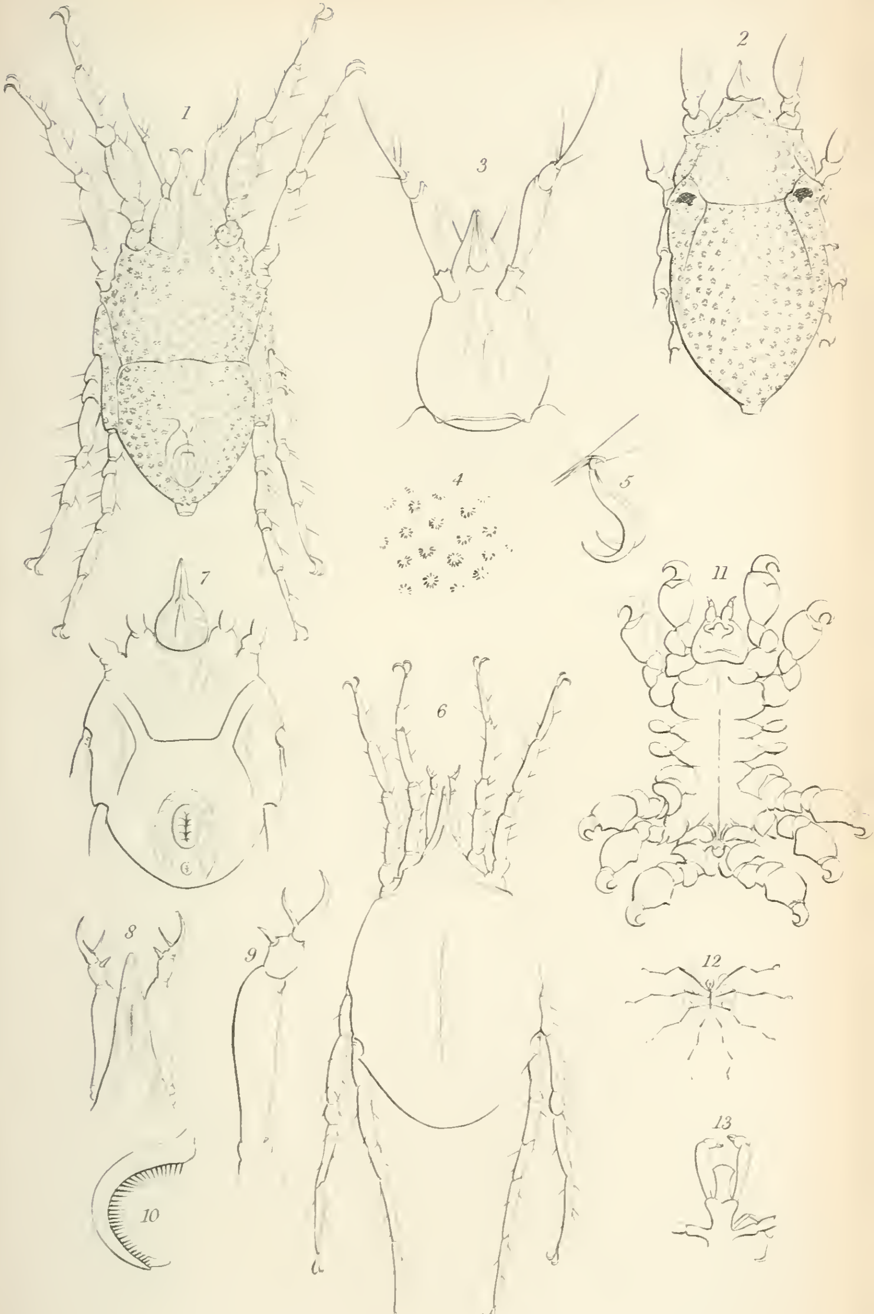
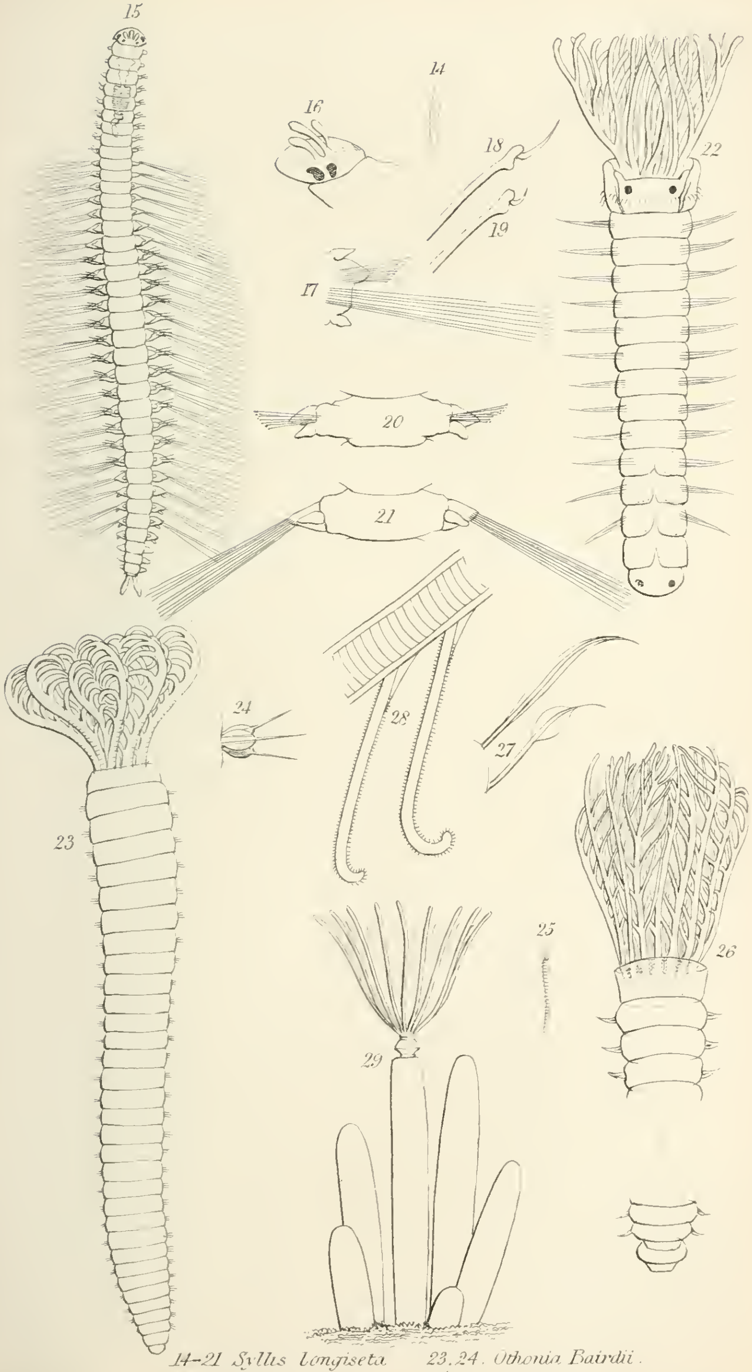
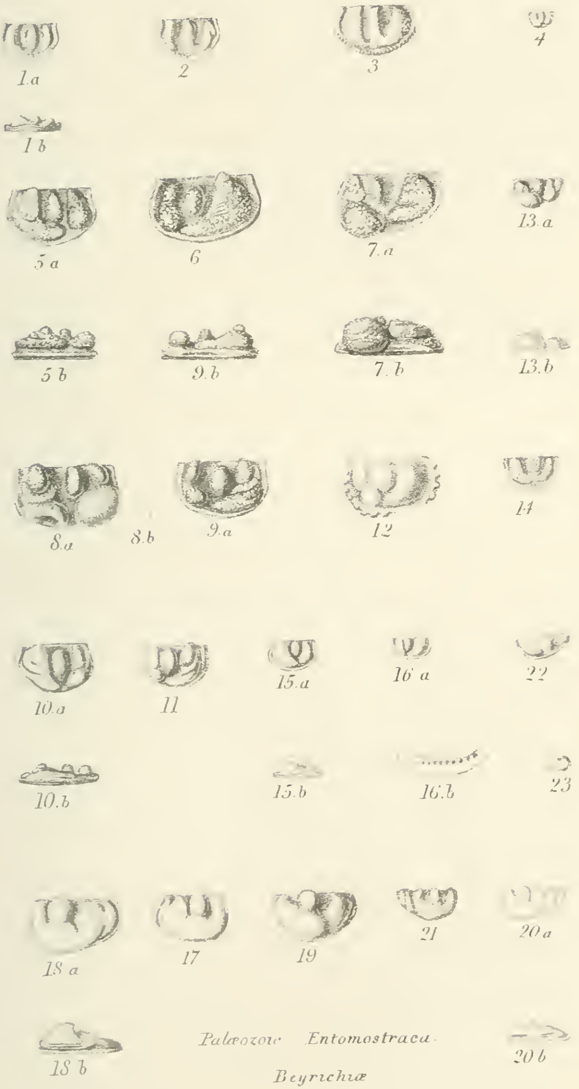


1–5 Halacarus rhodostigma *11 Cyamus Thompsoni*
6–10 *ctenopus* *12.13 Phoxichilidium olivaceum*



14–21 *Syllis longiseta.* 23. 24. *Othonia Bairdii.*
22. *Othonia Fabricii.* 25–28. *O. Johnstoni.*
29 *Nolella stipata.*

vir. del. J. De C. Sowerby



Palæozoic Entomostraca.

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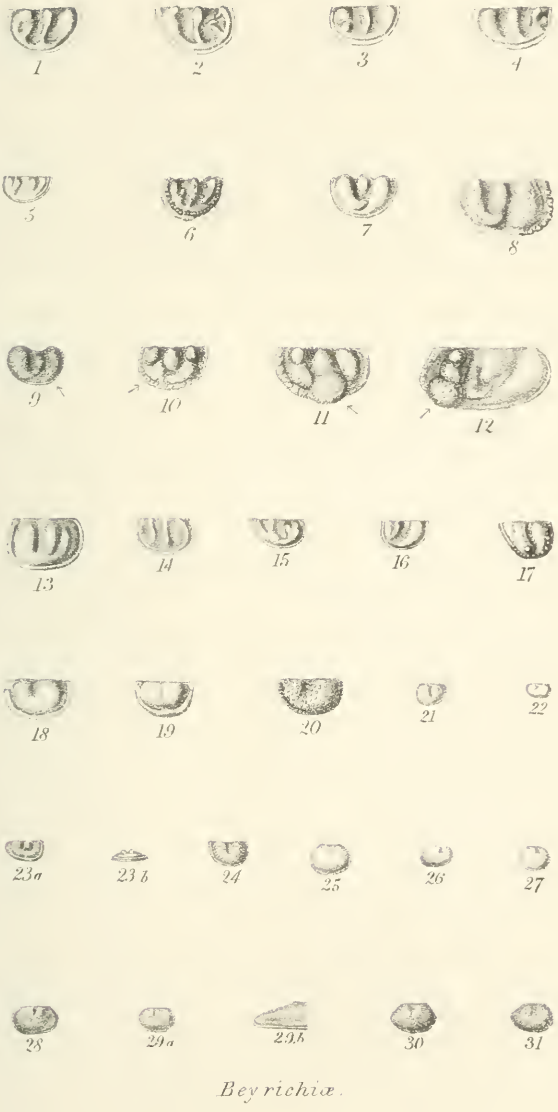

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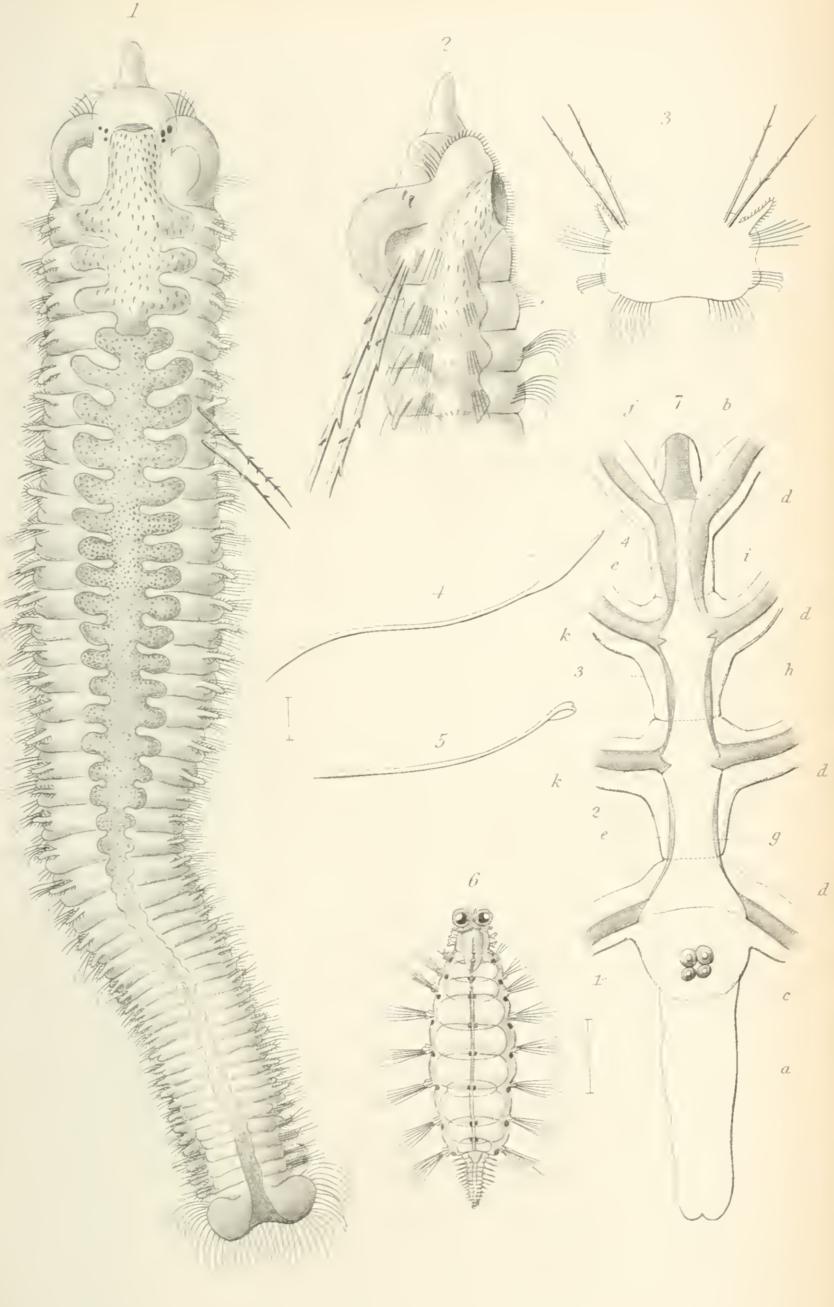

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P.H. Gosse ad viv. del.

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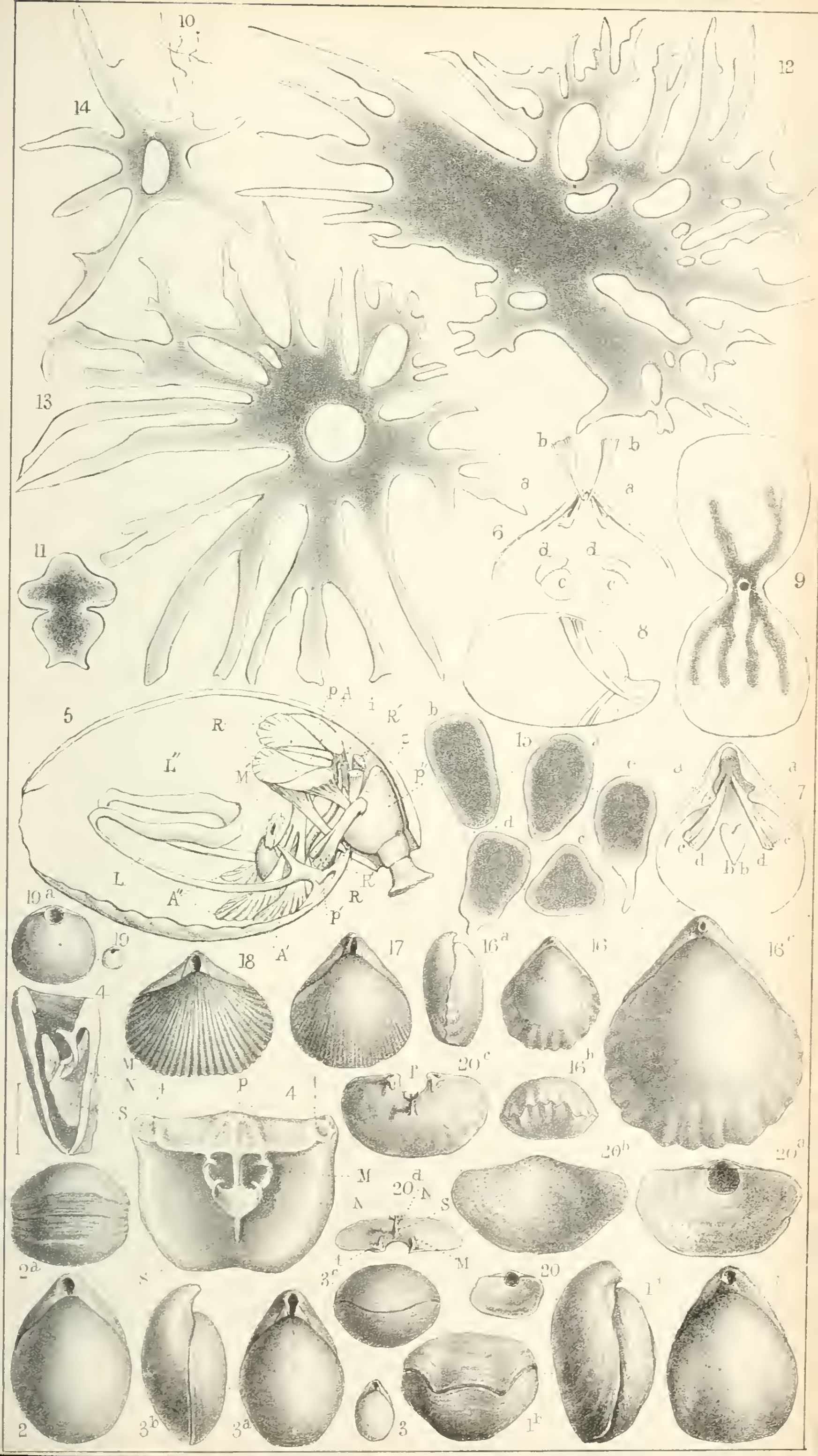
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